Heathkit®

PACKKIT®

Model HK-232

USER

595-3902-03

Heathkit®

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	**616-982-3411**
Credit	**616-982-3561**
Replacement Parts	**616-982-3571**

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Test Equipment, Weather Instruments, Clocks	**616-982-3315**
Television	**616-982-3307**
Home Products, Stereo, Security, Telephone, Marine, Automotive	**616-982-3496**
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YOUR HEATHKIT 1 YEAR LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 1 year from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 1 year from the date of purchase, any malfunction caused by defective parts or materials will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heath/Zenith Computers and Electronics center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of our Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirely. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORESEEABLE.

Some states do not allow the exlusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's resonsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

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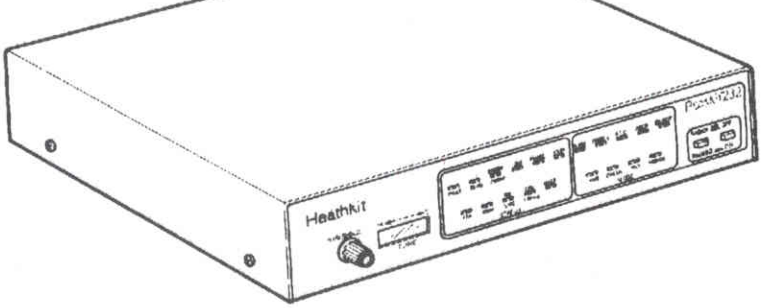


HEATH COMPANY

BENTON HARBOR, MICHIGAN 49022

Portions of this Manual have been adapted from the PAKRATT™ Model PK-232 Multi-Mode Data Controller Operating Manual.

Table of Contents

INTRODUCTION

The Heathkit PackKit® Model HK-232, is a data controller that provides decoding, encoding, and transmitter control routines. This multi-mode protocol converter and data controller operates in half- or full-duplex and converts Morse, Baudot ASCII, RTTY (RadioTele™Typewriter), AMTOR/SITOR and AX.25 packet to ASCII data via and EIA standard RS-232 serial port. You can use your computer or data terminal with the same communications program or terminal emulator that you use with a telephone line modem.

The PackKit has all of the features most frequently demanded by the modern amateur operator. These include:

- Packet Radio using the AX.25 international packet protocol.
- Host Mode, including raw HDLC mode.
- Link and terminal data rates to 9600 bits per second.
- AMTOR error-correcting operation using Mode A (ARQ), Mode B (FEC), Mode L (ARQ "listen"), and SELFEC (selective FEC).
- Baudot RTTY at standard speeds 45, 50, 57, 75, and 100 bauds (60, 66, 75, 100, and 132 words per minute)(WPM).
- Baudot RTTY Unshift-On-Space (USOS) to obtain maximum intelligibility under dropout or fading conditions.
- Baudot/CCITT International Alphabet #2 keyboard conversion.
- ASCII RTTY at 110, 150, 200, and 300 bauds.
- WRU? Activation and Answerback Response.
- Dual-polarity direct FSK outputs.
- Dual-polarity CW keying outputs.
- Monitor oscilloscope output.
- Time-of-day check.
- Automatic Morse operation from 5 to 99 WPM.
- Farnsworth Morse operation below 15 WPM.
- Morse speed clock.
- Selectable dual radio connector ports.
- LED discriminator-type tuning display.

- "Autobaud" selection: 300, 1200, 2400, 4800, and 9600 BPS.
- WEFAX (weather faxcimile) reproduction with EPSON compatible printer.
- Signal Identification Acquisition Mode (SIAM)™ for unknown radio teleprinter signals.

The PackKit incorporates the latest state-of-the-art design techniques. It is housed in an attractive charcoal gray cabinet, is compact enough to fit into most any ham station, and will give you many years of trouble-free service.

NOTE: You will need a 12- to 16-volt (13-volt nominal) regulated power supply @ 700 mA with less than 1 v p-p ripple to power your PackKit. A power cable is supplied with the kit.

COMPUTER CONNECTIONS

Before you can perform the "Operational Tests and Alignment", which follows this section, you will have to properly connect your Controller to a terminal or a computer and run the proper terminal emulation program, if you are using a computer. Read and comply with the following information that pertains to your situation under "Interconnection" and "Software Requirements."

If you use a computer, you will need a terminal emulator, or communications program such as CPS. NOTE: Since these programs allow a computer to operate like a terminal, the following information will use the term "computer" to refer to a computer or a terminal.

The Controller communicates with your computer through a serial port using signals that correspond to the RS-232C standard. Most computers that are available today either incorporate an RS-232C-style serial port, or have one available as an accessory. If you have already been using your computer with an RS-232C modem, you can use this Controller the same way.

INTERCONNECTION

Table 2-1 shows the minimum connections that are required between the RS-232 I/O connector on the rear of the Controller and your computer. These minimum connections do not permit hardware flow control. **DO NOT connect any wires other than pins 1 through 8 and 20.** Pins 17 through 19 and 21 through 25 are reserved for future use. Using a full 25-wire cable will cause your Controller to operate improperly. You may find that one of the ready-made cables that is available from the Heath Company will suit your particular needs. IMPORTANT: Whether you purchase a ready-made cable or make your own, make sure it is a **SHIELDED** cable.

Table 2-1

Pin	Signal Name	Description
2	Transmit Data	Serial data **from** the computer **to** the Controller.
3	Receive Data	Serial data **from** the Controller **to** the computer.
7	Signal Ground	Common ground for both data lines.

It is beyond the scope of this Manual to show you how to connect your Controller to every brand and model of computer. It does, however, provide you with information for several common computers. If your particular computer is not listed, you can probably adapt the information that is presented to suit your needs.

NOTE: If you intend to use the FAX (facsimile) mode, you will have to add several wires to the basic interconnection cable. Refer to "FAX Requirements" beginning on Page 2-5.

HEATH/ZENITH

Table 2-2 shows the proper cable connections for Heath/Zenith series 89, 90, 130, 140, 150, and 160 Computers.

Table 2-2

Computer 25-pin connector	Signal	Controller 25-pin connector
1*	Chassis Ground	1*
2	Transmit Data	2
3	Receive Data	3
4	Request To Send	4
5	Clear To Send	5
6	Data Set Ready	6
7	Signal Ground	7
8	Carrier Detect	8
20	Data Terminal Ready	20

* Connect this drain wire to the connector shells.

Table 2-3 shows the proper cable connections for the 200-series Computers.

Table 2-3

Computer 9-pin connector	Signal	Controller 25-pin connector
1	Carrier Detect	8
2	Receive Data	3
3	Transmit Data	2
4	Data Terminal Ready	20
5*	Ground	1,7*
6	Data Set Ready	6
7	Request To Send	4
8	Clear to Send	5

* Connect the drain wire to the connector shells.

APPLE MACINTOSH™

Table 2-4 shows the proper cable connections for an Apple Macintosh computer. NOTE: This computer uses an RS-422 serial port, but it will operate properly with your Controller.

Table 2-4

Computer 9-pin connector		Controller 25-pin connector
1*	Chassis Ground	1*
5	Transmit Data	2
9	Receive Data	3
3	Signal Ground	7
7	Carrier Detect	8
6	Data Terminal Ready	20

* Connect this drain wire to the connector shells. NOTE: Pin 1 is not connected inside the computer. We recommend, however, that you connect pin 1 to the main ground of the computer.

COMMODORE

Commodore (as well as other manufacturers) sells a voltage converter device that installs in the User Port connector on the rear of their computers. This adapter converts the internal TTL- level voltages of the computer to the proper RS-232C levels and polarities. Unless you are very familiar with the inner workings of your computer, you should obtain the necessary converter instead of trying to "do it yourself."

IBM

Refer to Table 2-2 for the proper cable connections for an IBM PC computer.

Refer to Table 2-3 for the proper cable connections for an IBM AT-series computer.

The IBM PCjr TM computer uses standard RS-232C voltage levels for its interface. The connector required, however, is nonstandard and is not readily available from electronic supply dealers. Refer to the IBM PCjr Technical Reference Manual for the proper cable connections.

IBM sells an adapter cable for serial devices which allows you to convert the connector on the PCjr to a standard RS-232C connector. Since this cable is only 3" long, you will have to obtain a standard male-to-female RS-232C extension cable to reach between this adapter cable and your Controller.

RADIO SHACK COLOR COMPUTER

The Radio Shack Color Computer series (except the Micro Color Computer) uses a 4-pin DIN-style connector for its serial interface. Table 2-5 shows the proper cable connections for a Radio Shack computer that has a 4-pin DIN connector.

Table 2-5

Computer 4-pin connector		Controller 25-pin connector
4	Transmit Data	2
2	Receive Data	3
3	Signal Ground	7

The Radio Shack Model 100/102 has a built-in standard RS-232C serial port that is compatible with the Controller. Use a standard male- to-male RS-232C extension cable to connect this computer to your Controller.

NEC

The NEC Model 8201 has a built-in standard RS-232C serial port that is compatible with the Controller. Use a standard male-to-male RS-232C extension cable to connect this computer to your Controller.

OTHER COMPUTERS WITH 25-PIN RS-232C PORTS

If your computer has a 25-pin RS-232C port, refer to its manuals to determine the transmit data, receive data, and signal ground pins. Follow the manufacturer's recommendations for connecting the serial port to a modem.

Your Controller is configured as Data Communications Equipment (DCE), while most computers are configured as Data Terminal Equipment (DTE). If this is true of your particular computer, you can probably connect pins 2, 3, and 7 of your Controller to the same number pin of your computer's RS-232C port. Standard 3-wire male-to-female and male-to-male RS-232C extension cables are readily available for this purpose.

If your computer is configured as DCE, you will have to cross the wires between pins 2 and 3 of the Controller and the computer. In other words, connect pin 2 of the Controller to pin 3 of the computer and pin 3 of the Controller to pin 2 of the computer. The signal ground is still pin 7 on both ends.

Some computers may require that you connect pin 5 of the serial port connector to an appropriate signal. Others may require connections to pins 8 and 20. You can use the computer's output signals on pins 4 and 6 for this purpose as shown in Table 2-6.

Table 2-6

Controller Connector		Computer Connector
2		2
3		3
7		7
	jumper pins 4 and 5	4, 5
	jumper pins 6, 8, and 20	6, 8, 20

OTHER COMPUTERS WITH NONSTANDARD SERIAL PORTS

Computers with nonstandard serial ports must meet the following conditions:

1. The signal levels should be RS-232C compatible. The Controller requires that the voltage levels that come from the computer be greater than about +3 volts in one state and less than 0 volts in the other state.

2. The polarity of the signals must conform to the RS-232C standard. A lower voltage state must correspond to a logical "1" and the higher voltage state to a logical "0".

3. The computer must be able to correctly receive a signal which meets the RS-232C specification. The Controller supplies signals that meet this specification.

Make or purchase a cable that provides the necessary connections. The serial port common pin must be connected to the Controller's serial port connector at pin 7. The data line that sends data **FROM** the computer must be connected to the Controller's connector at pin 2. The line that your computer uses to **RECEIVE** data must be connected to the Controller's connector at pin 3.

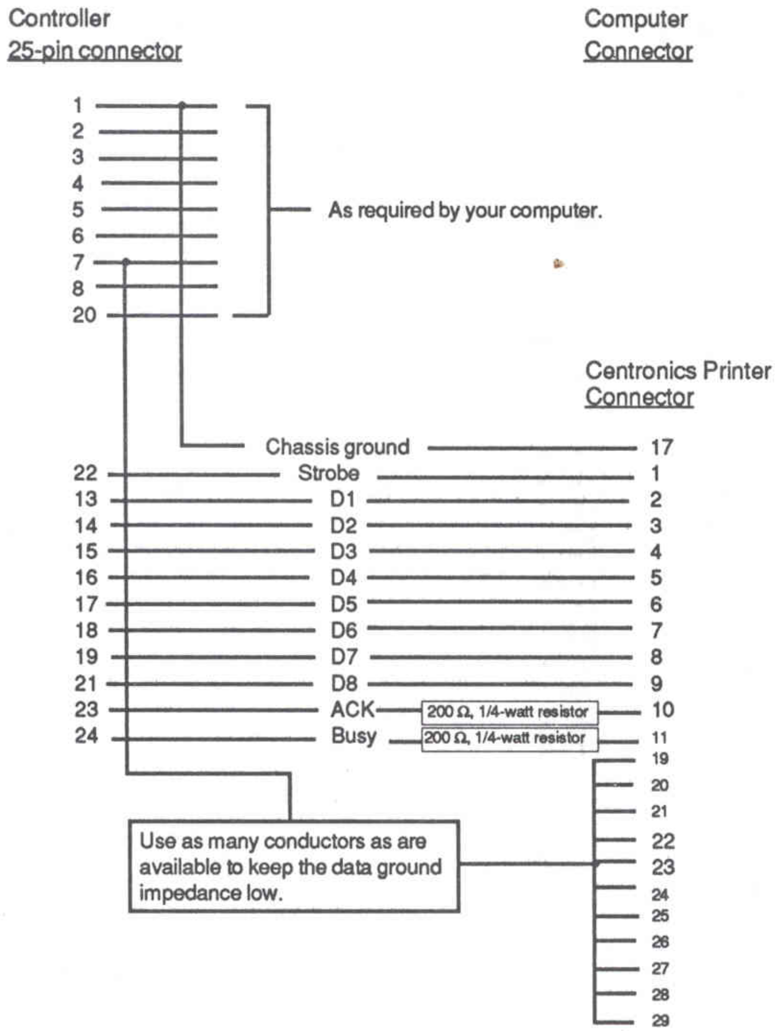
If your computer requires any other signals, you must find ways of providing them. The documentation provided with your computer or its accessory serial port should specify any special requirements of your particular port.

FAX REQUIREMENTS

Your Controller is capable of receiving black and white weather charts that are transmitted in FAX (facsimile). A special cable for this is included in your list. This cable connect to the Controller, your computer, and a parallel printer. NOTE: At this time, the Controller supports escape sequences that enable dot graphics only on Epson-type printers.

If you wish to make your own cable, Table 2-7 shows the wires that you will need in addition to those required between the Controller and your computer. NOTE: Be sure to use **SHIELDED** cable.

Table 2-7



SOFTWARE REQUIREMENTS

Any software package that enables your computer to act as an ASCII terminal with an ordinary telephone modem should work with your Controller. If you have a program that you have successfully used with a telephone modem, and you are familiar with its operation, use that same program to communicate with the Controller.

HEATH/ZENITH

Several acceptable terminal emulator software packages, such as CPS-86 and CPS-150 are available from Heath Company. The package you need depends upon your particular model of computer. Load the program and set the options as follows. NOTE: Be sure to run the system configure program to properly set up the computer's serial port, etc.

Baud Rate	1200
Word Length	7 bits
Parity	Even
Stop Bits	1

APPLE MACINTOSH

The MAC TERM program will work properly with your Controller. Load this program and set the options as follows:

Compatibility	Terminal
1200 baud	VT100
7 bits/character	ANSI
Even parity	UNDERLINE
Handshake Xon/Xoff	US
Modem connection	80 Columns
"Telephone" port	ON LINE
	AUTOREPEAT

COMMODORE

The Programmer's Reference Guide published by Commodore contains a BASIC communications program. This program converts Commodore's modified ASCII format to "true ASCII." Since Commodore's computers do not send too well at data rates greater than 300, we recommend that you operate the Controller at 300 baud.

IBM PCjr

The IBM PCjr has a built-in terminal program in the BASIC cartridge. Type TERM to start this program. Then refer to your PCjr's BASIC manual for details about it. For best results from your PCjr, do not operate the Controllers serial port at greater than 1200 baud.

RADIO SHACK COLOR COMPUTER

There are several terminal programs available for the Color Computer. You will probably want to use a commercially available program rather than writing your own, because the Color Computer has a "software UART" that is difficult to program in BASIC.

The Radio Shack Model 100 has a built-in terminal program in ROM. Refer to your computer's documentation for information about its use.

NEC

The NEC Model 8201 has a built-in terminal program in ROM. Refer to your computer's documentation for information about its use.

OPERATIONAL TESTS AND ALIGNMENT

This section of the Manual describes some operational tests you can perform to make sure your Controller is operating properly. An alignment procedure is also provided so you can adjust all of the tones to the proper frequencies.

PRELIMINARY TESTS

Make sure you have the Controller connected to a suitable power source. Also make sure you have the Controller connected to your computer as described in the "Computer Connections" section of this Manual.

Turn the computer on and boot up any necessary terminal emulation program.

Turn the THRESHOLD control on your Controller fully counterclockwise.

Depress the OFF/ON pushbutton on the front of the Controller. The MULT, SEND, STA, and CON LEDs should light briefly. When these four LEDs go out, the BAUDOT LED and one or two vertical bars on the display should light.

If your computer's data rate is set to 1200 baud, you will see the following message:

Please type a star (*) for the auto-baud routine.

NOTE: If your computer's baud rate is set to something other than 1200 baud, you will see meaningless characters on the screen. If this happens, go ahead and perform the next step anyway.

Type four or five asterisks (*), at one second intervals, until you see the sign-on message:

Heathkit HK-232 Multi-Mode TNC
Copyright (C) 1986, 1987 by
Heath Company and AEA, Inc.
Release DD-MMM-YY
Checksum $nn
cmd:

After you obtain the above message, the PKT and RQ/CMD LEDs will be lit as well as one or two bars on the bargraph.

The above procedure performed an auto-baud routine that determines the rate (300 - 9600 baud) at which data is transferred between the Controller and your computer or video terminal.

IMPORTANT: When the backup batteries are installed, **which you will do on Page 4-10,** the Controller will hold this initial baud rate in RAM. If you later change your terminal emulation program's data baud rate and then attempt to communicate with the Controller, no intelligent information will be transferred (because the two units will no longer be compatible).

SOLUTION: To correct the above compatibility problem, reset your computer or terminal to the original baud rate that is held in RAM and type "TBAUD xxxx" (xxxx = the new baud rate). Now turn off the Controller, reset the computer or terminal to the new TBAUD rate, and turn the Controller back on. The auto-baud routine will now place the new data rate in RAM. This method allows you to select a faster or slower srtart-up data rate. We strongly suggest that you write your initial baud rate in the space provided below for future reference.

TBAUD RATE ____________

CALIBRATION

Refer to Figure 3-1 while you perform the following steps.

1. Remove the cabinet top and unplug the connector coming from the battery holder, if this has not already been done.

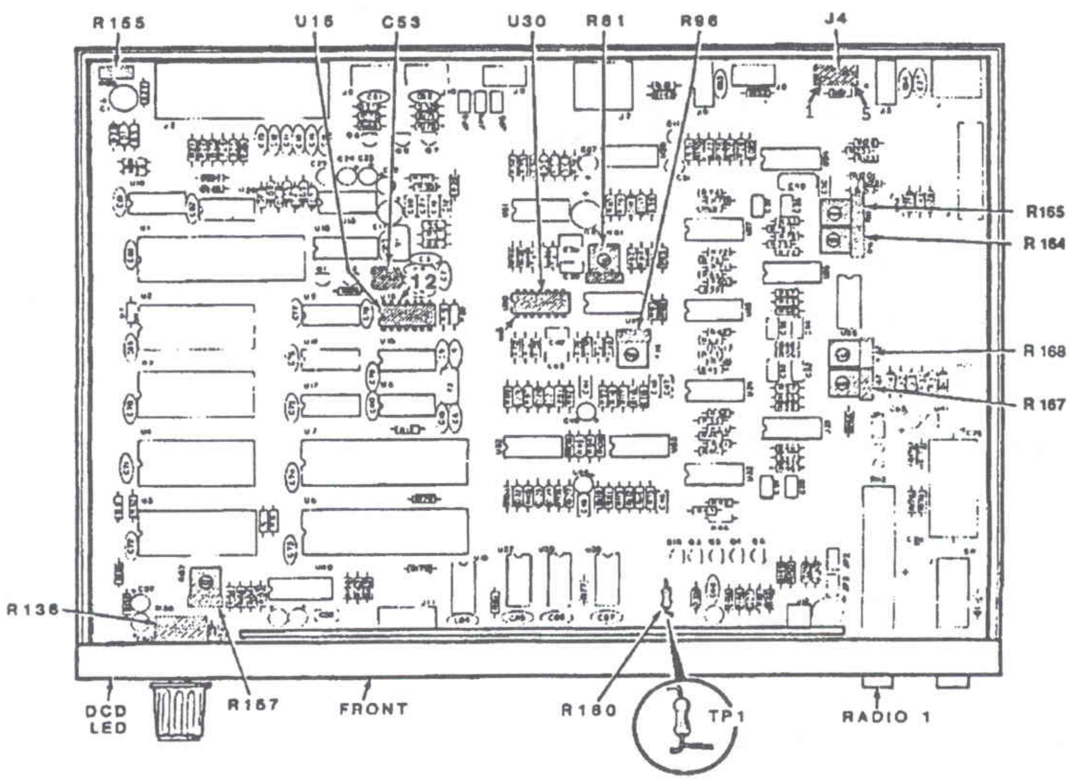


Figure 3-1

NOTE: If you accidently short two IC pins together in the following steps, the Controller may "lock up" so that you cannot make any further adjustments. If this happens, turn the Controller off for approximately 30 seconds. Then repeat the sign-on procedure.

2. Connect an accurate frequency counter to integrated circuit U15 pin 12. Then adjust trimmer capacitor C53 as close as possible to 4.000 MHz.

NOTE: The following steps direct you to adjust several controls using an indication on the computer's display. If you wish to use the frequency counter indication instead, connect its probe to TP1 (the indicated lead of resistor R160).

3. Preset controls R155, R164, R165, R167, and R168 to the center of their rotation.

4. Type CAL followed by a <RETURN> on the computer's keyboard.

5. Adjust control R167 until the indication on your computer's display is 1200 ± 10 Hz. If R167 has no effect on the indication, press the SPACE bar once and then adjust R167. NOTE: The SPACE bar is used during the calibration to toggle between the mark and space tones.

6. Press the SPACE bar.

7. Adjust control R165 for an indication of 2200 ±10 Hz.

8. Press the H key. NOTE: This key is used to toggle between wide and narrow bandpass.

9. Adjust control R164 for an indication of 2310 ± 5 Hz. If R164 has no effect on the indication, press the SPACE bar once and then adjust R164.

10. Press the SPACE bar.

11. Adjust control R168 for an indication of 2110 ± 5 Hz.

12. Press the Q key to exit the calibration procedure.

13. Connect an oscilloscope probe or an AC voltmeter to the indicated lead of resistor R160.

14. Adjust control R157 for minimum indication. This is the AFSK null adjustment.

15. Connect a jumper wire between RADIO-1 connector J4 pins 1 and 2. Then make sure the front panel RADIO 1 pushbutton is released.

16. Type CAL followed by a <RETURN>. Then press the H key. The on-screen frequency counter should indicate 2110 ± 5 Hz. Press the SPACE bar if it is indicating one of the other calibration frequencies.

17. Connect the oscilloscope or AC voltmeter probe to integrated circuit U30 pin 14. Then adjust control R81 for maximum indication.

18. Press the SPACE bar. The on-screen frequency counter should indicate 2310 ± 5 Hz.

19. Connect the oscilloscope or AC voltmeter probe to integrated circuit U30 pin 1. Then adjust control R96 for maximum amplitude.

NOTE: The next four steps will make sure the AFSK circuit is operating properly.

20. Connect the oscilloscope or AC voltmeter to the indicated lead of resistor R160.

21. Adjust AFSK LEVEL control R155 fully clockwise and observe an indication of approximately 10 mV peak-to-peak on the oscilloscope, or 3 mVAC on the voltmeter.

22. Adjust AFSK LEVEL control R155 fully counterclockwise and observe an indication of approximately 2 volts peak-to-peak on the oscilloscope, or 1 VAC on the voltmeter.

23. Set AFSK LEVEL control R155 to its center of rotation. You will perform the final adjustment of this control later.

24. Press the Q key to exit the calibration procedure.

25. Reconnect the battery connector.

26. Reinstall the cabinet top.

FUNCTIONAL TESTS

The following steps check the basic operation of the Controller.

1. Make sure the jumper wire is still connected between RADIO-1 connector J4 pins 1 and 2.

NOTE: If the PKT LED is not lit, type "PACKET" followed by a <RETURN>.

2. Set front panel THRESHOLD control R136 to the 1 o'clock position.

3. Type "MY TEST" followed by a <RETURN>. Your monitor should reply with:

   MYCALL was HK-232
   MYCALL now TEST
   cmd:

4. Type "C TEST" followed by a <RETURN>. Your monitor should reply with:

   ***** CONNECTED TO TEST**

5. Type "HK-232 OK WHEN THIS ECHOS BACK TO MONITOR SCREEN" followed by a <RETURN>. Your monitor should display this entry.

6. Adjust front panel THRESHOLD control R136 clockwise until the DCD LED lights. Then type "SEND LED, STA LED TEST" followed by a <RETURN>. The front panel SEND LED should not light, but the STA LED should light.

7. Observe the front panel LEDs while you adjust THRESHOLD control R136 counterclockwise until the DCD LED goes out. When this happens, the SEND LED will light, the STA LED will go out, and "SEND LED, STA LED TEST" will appear on your monitor.

8. Reset the THRESHOLD control to the point where the DCD LED just goes out.

9. Type CTRL-C. The monitor should respond with:

    cmd:

10. Type "VHF OFF" followed by a <RETURN>. Your monitor should respond with:

    VHF was ON. VHF now OFF

11. Type "HB 300" followed by a <RETURN>. Your monitor should respond with:

    HBAUD was 1200
    HBAUD now 300

12. Press the K key followed by a <RETURN>. Your monitor should line feed one line and display the cursor at the left edge of the screen.

13. Type "CONGRATULATIONS MY HEATHKIT HK-232 WORKS PERFECTLY" followed by a <RETURN>. Your monitor will display this entry.

14. Type CTRL-C. Your monitor should respond with:

    cmd:

15. Press the D key followed by a <RETURN>. Your monitor should respond with:

    DISCONNECTED: TEST,
    TEST*>TEST (UA)

16. Disconnnect the jumper from connector J4.

This completes the "Operational Tests and Alignment."

INSTALLATION

This section of the Manual provides you with the information you will need to connect the Controller to your radio equipment. You will also be directed to install three batteries inside it. You can operate the Controller without batteries, but each time you turn it off and back on, you will have to reprogram it with your call letters and any other parameter changes that you desire.

BASIC CONNECTIONS

Refer to Figure 4-1 while you read the following information.

In a typical installation, you only need to connect your radio equipment to RADIO 1 and RADIO 2 connectors J4 and J6 on the rear panel of the Controller. The following paragraphs describe the cable that mates with these connectors and the points in your radio where they need to be connected. In some cases, you may only need to install a connector on the free end of the 5-wire shielded cable (supplied) that mates with a connector on your transceiver. In other cases, you may need to connect the free end to various points inside your transceiver.

Your Controller may be connected to two separate radios at the same time. You may, for example, wish to use a 2-meter transceiver as "Radio 1" and an HF transceiver as "Radio 2". The following paragraphs describe the signals that are available at the 5-pin RADIO 1 and RADIO 2 connectors on the rear of the Controller. How many of the wires you need to connect to your transceiver(s) depends upon your particular situation.

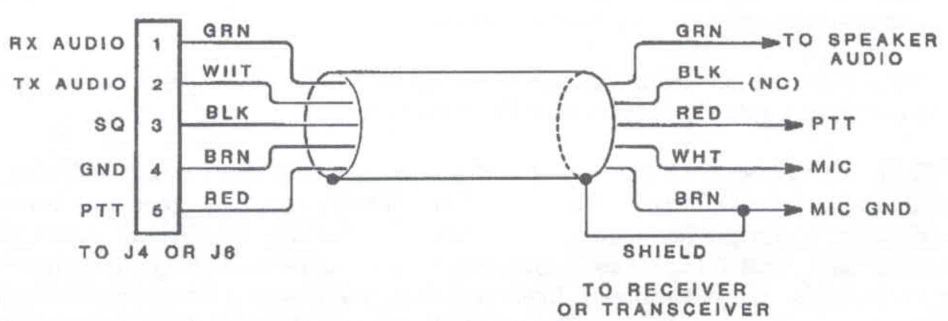


Figure 4-1

NOTE: Refer to Appendix I toward the rear of this Manual for information about connecting the Controller to several popular radios.

RX Audio — This wire (green) supplies receiver audio from your transceiver to the Controller. You could obtain this audio from a headphone jack or tap into the speaker connections.

TX Audio — This wire (white) feeds transmitter (microphone) audio from the Controller to your transceiver.

SQ (Squelch) — This wire (black) detects activity on a shared-mode channel (optional).

GND (Ground) — This wire (brown) is the common connection for the audio and PTT lines.

PTT (Push-To-Talk) — This wire (red) keys your transmitter. Refer to Page 4-9 for information about PTT configuration.

Keep the connections between the Controller and your radio equipment as short as practical. If you choose to make your own cables, use good quality shielded cable.

NOTE: Be sure you push the 5-pin sockets on the ends of the cables to the RADIO 1 and RADIO 2 plugs on the Controller so the wires exit the sockets **downward** (green wire toward pin 1).

AFSK ADJUSTMENT

You will now adjust the level controls of your Controller and transceiver(s) for proper operation. If you intend to use the Controller with an FM transceiver and an SSB transceiver, perform the "FM Adjustments" first.

FM ADJUSTMENTS

Use the following procedure to set the audio levels of the Controller and your FM transmitter:

1. Turn on your computer and Controller and start up it's terminal program.

2. Connect the transceiver to a dummy load and be ready to monitor it's transmissions with another nearby receiver.

3. Turn the transceiver on. Make sure the RADIO 1/RADIO 2 pushbutton on the front of the Controller is set to your FM transceiver.

NOTE: In the Calibrate mode only, the K key toggles the transmitter PTT line on and off, while the SPACE bar toggles the Controller's AFSK tone generator between "mark" (the lower-pitched tone) and "space" (the higher-pitched tone). The Controller has a watchdog timer circuit that automatically unkeys your transmitter after 60 seconds. We recommend, however, that while you perform the following adjustments you key the transmitter only long enough to make the required adjustments.

4. Type "CAL" followed by a <RETURN> to enter the calibrate mode.

5. Press the K key to key the transmitter. You should hear a continuous tone from your separate receiver.

6. Press the SPACE bar two or three times and make sure the Controller is transmitting the higher tone.

7. Press the K key to unkey the transmitter.

8. Turn the AFSK LEVEL control R155 on the back of the Controller fully counter-clockwise.

9. Again press the K key to key the transmitter.

10. Adjust the AFSK LEVEL control R155 to the point where no further rotation increases the audio level from your separate receiver. Then adjust the control counterclockwise just to the point where the audio signal is slightly, **but noticeably,** reduced from the maximum level. NOTE: This setting should be adequate for normal operation.

11. Press the K key to unkey the transmitter.

12. Press the Q key to exit from the calibration mode.

13. With your transceiver in the receive mode, turn it's squelch control until you can hear a steady hiss or noise from the speaker.

14. Set the THRESHOLD control on the front of the Controller to the 12 o'clock position.

15. Advance the receiver's volume control until the DCD LED on the Controller just lights (be sure the receiver is unsquelched). This setting should provide good receive performance.

16. Reset the receiver's squelch control for normal operation.

17. Use some suitable method to mark the AFSK LEVEL control so you can easily reset it to this level after you perform the "SSB Adjustments."

SSB ADJUSTMENTS

Digital modes with an SSB transceiver require you to set some controls differently for proper AMTOR and Packet operation. Be sure to observe the following precautions:

1. Set the VOX to OFF.

2. Set the speech compression to OFF.

3. Set the AGC to FAST (if possible).

4. Disconnect the ALC cables between your SSB transceiver and any external RF amplifier that you wish to use for AMTOR or Packet operation.

IMPORTANT: Baudot RTTY, ASCII RTTY, and Mode B (FEC) AMTOR use continuous key-down conditions - your transmitter operates at a 100% duty cycle for the duration of each transmission. If your SSB transmitter is not designed for continuous full-power operation, you **must operate the transmitter at reduced power.** Consult the manufacturer's specifications for more information about its acceptable duty cycle.

Use the following procedure to set the audio levels of the Controller and your SSB transmitter:

1. Turn on your computer and start up it's terminal program. Then turn on your Controller.

2. Connect the transceiver to a dummy load.

3. If your transceiver has a built-in monitor (such as an audio output that allows you to monitor the audio signals that enter the microphone or phone patch inputs), turn that monitor on.

4. Turn the transceiver on. Make sure the RADIO 1/RADIO 2 pushbutton on the front of the Controller is set to your SSB transceiver. Also make sure the transmitter is set for LSB (lower sideband) operation.

5. Set the transmitter's meter switch to read ALC. If your meter switch does not have an ALC position, set the switch to read plate current.

NOTE: In the Calibrate mode only, the K key toggles the transmitter PTT line on and off, while the SPACE bar toggles the Controller's AFSK tone generator between "mark" (the lower- pitched tone) and "space" (the higher-pitched tone). The Controller has a watchdog timer circuit that automatically unkeys your transmitter after 60 seconds. We recommend, however, that while you perform the following adjustments you key the transmitter only long enough to make the required adjustments.

6. Type "CAL" followed by a <RETURN> to enter the calibrate mode.

7. Press the K key to key the transmitter. You should hear a continuous tone from your transceiver's monitor.

8. Press the SPACE bar two or three times and make sure the Controller is transmitting the **lower** tone.

9. Press the K key to unkey the transmitter.

10. Turn the transmitter's microphone gain control fully counterclockwise. Then advance the control to about 1/4 rotation.

11. Set the AFSK LEVEL control on the rear of the Controller fully counter-clockwise.

12. Press the K key to key the transmitter. Then advance the AFSK LEVEL control until the ALC meter shows a small increase from the unmodulated indication. Also observe the transmitter's plate current or output power indicators.

13. Adjust the AFSK LEVEL control until the transmitter indicates approximately 30% of the manufacturer's recommended full-power reading. If the manufacturer's plate current specification for CW operation is 200 mA, for example, set the AFSK LEVEL control so the plate current is approximately 75 mA.

14. Press the K key to unkey the transmitter.

15. Press the Q key to exit the calibrate mode.

NOTES:

1. The AFSK LEVEL and transceiver's microphone gain control should now be set to the correct level for all Controller operating modes.

2. For CW, Mode A (ARQ) AMTOR, and Packet operation, you can increase the transceiver's microphone gain control to produce the manufacturer's recommended full-power output plate current. These modes are "bursty" and do not require the transmitter to stay keyed for more than a very few seconds at a time. The resulting duty cycle is much less than 100% and full-power operation is generally acceptable.

16. Set the THRESHOLD control on the front of the Controller to approximately 2 o'clock.

17. With your transceiver in the receive mode, tune it to a clear, unoccupied frequency. Then turn the receiver volume control until the DCD LED on the Controller just lights. This setting should provide good receive performance for all Controller operating modes.

OTHER CONNECTIONS

As was explained earlier, you will normally connect your radios to the 5-pin RADIO 1 and RADIO 2 plugs on the rear of the Controller. There are several other connectors, however, that you may also wish to use for different purposes. These connectors are described in the following sections.

RX-IN AUDIO 1 & 2

Use these jacks when you only wish to receive from either or both radio inputs. These jacks accept miniature phone plugs. Two cables are provided that have miniature phone plugs on both ends. These cables allow you to connect the Controller to the earphone or record jacks on many types of communication receivers.

SCOPE/FSK

Some HF SSB transceivers provide direct FSK (Frequency-Shift Keying) for RTTY operation. FSK sometimes offers advantages over AFSK, especially with transceivers that automatically acquire a CW or narrow-band IF filter. These filters can sometimes provide better results at lower Baudot and ASCII RTTY speeds, although very narrow filters can limit your data rate. Direct FSK is not always recommended for Mode A (ARQ) AMTOR or data speeds greater than 110 baud (100 WPM in either Baudot or ASCII).

To use 5-pin socket J7 for FSK, refer to Figure 4-2 and connect a shielded cable to the mating DIN plug (supplied) as follows:

NOTE: The polarity of FSK signals, which are DC rather than audio, is not standardized by radio manufacturers. Consult the manual for your particular radio to determine the correct FSK polarity.

1. Connect the inner lead at one end of the shielded cable to either pin 1 for FSK-N (normal) or pin 4 for FSK-R (reversed) of the mating DIN plug (supplied). Connect the shield wires to pin 2.

2. Connect the free end of the cable to your transmitter's FSK input as required.

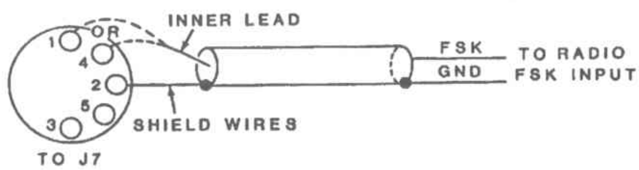


Figure 4-2

NOTE: When you use FSK for Baudot RTTY, ASCII RTTY, and AMTOR Mode B (FEC), be sure to observe the same power and duty-cycle restrictions that apply to AFSK operation. Some transmitters provide lower output power in the FSK mode. Refer to your particular transmitter's manual.

If you wish to connect an X-Y display oscilloscope to your Controller to aid in tuning, refer to Figure 4-3 and connect shielded cables to the mating DIN plug (supplied) as follows:

1. Connect the inner lead at one end of a shielded cable to pin 3 (mark) and the shield wires to pin 2.

2. Connect the inner lead at one end of another shielded cable to pin 5 (space) and the shield wires to pin 2.

3. Connect the free ends of these cables to the X and Y inputs of your oscilloscope.

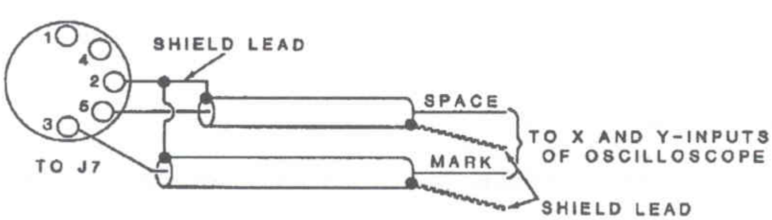


Figure 4-3

EXTERNAL MODEM

An external modem port is provided on the rear of your Controller so you can use baud rates higher than 1200 baud. Before you can use this port, you must cut three foils on the bottom of the main circuit board and install three jumper wires. After you finish this modification, the pins of the EXT MODEM plug J8 will have the following signals present:

Pin 1 — Receive Data (TTL-level data coming from an external modem to the Controller.

Pin 2 — Transmit Data (TTL-level data from the Controller to an external modem.

Pin 3 — Data Carrier Detect (+5 volts when the channel is clear; 0 volts when a carrier is detected on the channel).

Pin 4 — Ground.

Pin 5 — PTT signal from the Controller (+5 volts is present during receive, and 0 volts is present during transmit. The Controller's PTT circuitry also remains active).

To use an external modem perform the following steps:

1. Remove the cabinet top and unplug the connector coming from the battery holder, if this has not already been done.
2. Remove the main circuit board from the chassis. Be sure to unplug the battery connector.
3. Position the main circuit board foil-side-up as shown in Figure 4-4. Then locate the foils that connect two pins on JP4, JP5, and JP6 together.
4. Refer to the inset drawing on Figure 4-4 and use a sharp modeler's knife to carefully cut the three indicated foil traces.

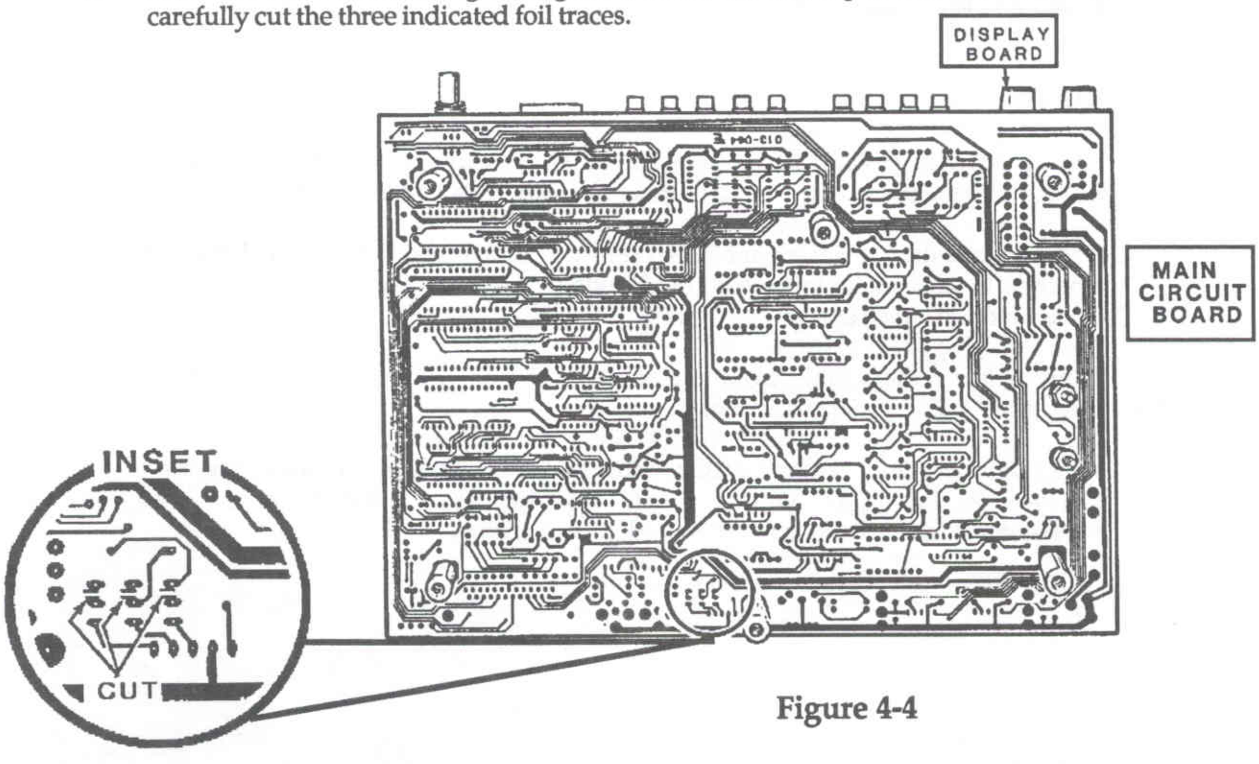


Figure 4-4

5. Reposition the main circuit board component-side-up. Then refer to Figure 4-5 and install and solder bare jumper wires between the indicated holes of JP4, JP5, and JP6. Cut off any excess wire ends.

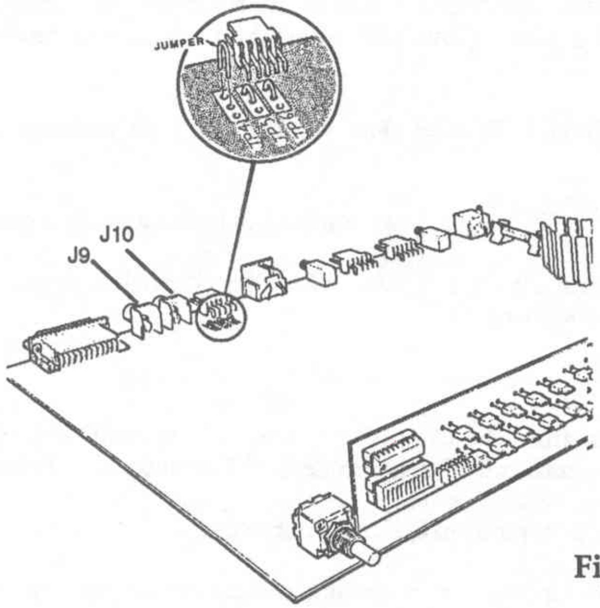


Figure 4-5

6. Reconnect the battery connector.

7. Reinstall the cabinet top. Be sure to reconnect the battery connector.

The external modem port is now enabled and the internal modem is no longer used. If you wish to use the internal modem in the future, simply remove the three jumper wires and install them in their other positions.

DC KEYING + AND -

Your Controller permits CW operation by either directly keying the transmitter's CW key circuits or by using AFSK in upper or lower sideband to simulate CW keying.

If you choose the DC keying method, refer to your transmitter's manual to determine whether it uses negative or positive keying polarity. This information will help you determine which socket you need to use.

Connect a shielded cable from the positive (J9) of negative (J10) socket to your transmitter's CW key input connector.

When you operate CW, set the transmitter's mode switch to CW and operate it just like you would if you were using a hand key. Your Controller will key the transmitter in Morse code without any additional wiring.

AFSK CW KEYING

If you choose to use the audio keying method, use the same cables and connections to your transceiver as was described earlier for RTTY, AMTOR, and Packet operation. Connect your transceiver to a dummy load.

Set your Transceiver's mode switch to USB or LSB. The Controller will key the PTT line and send a keyed single audio tone to the transceiver's microphone input.

Type random letters on the keyboard and adjust the transceiver's microphone gain control until the plate current or output power level is correct according to the manufacturer's ratings for CW operation. All other adjustments are the same as for RTTY, AMTOR, and Packet.

PTT CONFIGURATION

Your Controller has provisions for changing the polarity of the PTT configuration at both radio ports. When you assembled it, you set it for a positive PTT configuration. If you wish to change the configuration at either or both radio ports, use the following procedure:

1. Remove the cabinet top and uplug the connector coming from the battery holder, if this has not already been done.

2. Refer to Figure 4-6 and locate jumper blocks JP2 and JP3. When these jumpers are installed on the plugs so they connect the center pins with the pin that is toward the front panel, the ports are configured for a positive PTT configuration.

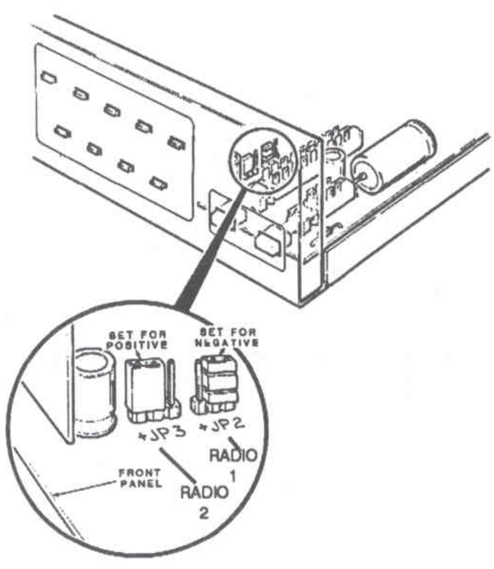


Figure 4-6

3. If you wish to change the RADIO 1 port to a negative configuration, move jumper block JP2 so it connects the center pin to the pin that is away from the front panel.

4. If you wish to change the RADIO 2 port to a negative configuration, move jumper block JP3 so it connects the center pin to the pin that is away from the front panel.

5. Reconnect the battery connector.

6. Reinstall the cabinet top.

BATTERY BACKUP

Your Controller has provision for battery memory backup. These batteries will enable its memory to retain all of the parameters you have set, except for the day clock and the monitor heard list functions. These two functions are controlled by the microprocessor and require full power to retain them in memory.

NOTE: If you decide to install batteries in your Controller, we recommend that you use three, fresh size "AA" **alkaline** types.

To install batteries inside your Controller, use the following procedure:

1. Remove the cabinet top and unplug the connector coming from the battery holder, if this has not already been done.

2. Refer to Figure 4-7 and locate the positive (+) and negative (-) symbols that are embossed inside the battery holder.

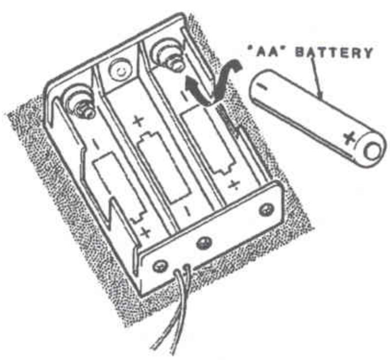


Figure 4-7

3. Match the positive (+) mark on each battery with the positive (+) symbols on the holder and press the battery into place.

4. Refer to Figure 4-8 and use electrical tape, or something similar, to secure the ends of the batteries in place. This will help reduce the possibility of the batteries becomming dislodged when you transport the Controller from one place to another.

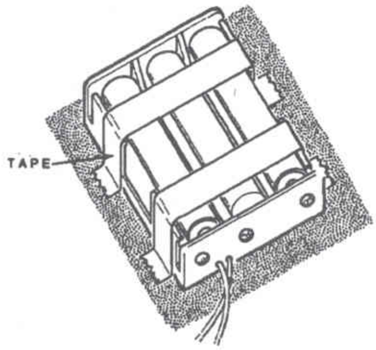


FIgure 4-8

5. Move the jumper socket at JP1 so it makes contact with both pins, if this has not already been done.

6. Reinstall the cabinet top.

NOTE: If you are anxious to try the Controller, you may wish to skip the "Basic Operation" section and proceed to the "Detailed Operation" section, beginning on Page 6-1, for a quick start. Other sections provide much more detailed information and are important to obtain the maximum performance and enjoyment from your Controller.

BASIC OPERATION

This section shows you how to use your Controller in each of its operating modes, and describes the keyboard commands you will use to "talk" to your Controller, as well as the answers, prompts, and error messages you will receive from it.

LED STATUS AND MODE INDICATORS

Your Controller's front panel LEDs show you the operating mode and system status at any moment. Each LED is labeled with an abbreviated name. Note that some LEDs have two name markings. All markings that refer to **packet** operation are below the LEDs, while all other operational mode markings are **above** the LEDs. Beginning in the upper left corner, look at your Controller's front panel while you review the LEDs and their meanings.

STATUS INDICATOR LEDS

ERROR	ARQ Error	Lights when the system receives errors from another station.
IDLE	ARQ/FEC Idle	Lights when the system sends synchronizing or idle characters.
PHASE	ARQ Phasing	Lights when the system sends its SELCAL or phasing signals to another station.
STBY	ARQ Standby	Lights when the system is available to answer an ARQ SELCAL from another station.
RQ	ARQ Repeat Request	Lights when another station requests a repeat of previous information blocks.
TFC	ARQ/FEC Traffic	Lights when the system sends information.

OVER	ARQ Changeover	Lights when the system sends a changeover command to another station.
MULT	Multiple	Lights when multiple connections exist.
SEND	Send	Lights when the PTT line is active.
CONV	Converse	Lights when the system is in the Converse Mode.
STA		Lights when there are unacknowledged packet frames.
CON	Connect	Lights when the packet link is in a connected state.
CMD	Command	Lights when the system is in the Command Mode.
TRANS	Transparent	Lights when the system is in the Transparent Mode.

MODE INDICATOR LEDS

STBY	ARQ/FEC Standby	Lights when the system is in the AMTOR ARQ or FEC Mode.
MODE L	ARQ - Listen	Lights when the system is in the AMTOR Listen Mode.
FEC	FEC - Mode B	Lights when the system is in the AMTOR FEC Mode.
ASCII	ASCII Code	Lights when the system is in the ASCII RTTY Mode.
BAUDOT	Baudot/CCITT Code	Lights when the system is in the Baudot RTTY Mode.
ARQ	ARQ - Mode A	Lights when the system is in the AMTOR ARQ Mode.
CHECK	Undefined	Reserved for possible future applications.
PKT	Packet	Lights when the system is in the Packet Mode.
MORSE	Morse Code	Lights when the system is in the Morse Mode.

THE DCD (DATA CARRIER DETECT) LED

Use the DCD LED as an indication of channel activity. Your Controller detects activity on the channel (busy condition) by monitoring the demodulator's lock-detect signal and lights the DCD LED when a valid signal exists. When the other station transmits, the DCD LED on your Controller should light for the duration of the received packet frame.

If the DCD LED is lights with random noises, turn the THRESHOLD control counterclockwise until the DCD LED extinguishes. Valid received packets will almost always light the DCD LED, although your Controller may actually decode packets that are too weak to light the DCD LED.

LEDS AT SYSTEM START

Your Controller always powers up in the Command Mode. At system power- up, or each time you type the RESTART command, your Controller shows its status on the front panel LEDs:

STATUS: CMD lit
MODE: PKT lit

TUNING INDICATOR (Figure 5-1)

This 10-segment bargraph LED display helps you properly tune in received mark and space tones while you are using your Controller.

One or two center bars will light when no tones are present. When a **"mark" tone** is received, the bars on the left side of the display will light, while **"space" tones** will light bars on the right side of the display. Except for CW, a properly-tuned signal is symmetrically divided, with the brighter bars near the ends of the display. A properly-tuned CW signal shifts the lit bars from the center to the right side of the display in rhythm with the Morse keying.

During FM operation, the tones are set by the sending station and cannot be changed at the receiving station.

NOTES:

1. When you have an RTTY signal properly tuned in and the constant tone lights a bar near the left side of the bargraph, the signal is right-side-up (normal). If the constant tone lights a bar near the right side of the bargraph, the signal is upside down (reversed). This holds true only when the receiver is set to lower sideband (LSB). The opposite is true when you operate in upper sideband (USB).

2. You will find it much easier to tune in an RTTY, Packet, AMTOR, and FAX signal if you use the RIT control that is available on most of today's receivers.

Noise or no signal   FSK or Packet during keying

Figure 5-1

OPERATING MODES

Your Controller uses three operating modes: the Command Mode, the Converse Mode, and the Transparent Mode. Each of these modes is described in the following pages.

COMMAND MODE

The Command Mode provides the communication or dialogue only between your keyboard and your Controller; nothing goes to the "outside world." You must use the Command Mode to enter commands which alter the Controller's operating parameters. When the Controller is in the Command Mode, the following Command Mode prompt is shown at the beginning of each input line:

cmd:

NOTE: The "cmd:" prompt may scroll off the screen when the Controller receives and displays packets.

Your Controller always enters the Command Mode after a RESTART, RESET, or a power cycle. After a power-off/power-on sequence, resident software reinitializes the Controller's operating parameters with values that are stored in RAM.

After you issue a RESET command, all operating parameters are reset to the default values stored in EPROM. Since the values of most parameters are stored in RAM, they can be easily changed.

Special Command Mode Characters

The following commands set special characters which are active in the Command Mode. Refer to the "Controller Commands" section of this Manual for more detailed descriptions of these commands.

COMMAND	DESCRIPTION
CANLINE	Cancel current line.
CANPAC	Cancel packet output.
DELETE	Delete a character with a destructive backspace.
PASS	Insert after a special character.
REDISPLA	Redisplay the current typed line.
START, STOP	Computer flow control characters (sent to the Controller).
XOFF, XON	Controller flow control characters (sent to the computer).

Display Control in the Command Mode

The following commands affect display features which are active in the Command Mode. Refer to the "Controller Commands" section of this Manual for more detailed descriptions of these commands.

COMMAND	DESCRIPTION
ALFDISP	Add <LF> after a <CR> in data sent to the terminal.
BKONDEL	Echo after a character deletion.
ECHO	Automatic echo of serial port input.
FLOW	Type-in flow control.
LCOK	Lowercase translation.

COMMAND	DESCRIPTION
NUCR	Nulls after a <CR>.
NULF	Nulls after a <LF>.
NULLS	Null count.
ACRDISP	Automatic <CR> insertion after n characters.

CONVERSE MODE

The Converse Mode is the data transfer mode that you will use most often for ordinary conversations and message handling. Your Controller assembles data you have typed into packets and sends the data to the radio.

To return to the Command Mode from the Converse Mode, type the Command Mode entry character (default CTRL-C), or send a BREAK signal to the serial port.

NOTE: Although "BREAK" is not a regular ASCII character, you can frequently send it by typing a special key on the keyboard. A BREAK signal is a continuous "mark" (or 1) signal on the serial port's Transmit Data line that lasts approximately 200 milliseconds. The timing of the BREAK signal is not critical; most serial ports will recognize a BREAK if the "mark" signal lasts significantly longer than the time required for transmission of a character.

Since the BREAK signal is simple, it is easy to generate a BREAK with circuitry outside the computer. This guarantees that it will return to the Command Mode in automatic station operation.

SENDPAC Character

The "send-packet" character packetizes the characters you have typed for transmission. If you type a full-length packet of characters (the default value is 128 characters) without typing the send-packet character, your input is packetized and automatically sent after the 128th (PACLEN value) typed character.

Use the SENDPAC command to select a character for use as the "send-packet" command ("<CR>" is the default character). You can elect to include or not include the send-packet character in the transmitted packet. If "<CR>" is the send-packet character, it is natural to include it in the packet as part of the text as well as interpreting it 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.

CANPAC Character

If you set the send-packet character to something other than <CR>, use the "cancel-packet" character to cancel packets that are longer than one line. Use the CANPAC command to select the cancel-packet character. You can cancel single-line packets with either the cancel-line character or the cancel-packet character.

Special Converse Mode Characters

The following commands set special characters which are active in the Converse Mode. Refer to the detailed descriptions of these commands in the "List of Commands" section of this Manual.

COMMAND	DESCRIPTION
CANLINE	Cancel current line.
CANPAC	Cancel current packet.
COMMAND	Command Mode entry.
DELETE	Character deletion with destructive backspace.
MFILTER	Characters to be filtered in monitored packets.
PASS	Insert following special character.
REDISPLA	Redisplay current line.
SENDPAC	Send current packet.
START, STOP	Computer's flow control characters (sent to the Controller).
XOFF, XON	Controller flow control characters (sent to the terminal).

Display Features in the Converse Mode

The following commands activate the display features which are active in the Converse Mode. Refer to the detailed descriptions of these commands in the "List of Commands" section.

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

TRANSPARENT MODE

Packet radio is an ideal means of transferring data between computers. The Converse Mode works well for transferring ASCII text files. Some files, however, use all eight bits of each byte, rather than the seven bits used in ASCII code.

In addition, executable code files, such as CP/M ".CMD" or ".COM" and PC/MS-DOS ".COM" or ".EXE" files, contain characters that conflict with the control characters used in the Converse Mode. Listings of BASIC programs and documents written with word processors that do not create ASCII files can also exhibit this problem. Use the Transparent Mode to transfer these types of files.

The Transparent Mode is a data mode similar to the Converse Mode, but is primarily intended for computer data interchange instead of human conversation. "Special" characters, however, do not exist in the Transparent Mode. Everything you type (or everything your computer sends to your Controller) is transmitted exactly as your Controller receives it.

Input Editing and Packet Timing

The Transparent Mode does not permit input editing, and the send- packet character does not exist. Packets are sent at specific regular intervals, or when a full packet of information (PACLEN = 128 bytes) is ready. Use the PACTIME command to set the time intervals at which the data is packetized.

Display Features in the Transparent Mode

The Transparent Mode modifies your Controller-monitor display characteristics. Data is sent to the computer exactly as it is received over the radio, with all eight bits of each byte received. Features such as auto-linefeed insertion and screen wrap are disabled, along with the echoing of input characters.

The parameters controlling these latter features in the Command and Converse Modes are not changed upon entry into the Transparent Mode. All display features are re-established when your Controller returns to the Command Mode.

The Transparent Mode also disables most of the link status messages that appear as your Controller cycles between disconnected and connected states.

Escape or Exit from the Transparent Mode

In order for the Command Mode entry character (default is <CTRL- C>) to be transmitted freely in the Transparent Mode, escaping or exiting from the Transparent Mode to the Command Mode becomes a bit more complicated. First use BREAK to return to the Command mode, just as you do in the Converse Mode. Then use the Command Mode entry character (<CTRL-C>) as follows:

1. Wait a moment after you type the last character you wish to send. The minimum required wait is set by the CMDTIME command.

2. Type three Command Mode entry characters (<CTRL-C>) within a CMDTIME interval of each other.

After a final CMDTIME interval expires during which you have typed no characters, you will see the command prompt. The default value of CMDTIME is one second. NOTE: You cannot use this second procedure to escape from the Transparent Mode if CMDTIME is set to zero.

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

THE CONTROLLER COMMANDS

The Controller is a command-driven system. You will perform all control functions by typing single- and multiple-character commands from your computer's keyboard. The Controller does not use menus.

Commands can specify the variable values of the parameters that affect the Controller's general operation and its performance during specific actions. Many commands have several correct responses. All of the following parameters, for example, work properly with the WIDESHIFT command:

WI	ON
WI	OFF
WI	NO
WI	YES
WI	N
WI	Y
WI	T (toggle)

ENTERING COMMANDS

Commands must be entered after the Command Mode prompt: "**cmd:**".

NOTE: Type <CTRL-C> if the "**cmd:**" prompt is not visible.

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

Commands are keywords or mnemonics (special abbreviations that trigger your memory) that are composed of strings of characters chosen by the operator. You will probably never change the values of some parameters. Each operator, however, has maximum flexibility to adapt the Controller to the local environment and operating conditions.

Use the following procedure to enter commands:

1. Use either uppercase (capital letters) or lowercase (small letters) when you enter commands.

2. End the command with a carriage return <CR>. NOTE: Carriage returns **are not** shown in the following examples.

3. Correct your typing mistakes or cancel the line completely before you type the final <CR> of your command. Refer to the "Operating Modes" section for information about line editing.

This section uses UPPERCASE letters to show you the commands, and lowercase to explain the text.

COMMAND RESPONSES

Whenever the Controller accepts a command that changes a value, it will respond with the previously stored value. If you type XFLOW OFF when "XFLOW" was "ON", for example, the display will show:

XFLOW was ON
XFLOW was OFF

This message indicates that you have successfully changed the value.

ERROR MESSAGES

If your Controller cannot understand what you have typed, it will produce an error message (in English) that shows you the nature of the error:

If you type a command your Controller cannot understand at all, it will display:

?What?

If you type a correct command word with an incorrect argument, it will display:

?bad

If you type a numerical value outside a particular parameter's range, it will display:

?range

If you set the BEACON timing too short for busy channels, it will display:

WARNING: BEACON too often

If you try to enter an improper SELCAL, it will display:

?call sign

Here are some typical entries, the error messages that were produced, and what was wrong with each entry:

cmd:ASDFASDF **?What?**	—	This is not a command.
cmd:BEACON E **?bad**	—	A parameter was left out.
cmd:PACLEN 265 **?range**	—	Unacceptable numerical value.
cmd:DAY	—	You did not set the Controller's clock. ?clock not set.
cmd:x	—	Command is invalid for the ?not while in PACKET mode in use.
cmd:C N6IA	—	Command is invalid for the ?not while in MORSE mode in use.
cmd:C N6IA	—	Command is invalid for the ?not while in ASCII mode in use.
cmd:C N6IA	—	Command is invalid for the ?not while in BAUDOT mode in use.

COMMAND NAMES

The command name is the full word you can type in order to have your Controller execute a command. You can also send instructions to your Controller 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. You can simply type "MY", for example, to enter the command MYCALL. NOTE: DO NOT type the "quotation marks". These are shown for clarity in identifying the letters you will type.

The abbreviation "M" is not sufficient (and will be interpreted as a different command), but "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. A letter "n", for example, means the command takes a numerical parameter value.

DEFAULT VALUES

Some commands have initial default, or "used most often", values. These defaults are stored in EPROM and loaded into RAM whenever you first turn the Controller on, or when you type the RESET command.

PARAMETERS, ARGUMENTS, AND VALUES

Some commands need additional information before they can be executed. This type of command has "parameters" or requires "arguments." A command such as FULLDUP, for example, has a Boolean parameter. When you type FULLDUP ON, FULLDUP is the command and ON is its argument (the value you want the Controller to use to execute the command FULLDUP). The values that fill this parameter are either ON or OFF.

Immediate commands such as ID have no parameters. You need to only type "ID" to cause the Controller to execute the command.

Some commands such as CONNECT have optional parameters. If you type "CONNECT" without an argument, the Controller displays the current status of the link. If, however, you type "CONNECT N7ML", the Controller issues the connect request and tries to establish the link to N7ML.

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 of these are legal commands.

Parameters can be Boolean, numeric, or text (or string). These are each described separately in the following paragraphs.

Boolean Parameters

Boolean parameters are restricted to 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 fraction bar (/).

Numeric Parameters

A parameter designated as "n" is a numeric value. You can enter these values by typing familiar decimal numbers, or optionally as
hexadecimal numbers.

When you use hexadecimal notation, you must prefix the number you type with a "$" character.

The Controller displays some numeric parameters (those which set special characters) in hexadecimal format. The "digits" of a hex number represent powers of 16 in the same manner as the powers of 10 are represented by a decimal number. The decimal 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 256) + (2 x 16) + (0 x 1) = 288 (decimal)

Text or String Parameters

You can type a text parameter such as the "message" for BTEXT (your "beacon" message) or CTEXT (your "connect" message) in either upper- or lowercase. This parameter is accepted exactly as you type it and can include numbers, spaces, and punctuation.

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

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

The call sign and SSID are entered and displayed as "call-n" (such as "WX1AAA-3"). If an SSID is not entered, the system sets it to 0 (zero). NOTE: SSID "0" is not displayed by the Controller.

Some commands have parameters made up of lists of call signs. The CFROM and DFROM commands, for example, allow you to specify from one to eight call signs for selective monitoring. You must use a blank space or a comma to separate multiple call signs.

The following examples will help you understand how this works.

Example 1: 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" which you may chose from a range of values.

A typical entry would be BEACON EVERY 180. This causes a beacon to be sent every 180 X 10 seconds (every 1800 seconds, or 30 minutes). Another typical entry would be BEACON EVERY 0. This turns the beacon off.

Example 2: CONNECT call1 [VIA call2[,call3...,call9]]

The CONNECT command requires a string argument "call1." You may optionally 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) or by blank spaces. An acceptable entry would be:

Example 3: C WX1AAA V WX2BBB,WX3CCC.

USING COMMANDS WITHOUT ARGUMENTS

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

cmd:MDIGI Y	Sets the value to YES (ON).
MDIGI was OFF	Displays the previous value.
cmd:MDIGI	Command with no arguments.
MDIGI ON	Displays the present value.

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

CONTROLLER MESSAGES

This section describes your Controller's messages and the circumstances under which they can appear.

GENERAL MESSAGES

The following sign-on message appears when you turn your Controller on, or when you type "RESET":

Heathkit HK-232 Multi-Mode TNC
Copyright (C) 1986, 1987 by
Heath Company and AEA, Inc.
Release DD-MMM-YY
Checksum $nn
cmd:

The release number shows the version of the firmware in your particular Controller. The checksum is a hex number which you can compare against the correct checksum available from the Heath Company for the firmware version you are using.

The message "HK232 is using default values" appears in addition to the sign-on message if the bbRAM (battery-backed RAM) checksum verification fails at power-up. This failure causes the Controller to load the default parameters from ROM. (This also occurs the first time you turn your Controller on.)

This message also appears if the Controller loads the defaults in response to the RESET command.

cmd:

This is the Command Mode prompt. When this prompt appears, the Controller waits for you to issue a command. Anything you type after this prompt is interpreted as a command by the Controller. If a monitored packet has been displayed, the prompt may not be visible, even though the Controller is in the Command Mode. You can type the redisplay-line character (set by REDISPLA) to make the prompt reappear.

The following message would appear if the Controller does not understand your command at all:

?What?

This will happen at any time that you give your Controller an invalid command that is a complete mystery to its command interpreter.

Whenever you change the value of one of the Controller's parameters, the previous value will be displayed after the word:

was

This confirms that the Controller properly interpreted your command, and reminds you of what you have done.

COMMAND MODE ERROR MESSAGES

An error message like the one shown below appears if you make a mistake when you type a command to the Controller.

?bad

This message shows that you typed a command correctly, but the remainder of the command line could not be interpreted.

If you type more than one call sign for the CONNECT or UNPROTO commands without the required VIA keyword, you will see:

?VIA

If you type a call sign that does not meet the Controller's call sign requirements, it will display:

?callsign

A call sign may be any string of numbers and letters that include at least one letter. Punctuation and spaces are not allowed. The substation ID, if given, must be a decimal number between 0 and 15, separated from the call by a hyphen.

If you type the command DAYTIME to display the date and time but you have not yet set the clock, you will see:

?clock not set

DAYTIME sets the clock if you enter it with the daytime parameters, and just displays the date and time if it is given without parameters.

When you enter a command that requires several parameters but you do not enter the required number, the Controller will display:

?not enough

The following messages appear in response to the CONNECT command:

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

This shows that your station is connected to another station. If there are any digipeaters involved in the particular connection, the path will also be shown. The call signs are in the same sequence you would use to initiate the connection.

Link state is: DISCONNECTED

This shows that no link or connection exists right now. You may use a CONNECT command to initiate a connection.

Link state is: CONNECT in progress

This indicates that you have already typed a connect request, but an acknowledgment from the other station has not been received. If you type the DISCONNE command, the connect process will be canceled.

Link state is: DISCONNECT in progress

This shows that you have entered a disconnect request, but the acknowledgment from the other station has not been received. If you type a second DISCONNE command, the Controller will immediately enter a disconnected state.

Link state is: FRMR in progress

This shows that your Controller is connected to another station, but a protocol error has occurred. This should never happen when two Heathkit AX.25 systems are connected. An improper implementation of the AX.25 protocol could cause this condition. Your Controller will attempt to resynchronize frame numbers with the controller on the other end, although a disconnect may result. Connections are not valid in this state, but a DISCONNE command will begin the disconnect process.

Your Controller will advise you whenever the link status changes. It may change, for example, in response to a command you have entered (CONNECT or DISCONNE), a connect or a disconnect request packet from another station, an automatic disconnect because the retry count was exceeded, an automatic time-out disconnect (CHECK), or a protocol error.

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

This message appears when your Controller changes from a "disconnected" or "connect in progress" state to a connected state. The connection may be a result of a CONNECT command that you have typed, or a connect request packet received from another station.

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

This message indicates that your Controller has received, but has not accepted a connect request from another station. This can happen when you set CFROM to NONE, or if you are already connected to another station.

If you do not provide the arguments that are needed for CFROM, DFROM, MFROM, or MTO, you will see:

?need ALL/NONE/YES/NO

If you enter too many parameters for a command that requires parameters, the Controller will display:

?too many

MFILTER, for example, can have up to four arguments. The following example shows you what happens if you enter five arguments:

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

The Controller indicates a line that is too long with:

?too long

For example, if you type a BTEXT or CTEXT message that contains more than 120 characters, you will see this message. When the Controller displays this specific message, the new line is ignored and the previous text entry is not changed.

Any attempt to change MYCALL or AX25L2V2 while the Controller is connected or attempting to connect to another station will cause the Controller to display:

?not while connected

If you type a numeric argument too large or too small for that specific command, you will see:

?range

The following message appears in response to a CONVERS or TRANS command, under special circumstances:

too many packets outstanding

This message would appear, for example, if you have already typed packet data and filled the outgoing buffer in the Converse Mode or the Transparent Mode, and then tried to return to the Command Mode. You will be allowed to enter one of these modes, however, when some of the packets have been successfully transmitted.

LINK STATUS MESSAGES

Link status messages show you the status of any packet AX.25 connections in which your Controller may be involved.

You can type the CONNECT command by itself at any time while the Controller is in the Command Mode to check the link status.

If you attempt a connection while your Controller is already in a connected state, your monitor displays the link status and takes no other action. If you have set AX25L2V2 ON, you will also see the number of unacknowledged packets (if there are any).

When your Controller displays this message, it also sends a DM packet (busy signal) to the station that initiated the connect request. If your Controller rejects a connect request because you have set CFROM to NONE, you can issue your own connect request to the other station.

***** DISCONNECTED: (call sign)**

This message indicates that your Controller has changed to the disconnected state from some other link state. This message may be preceded by a message explaining the reason for the disconnect, such as the one shown below:

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

In this case, the message shows you that the Controller has been disconnected due to a retry failure, rather than a disconnect request from another station.

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

This indicates that your connect request was rejected by a DM packet (busy signal) from another station. Similarly, your Controller 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

This message shows that your Controller is connected, but a protocol error has occurred. Your Controller has transmitted a special FRMR packet and is trying to resynchronize frame numbers with the other station's packet system. The string xxxxxx is replaced with the hex codes for the three bytes sent in the information part of the FRMR frame. NOTE: This message will not appear if your Controller is in the Transparent Mode.

FRMR rcvd: xx xx xx

This indicates that your Controller has received an FRMR (protocol error as described above). NOTE: This message will not appear if your Controller is in the Transparent Mode.

SPECIAL KEYBOARD CONTROL CODES

CLEAR STRING COMMANDS

When the Controller is in the Command Mode, you can clear the commands listed below by typing the command word followed by a single percent sign (%), an ampersand (&), "N," "NO," "NONE", or "OFF" as the command's argument:

BTEXT	CTEXT	MBX	MYALIAS	MHEARD
MFROM	MTO	CFROM	DFROM	

DETAILED COMMAND DESCRIPTIONS

The "List of Commands" section of this Manual presents detailed descriptions of each command that is contained in the Controller's operating system software. You will find more information about the meaning, use and effects of each command, its parameters, default values, and arguments. Examples of proper command usage are also included.

TYPES OF OPERATION

Your Controller is capable of six types of operation. This section of the Manual describes each of these types briefly. Refer to the "Detailed Operation" section of this Manual for more information about the types of operation.

Appendix G provides you with a detailed discussion of appropriate amateur radio applications of ASCII, Baudot/Murray, and AMTOR RTTY codes.

MORSE CODE

Morse continues to be the foundation of amateur radio operation. The traditional Morse code QSO is greatly improved by computer- based Morse operation. Messages formerly handled manually can now be sent at much higher speeds, with greater ease of operation. Computer-based Morse operation automatically creates and maintains a permanent record of your Morse communications. This results in a major advantage over manual operation.

All amateur radio operators are familiar with CW operation. There are some differences, however, between manual and automatic Morse operation. Generally, computer-based Morse needs stronger signals to achieve the lowest number of errors when received text is being automatically decoded. Computers are not as forgiving or tolerant of a "bad fist". Trying to decode poorly-sent Morse Code with any computer system is like the GIGO rule--Garbage-in, Garbage out! Even the best computers will send garbled characters to the screen or printer when they are trying to decipher CW in which the dot-dash lengths, intervals and ratios, or intercharacter and interword spacing are really out of the normal specifications.

Do not expect your Controller to do miracles and produce good copy from bad fists.

BAUDOT RTTY

Computer-based Baudot operation is growing daily. The combination of the economical personal computer and the amateur radio station opens new vistas of enjoyment and provides better methods of handling message traffic in the amateur radio service.

The Baudot/Murray code, also known as International Telegraph Alphabet Number 2, is a five-bit asynchronous text transmission code that is used for text or message transmission when you do not need the full character set as contained in ASCII. Most of the amateur radio RTTY operators in the world still use the Baudot/Murray code.

ASCII RTTY

The ASCII (American Standard Code for Information Interchange) code is also known as International Alphabet Number 5. ASCII is a seven-bit asynchronous transmission code used to send text or data traffic that requires a more complete character set than that provided by the older, less-sophisticated Baudot code. The ASCII code is generally suitable for any form of data transfer, and is required when you transmit computer program listings and executable or binary code files.

The Controller provides RTTY operation in the ASCII code at 110, 150, 200 and 300 bauds, which correspond to approximately 100, 150, 200 and 300 words-per-minute (WPM).

AMTOR

Your Controller provides AMTOR operation in accordance with FCC Part 97.69 and CCIR Recommendations 476-2/476-3, Mode A (ARQ) and Mode B (FEC) in normal, semiautomatic, and fully-automatic modes.

AMTOR, an adaptation of the SITOR system used in high-seas ship telex, uses a unique seven-bit synchronous code for error- detection and error correction. AMTOR has been widely used overseas since 1977, and is growing rapidly among U.S. amateurs who wish to obtain almost error-free RTTY under the worst-case conditions sometimes found in HF radio.

AMTOR Mode A (ARQ) is considered to be the most error-free method of HF radiogram message and text transmission available in the amateur radio service today.

Use AMTOR Mode A (ARQ - Automatic Request for Repetition) to answer another station's CQ call, or to set up a synchronous, interactive link with error detection and correction.

When you use AMTOR with EAS set to ON, Mode A allows you to "see" the quality of the path, the circuit link and band conditions, to watch the flow of the data and accurately estimate the "throughput" rate.

Use AMTOR Mode B (FEC) to call CQ and to transmit information to more than one station at the same time ("roundtable" mode).

We strongly recommend that before you operate AMTOR you read Appendix D written by J. Peter Martinez, G3PLX, the "father" of AMTOR, and published in this Manual with his permission.

FAX

FAX (facsimile) is used to transmit maps, drawings, photographs, and other fixed images to another station. The image is scanned at the originating station and converted into an electrical signal before it is transmitted. A receiving station then reconstructs the electrical signal into a likeness of the original.

Receiving WEFAX (weather FAX) stations is growing in popularity and allows you to graphically observe up-to-date weather maps.

PACKET RADIO

Packet radio, one of the newest forms of communication, offers a major improvement in the reliability of text and data transmission. Your Controller uses the AX.25 packet protocol, which is based on the international protocols standardized throughout the telephone networks. It has been modified within our fraternity for use in amateur radio.

GENERAL OPERATING INFORMATION

Before you learn the specifics of each of your Controller's six types of operation, you should understand some ideas and command concepts that apply to all of the operating types.

SIGNAL FUNCTION COMMANDS

The following commands affect transmitted signals by allowing you to change data polarity and set automatic function commands.

Invert Received Data (RXREV)

The "RXREV" command reverses the mark and space (stop and start) tones in Baudot and ASCII RTTY, and AMTOR reception. The polarity of the transmitted data is not affected. Use this option if you cannot receive with the opposite sideband to match a station that is sending inverted data.

Invert Transmitted Data (TXREV)

The "TXREV" command reverses the mark and space (stop and start) tones in Baudot and ASCII RTTY and AMTOR transmission. The polarity of the received data is not affected. Use this option if you cannot transmit with the opposite sideband to match a station that is receiving inverted data.

Return to Receive Mode <CTRL-D>

In the Baudot and ASCII RTTY modes, you can insert the RECEIVE command <CTRL-D> while you type "live" into the Controller's transmit buffer, or you can include a <CTRL-D> in a pretyped message that is stored on disk or tape. As soon as your Controller receives this command, it immediately turns off your transmitter and returns to the Command Mode. Type "X" to begin another transmission.

Send Time of Day <CTRL-T>

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

The Controller detects the control code and sends the time to your radio in the data transmission code in use at that time. It will be in the format HH:MM, where "HH" is the hour in the 24- hour system and "MM" is the minute. The "colon" is transmitted in all codes, including Morse. If DAYSTAMP is ON the date is included with the time.

Note: The TIME command cannot be embedded in the a BTEXT or CTEXT message.

CW Identifier <CTRL-F>

In the Baudot and ASCII RTTY modes, you can insert the character that is specified by the CWID command (default <CTRL-F>) as you type "live" into the Controller's transmit buffer, or you can write <CTRL-F> in a pretyped message stored on disk or tape. When your Controller detects a <CTRL-F>, it switches to the Morse Mode, sends your previously stored call sign in Morse code (prefixed by "DE"), turns off your transmitter, and returns to the Command Mode.

NOTE: In the U.S.A., the requirement for identifying your station in Morse code has been eliminated. U.S. amateurs may now identify in whatever mode they are operating. Check local government requirements if you reside in a different country.

Wide Shift (WIDESHFT)

Use the WIDESHFT command to select wide (1000 Hz) or narrow (200 Hz) shifts. MARS stations will generally find WIDESHFT compatible with standard MARS 850-Hz shift Baudot RTTY operations. Nearly all amateur radio VHF and HF Baudot and ASCII RTTY operators use 170-shift. The Controller's 200-Hz shift is within the passband and filter tolerances of any RTTY demodulator in general service.

NOTE: Shifts of up to 1000 Hz on HF radio is authorized in FCC Part 97.69.

Type "WIDESHFT ON <RETURN>" if you require a 1000-Hz shift. The Controller will respond with:

```
WIDESHFT   was OFF
WIDESHFT now ON
```

Answerback (AAB)

The answerback and WRU? functions are widely used in low-speed Baudot TTY, telex, ASCII, and AMTOR/SITOR services to confirm that the traffic is being received by the proper station and is mostlikely being received correctly.

You can store up to 17 characters in your answerback field. The text string can be whatever suits your needs. If you use Baudot RTTY or AMTOR to handle traffic, for example, you can type in a "QSL" string:

Type "AAB QSL DE MYCALL<RETURN>"

If the station that is sending traffic to you starts and ends his transmission with the WRU? character "FIGS D", "$" in Baudot and AMTOR, or <CTRL-E> in ASCII, your Controller will turn on your transmitter, send the message "<CR><LF>QSL DE MYCALL" stored in the Answerback field (AAB), and then turn your transmitter off and return to the receive status. NOTE: The <CR><LF> sequence is created by the Controller. DO NOT type it as part of your answerback text.

WRU? (Who Are You?)

Use the WRU? feature in Baudot and AMTOR to enable or disable your Controller's automatic answerback feature. The default value is OFF.

If WRU? is set to ON, your Controller sends your answerback on receipt of another station's WRU? request character "FIGS D" or "$". Your Controller turns on your transmitter, sends the text string stored in the answerback field (AAB), and then turns your transmitter off and returns to a receive status.

You can use this feature when you handle messages (in either direction) to confirm that you are sending to the proper station, and that the other station is probably receiving your traffic successfully.

FORMATTING COMMANDS

The following commands affect transmitted signals, displayed signals, or both.

Screen Line Length (ACRDISP n)

The ACRDISP command (default 80) formats your computer's screen display. A <CR><LF> sequence is sent to your computer at the end of a line when "n" characters have been displayed. If your computer automatically formats output lines, set ACRDISP to zero (0) to disable this function.

Monitor Echo (ECHO)

The ECHO command controls local echo by your Controller in all modes except Packet radio's 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 each character you type appears doubled, set ECHO to OFF.

Automatic Word/Character Output (WORDOUT)

In Morse, Baudot and ASCII RTTY, and AMTOR, the WORDOUT command permits you to toggle between two different ways of outputting your hand-typed characters. If "WORDOUT" is set to ON, you have a limited form of editing of your typing errors.

If "WORDOUT" is OFF, each character you type will be transmitted as soon as you type it and it enters the Controller's transmit buffer.

If "WORDOUT" is ON, nothing is sent until you type a "SPACE" character (space bar), a "RETURN", or any punctuation marks such as parentheses, plus sign, asterisk, etc. This gives you the opportunity to correct your spelling or even change words before the transmit buffer's contents are transmitted (even though the transmit buffer has been emptied).

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 include a "<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 you format text files in your buffers.

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 you format text files in your message buffers.

Automatic Carriage Returns (ACRDISP, ACRDISP, ACRPACK, & CRADD)

ACRDISP — Affects the data that flows from the radio or the Controller to your terminal. An argument number between 0 and 255 sets the terminal's screen width. The default value of 80 causes an automatic carriage return to be inserted after the 80th consecutive non-carriage return character. Set the argument to 0 to disable this feature.

ACRRTTY — Affects the data that flows from the terminal to the radio in the Baudot, ASCII, and AMTOR modes. An argument value between 0 and 255 sets the assumed screen width of another station. The default value of 71 causes a carriage return to be substituted for the first space the Controller finds after 66 consecutive non-carriage return characters, or is inserted after the 71st consecutive non-carriage return character, whichever comes first. Set the argument to 0 to disable this feature.

Use this option when you are hand typing text into the transmit buffer and do not want to watch the screen to see when you come to the end of a line.

NOTE: You should not use this option in any of the following three cases:

1. Do not use this option when you retransmit text, such as ARRL RTTY bulletins received from another station. The received text already contains carriage returns. If you enable "Automatic CR" in this instance, the Controller will send double or triple line feeds. These look very strange to the other station operator.

2. Many stations using electromechanical teleprinter and Teletype™ machines habitually send the traditional <CR> <CR> <LF> <LTRS> needed to allow the slower machines to return to the left margin. The double <CR> will produce a double line feed if you set ACRRTTY to less than the number of columns or characters-per-line that are used by the originating station. The default value of 71 is acceptable for most received traffic.

3. When you send RTTY pictures, you want everything to be exactly as it was originally typed.

ACRPACK — Affects the data that flows from the terminal to the radio in the Packet Mode.

When ACRPACK is set to OFF, the SENDPACK character is not added to outgoing packets.

When ACRPACK is set to ON (default), the SENDPACK character itself is added to the end of the packet.

CRADD — Affects the data that flows from the terminal to the radio in the Baudot RTTY Mode.

When CRADD is set to OFF (default), the data is not modified.

When CRADD is set to ON, each carriage return from the terminal is transmitted followed by a second, inserted carriage return.

Automatic Line Feeds (ALFDISP, ALFPACK, ILFPACK, & ALFRTTY)

ALFDISP — Affects the data that flows from the radio or the Controller to your terminal.

When ALFDISP is set to OFF, the data is not modified.

When ALFDISP is set to ON (default) in the Packet Mode, all received line feeds are ignored, and every received carriage return passes to the terminal followed by an inserted carriage return. In the Baudot, ASCII, and AMTOR modes, all received carriage returns are ignored, and each received line feed passes to the terminal preceded by an inserted carriage return.

ALFDISP ON inserts a line feed after every automatic carriage return that is caused by ACRDISP.

ALFPACK — Affects the data that flows from the terminal to the radio in the Packet Mode.

When ALFPACK is set to OFF (default), the data is not modified.

When ALFPACK is set to ON, line feeds from the terminal are ignored, and each carriage return from the terminal is transmitted followed by an inserted line feed.

ILFPACK — Affects the data flowing from the terminal to the radio in the Packet Mode.

When ILFPACK is set to OFF (default), all line feeds pass without modification.

When ILFPACK is set to ON, all line feeds from the terminal are ignored. This is useful when you send computer files that contain line feeds.

ALFPACK ON overrides ILFPACK as shown below:

ALFPACK	ILFPACK	Action: CR LF
OFF	OFF	CR LF
OFF	ON	CR –
ON	OFF	CRLF –
ON	ON	CRLF –

ALFRTTY — Affects the data that flows from the terminal to the radio in the Baudot, ASCII, and AMTOR modes.

When ALFRTTY is set to OFF, the data is not modified.

When ALFRTTY is set to ON (default), all line feeds from the terminal are ignored, and each carriage return from the terminal is transmitted followed by an inserted line feed.

ALFRTTY on inserts a line feed after every automatic carriage return that is caused by ACRRTTY.

Use this option when you are hand typing text into the transmit buffer and do not want to watch the screen to see when you come to the end of a line. The same restrictions apply to this option as they do to the automatic carriage return option described earlier.

The following chart summarizes the automatic line feed commands:

COMMAND	DIRECTION	Action: CR LF
ALFDISP ON (Packet)	Terminal <- radio	CRLF --
ALFDISP ON (RTTY)	Terminal <- radio	-- CRLF
ALFPACK ON	Terminal -> radio	CRLF --
ALFPACK ON	Terminal -> radio	CR --
ALFRTTY ON	Terminal -> radio	CRLF --

Controller To TAPR TNC-2 Command Cross Reference

The following table of equivalent commands is provided to help those operators who are familiar with the formatting commands that are used in the TAPR TNC-2 Packet TNC, and its commercial clones, to gain a clearer view of the differences in command words and their equivalent functions.

HK-232	TNC-2
ACRDISP	SCREEDLN
ACRPACK	CR
ACRRTTY	--
CRADD	--
ALFDISP	AUTOLF
ALFPACK	LFADD
ALFRTTY	--
ILFPACK	LFIGNORE

Backspace and Delete <DEL>

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

If you type a <BACKSPACE> when "DELETE" is ON, it erases the characters from the screen and from the transmit buffer as well.

Escape Functions <ESC>

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

This option is provided because some terminals and computer terminal emulator programs may interpret the ESCAPE character as a special command prefix. These types of terminals change the display functions, depending upon the characters that follow the ESCAPE key. If your computer exhibits this problem, set ESCAPE to ON.

Also refer to the MFILTER command, which lets you strip or filter out any received characters and prevent them from reaching your computer or terminal.

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Also refer to the MFILTER command, which lets you strip or filter out any received characters and prevent them from reaching your computer or terminal.

Echo As Sent (EAS)

The Echo-As-Sent (EAS) command can be used in all modes but Packet. EAS permits you to choose the type of data displayed on your screen or printer.

Set EAS to ON when you operate Morse, Baudot RTTY, or AMTOR. These modes do not use lowercase characters. You can operate in a relaxed and normal manner, typing entirely in lowercase if that is easier for you. With EAS ON, your Controller translates your lowercase typing into UPPERCASE Morse or Baudot/CCITT characters.

When EAS is ON while you operate Morse, Baudot, or AMTOR, only UPPERCASE characters appear on your screen, representing the data sent to the other station. Each character appears on the screen at the time it is sent to the other station.

Type "EAS OFF" to see your typing exactly as you type the characters, or to send from a disk file. The Controller responds with:

```
EAS was ON
```

Type "EAS ON" to see the data as it appears to the other station. The Controller responds with:

```
EAS was OFF
```

Clear Transmit Buffer (TCLEAR)

Use the TCLEAR command to clear your Controller's transmit buffer and cancel any further transmission of data. Simply type "TCLEAR" or "TC" followed by a <RETURN>.

NOTES:

1. Your Controller must be in the Command Mode before you use TCLEAR.
2. Use a <CTRL-C> (default) command to return to the Command Mode.
3. Type "TCLEAR <RETURN>" or "TC <RETURN>" to clear the transmit buffer.

DETAILED OPERATION

This section of the Manual shows you how to use each of the Controller's six types of operation.

NOTE: Your Controller features a Signal Identification Acquisition Mode (SIAM) that helps you determine what unknown radio teleprinter signal is using. Refer to the SIGNAL and OK commands in the "List of Commands" section of this Manual for detailed information about this feature.

MORSE CODE OPERATION

All amateurs are familiar with CW operation. There are some differences, however, between manual and automatic Morse operation. As a rule, computer-based Morse needs stronger signals to achieve the lowest number of errors in automatic decoding of the received text. Computers are not forgiving or tolerant of a "bad fist!" Trying to decode poorly sent Morse Code with any computer system is like the "GIGO" rule - Garbage In, Garbage Out! Even the best computers will send garbled characters to the screen or printer when they try to decipher CW in which the dot-dash lengths, intervals and ratios, and intercharacter and interword spacing are really outside of normal specifications.

Do not expect your Controller to do miracles and produce good copy from bad fists! Later in this Manual you will learn how to use the Controller program with your computer to improve your own CW fist.

To enter the Morse Mode, first make sure the Controller is in the Command Mode. Then type "MORSE" or "MO" followed by a <RETURN>. The Controller will respond with the previous mode:

```
OPMODE was PACKET
OPMODE now MORSE
```

The following front panel LEDs should now be lit:

STATUS LED: CMD

MODE LED: MORSE

Type WI OFF to make sure WIDESHIFT is set to OFF. The Controller will respond with:

> **WIDESHIFT was OFF** (or ON, if you prevciously set it to ON)
> **WIDESHIFT now OFF**

To use the Morse mode, make sure you transceiver is set for either CW or USB. If your transceiver has IF Shift or Pass Band Tuning controls, make sure they are centered. Tune the transceiver to a point on the band where you do not hear any signals. Then turn the THRESHOLD control on the Controller fully clockwise, and then counterclockwise to the point where the DCD light just extinguishes.

If you have your transceiver set for CW and have additional filtering available, you may wish to enable it to improve selectivity. If you wish to use tone-modulated CW, set the transceiver for USB operation. The Controller can simultaneously provide direct keying and tone modulation keying. The tone modulation is 1200 Hz and turns on and off to simulate CW. If you decide to use USB, keep in mind that you are transmitting a 1200 Hz tone and receiving an 800 Hz tone. You will have to use the transceiver's RIT control to correct the offset between the transmit and receive tones.

You can now tune your transceiver to a Morse signal. Refer to "Tuning Indicator" in the "Basic Operation" section of this Manual to properly tune in the signal. The DCD light should now be lit and you should see readable text on your monitor.

Use the following commands to control your transmitter:

> Type "X" to turn on your transmitter and enter the Converse mode. (The "K" command is not required.)
>
> Type <CTRL-D> to shut off your transmitter (after the transmit buffer empties) and return to the Command Mode OR,
>
> Type <CTRL-C> to return to the Command Mode, and then
>
> Type "R" to turn off your transmitter and end the contact.

TRANSMIT/RECEIVE FUNCTION KEYS

The following keys are active from the Command Mode:

> "L" Locks the system to the speed of the incoming signal.
>
> "R" Switches the system to the receive mode, unlocks the receive speed, and forces the receive speed to equal the transmit speed.
>
> "X" Switches the system to the transmit mode and forces an immediate entry into the Converse mode.
>
> "MO" Unlocks from the speed of the Morse receive speed.

Embedded in transmitted text:

<CTRL-D> immediately turns off the transmitter and switches to the Command Mode.

To transmit CW, type a letter "X" (from the Command Mode) followed by a <RETURN>. The Controller will key the PTT circuit of your transceiver. The SEND, CONV, and MORSE LEDs on the Controller should light. Any data that you attempt to send, it will be sent depending upon the status of the WORDOUT parameter. If WORDOUT is OFF, characters will be transmitted as you enter them. If WORDOUT is ON, however, characters will be transmitted as complete words. They will not be transmitted until you press the space bar or enter a <RETURN>.

To return to the receive mode, enter a <CTRL-D>. This places both the receiver and the Controller in the receive mode.

At times, you may wish to copy the CW signal in your head and use the Controller as a CW keyboard. To do this, put your transceiver in the VOX or QSK mode of operation. Make sure WORDOUT is OFF and use the letter "K", as explained earlier, to direct the Controller to enter the MORSE SEND mode. Make sure you disconnect the microphone cable between the Controller and the transceiver, or it will be stuck in transmit. NOTE: This procedure works only when you use the KEY OUTPUT socket on the back of the Controller.

SPEED CHANGE

Use the MSPEED command to change Morse keying speed. To read the present Morse speed, type "MSPEED (RETURN)" or "MSP (RETURN)". The Controller will respond with a message similar to:

MSPEED 20

Type "MSPEED" followed by one or two digits from "5" to "99" and a <RETURN>. The Controller will respond with the previous Morse speed.

MSPEED was 20
MSPEED now XX (whatever new speed digits you typed)

The number you enter becomes the new transmit speed and replaces the value that was previously stored in the program. The slowest available Morse speed is 5 words-per-minute. If you enter a number less than 5, the program will use 5 words-per-minute.

For speeds between 5 and 14 words-per-minute, the transmitted code is sent with Farnsworth spacing. This means that the characters are sent at 15 words-per-minute, while the spaces between characters are lengthened to yield an overall code transmission rate between 5 and 14 words-per-minute.

SPEED LOCK

The LOCK command enables the Controller to keep track of the received signal speed. This can enhance reception of Morse code when noise is present. When the Controller is properly copying a CW station, enter the Command mode. Then type an "L" to lock the Controller to the receive speed. This will prevent static crashes or other adjacent stations from causing the speed-tracking feature from trying to lock onto a new speed. The LOCK feature is especially helpful when the band is noisy or cluttered with several stations. To unlock the speed, type "R" or "MO", followed by a <RETURN>. This will cause the Controller to re-enter the free-running mode where it can automatically track the CW speed.

SPECIAL MORSE CHARACTERS

The Controller's Morse program contains special keystrokes that you can use to make transmission easier, faster, and more enjoyable. The most-frequently-used Morse "prosigns" are coded into the keyboard with keys that have no direct representation in standard Morse. These special "reserved" keys are listed in the following table:

Keystroke	Abbreviation	Meaning
*	SK	End of QSO.
&	AS	Wait.
+	AR	End of message.
(	KN	Go only.
=	BT	Break or pause.
>	AA	New line.
!	SN	Understand.
%	KA	Attention.

NOTE: Refer to the CODE command in the "List of Commands" section of this Manual for information about other alphabets.

MORSE CODE PRACTICE

You can use your computer and your Controller to develop and improve your manual CW sending and receiving skills.

To use this feature, set your Controller for Morse receive operation and operate the hand key attached to your radio. In most typical installations, if your radio has an "input monitor" or "sidetone" output, your hand keying will be sent to the Controller and displayed on your monitor. Send test words for a few minutes to familiarize yourself with the relationship between your handkeying and the Morse appearing on your screen. Practice keying at various speeds and observe how the system decodes your "fist." NOTE: At first you may be a bit unhappy or surprised at the quality of your keying, but after a few sessions you will notice an improvement.

BAUDOT RTTY OPERATION

To enter the Baudot RTTY Mode, first make sure the Controller is in the Command Mode. Then type "BAUDOT" or "BA" followed by a <RETURN>. The Controller will respond with the previous mode:

OPMODE was MORSE
OPMODE now BAUDOT

The following front panel LEDs should now be lit:

STATUS LED: CMD

MODE LED: BAUDOT

Make sure RBAUD is set to 45. Also make sure RXREV, TXREV, and WIDESHIFT are set to OFF.

To use the Baudot Mode, make sure your transceiver is set to LSB. If your transceiver has IF Shift or Pass Band Tuning controls, make sure they are centered. Tune the transceiver to a point on the band where you do not hear any signals. Then turn the THRESHOLD control on the Controller fully clockwise, and then counterclockwise to the point where the DCD light just extinguishes.

You can now tune your transceiver to a Baudot signal. Refer to "Tuning Indicator" in the "Basic Operation" section of this Manual to properly tune in the signal. The DCD light should now be lit and you should see readable text on your monitor. If the tuning indication appears to be correct and the DCD light is lit but you are not copying readable text, the station may be transmitting at a speed other than 45 baud.

Included in your Controller is the SIAM™ (Signal Identification and Acquisition Mode) feature, which automatically determines the various parameters about an unknown signal for you.

To activate this feature, enter "SI" followed by a <RETURN>. After a few seconds, the Controller will display the type of signal, its speed, and whether the signal is right-side-up or reversed. If you wish to try these parameters, just type "OK" followed by a <RETURN>. You do not have to change each parameter separately.

Refer to the SIGNAL command on Page 8-92 for more information about the SIAM feature.

NOTE: An RBAUD setting of 45 and LSB operation is most common on the amateur radio bands. There are some stations that use 75 baud, but these are usually mailbox stations. A good place to look for Baudot RTTY stations is between 14.080 and 14.100 MHz.

Use the following keys to control your transmitter:

Type "X" to turn on your transmitter (after the transmit buffer empties) and enter the Converse mode.

Type <CTRL-D> to shut off your transmitter and return to the Command Mode, OR

Type <CTRL-F> to send your call sign in Morse, shut off your transmitter, and return to the Command Mode, OR

Type <CTRL-C> to return to the Command Mode, and then

Type "R" to immediately shut down your transmitter and end the contact.

TRANSMIT/RECEIVE FUNCTION KEYS

The following keys are active from the Command Mode:

"L" Forces LETTERS case.

"R" Switches the system to the receive mode and forces LETTERS case.

"X" Switches the system to the transmit mode and forces an immediate entry into the Converse mode.

Embedded in transmitted text:

<CTRL-O> sends LETTERS character.

<CTRL-N> sends FIGURES character.

<CTRL-D> immediately shuts off the transmitter.

<CTRL-F> sends your call sign in Morse and shuts off the transmitter.

A TYPICAL BAUDOT RTTY CONTACT

Assume that you hear station KZ7G calling CQ. When he completes his CQ and turns his transmitter off, do this:

Type "X" to key your transmitter and make the Controller start sending.

Call the other station by sending his call sign followed by your call sign (KZ7G DE N7BTT, for example). If you wish, you can start the transmission with a line of RYs so the other station can make sure he has you tuned in properly. Here is a typical sequence:

RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
KZ7G KZ7G KZ7G DE N7BTT N7BTT N7BTT
KZ7G KZ7G KZ7G DE N7BTT N7BTT N7BTT
KZ7G KZ7G KZ7G DE N7BTT N7BTT N7BTT
<CTRL-D> <RETURN>

NOTE: If the other station cannot copy the above four lines of text, chances are that he will not be able to copy any more than that. There is no need to waste bandwidth by typing 15 or 20 lines of the same thing.

Wait to see if you get a response. If you do not, you can repeat the above procedure.

<CTRL-D> causes the Controller to turn off the transmitter. If you do not use this command, you will have to wait until you think the Controller has finished transmitting the text, type <CTRL-C> to return the Controller to the Command Mode, and then type "R" to force the Controller into the receive mode (regardless of any other text that is to be transmitted.

BAUD RATE (SPEED) CHANGE

The Controller provides RTTY operation in the Baudot/Murray code at 45, 50, 57, 75, 100, 110, 132, 150, 200, and 300 bauds, which corresponds to approximately 60, 66, 75, 100, 132, 150, 200, and 300 words-per-minute (WPM).

The RBAUD command allows you to change the Baudot data rate.

To read the present baud rate, type "RBAUD <RETURN>" or "RB <RETURN>". The Controller will respond with a message similar to:

RBAUD	**45**

Type "RBAUD" followed two or three digits and a <RETURN>. The Controller will respond with the the old baud rate:

RBAUD	**was 45**
REBAUD	**now XX** (whatever rate you selected)

The number you enter becomes the new data rate and replaces the value previously stored in the program. NOTE: "RB n" must be one of the following speed options: 45, 50, 57, 75, 100, 110, 150, 200, or 300 bauds.

You can also change the baud rate one step up or one step down at a time by typing "RB U" or "RB D" respectively. The Controller will return the previous data rate and adopts the new rate.

NOTE: The expression "words-per-minute" (WPM) is no longer always used in commercial telegraphy. Baudot speeds are now generally specified by baud rates. The Baudot "WPM" speeds relate to modern terminology as follows:

Words per Minute	Baud Rate
60	45 bauds
66	50 bauds
75	57 bauds
100	75 bauds
132	100 bauds
110	110 bauds
150	150 bauds
200	200 bauds
300	300 bauds

CCITT ON/OFF

Use the CCITT command when you operate Baudot RTTY to select the correct character translation between the standard "American keyboard" and the internationally standardized keyboard used outside the U.S.A. The CCITT option automatically translates your typing into International Telegraph Alphabet Number 2 (ITA #2) to avoid character conflicts when you work overseas station. (Part 97.69 of the FCC Rules requires you to use this code when you operate Baudot RTTY.)

If CCITT is set to ON, characters typed on the keyboard or loaded from disk files are translated into CCITT ITA #2 before they are sent. If CCITT is set to OFF, characters sent to the Controller are not translated into CCITT ITA #2, but remain in the American standard Baudot format (typically Western Union). For a description of the keyboard configurations, refer to the CCITT command in the "List of Commands" section of this Manual.

UNSHIFT-ON-SPACE (USOS)

Unshift-On-Space automatically changes the program to the LETTERS or lowercase condition after the Controller receives the "space" character.

When you operate Baudot RTTY under poor HF receiving conditions, a LETTERS-SHIFT character can become garbled, or another character can be wrongly interpreted as a FIGURES-SHIFT character. Many otherwise good characters that are received after this point would be interpreted as "uppercase," (numbers and punctuations) rather than the lowercase letters typed by the originating station.

USOS helps reduce reception errors under poor conditions. Be aware, however, that some commercial, weather, and utility RTTY services send consecutive groups of numbers separated by spaces. If you use USOS with these stations, it will produce unacceptable results by returning the system to lowercase characters when the originator may have intended the data to be uppercase characters.

TYPICAL AMATEUR RADIO RTTY FREQUENCIES

The following list shows some of the frequencies where you are likely to find amateur RTTY stations. NOTE: All frequencies are in kiloHertz (kHz).

3590 (RTTY DX)

3610 -- 3630

7040 (RTTY DX)

7090 -- 7100

10,140 -- 10,150

14,075 -- 14,100

21,090 -- 21,100

24,920 -- 24,930

28,090 -- 28,100

RECEPTION OF COMMERCIAL OR BROADCAST STATIONS

You may find that listening to commercial or broadcast stations to be one of the more enjoyable things you can do with your Controller. A general-coverage receiver is helpful for this purpose, but it is possible to find several broadcast stations just outside of the amateur radio bands. Commercial stations can be difficult to tune because it is difficult to determine the format the station is using. There are four variables that you must determine before you can expect to copy a commercial or broadcast station. These are:

Baud Rate

Frequency Shift

Sideband (upper or lower)

Signal encryption

The Controller requires you to enter the proper values for each of the above variables. You can use trial and error to determine the proper settings, or you can consult one of the many press Teletype listings that are available from amateur radio dealers. These books list the time, frequency, baud rate, frequency shift, and whether the station uses upper or lower sideband. They can also save a lot of time by pointing out stations that use signal encryption. Encrypted signals cannot be readily copied.

You can also use the procedure described in the next section to determine some of the above variables.

NOTE: Refer to the CODE command in the "List of Commands" section of this Manual for information about other alphabets.

FREQUENCY SHIFT AND TUNING

The Controller's WIDESHIFT parameter sets frequency shift. When WIDESHIFT is set to OFF or NO, the Controller uses standard filter tone frequencies of 2100 Hz and 2310 Hz and accomodate a frequency shift of 200 Hz. When WIDESHIFT is set to ON or YES, the Controller uses 1200 Hz and 2200 Hz tones for frequency shift of 1000 Hz.

If you know that the commercial or broadcast station you are attempting to copy is using a 170 Hz shift, set WIDESHIFT to OFF. If you know the station is using an 850 Hz shift, however, set WIDESHIFT to ON.

You can use either WIDESHIFT ON or OFF to copy 425 Hz stations. The bandwidth of the narrow filter is 450 Hz and begins to attenuate shifts beyond 450 Hz. Since 425 Hz is just inside the filter rolloff frequencies, you should have no problem using WIDESHIFT OFF. You should also be able to use WIDESHIFT ON to copy 425 Hz shifts due to its bandwidth characteristics, but we have found from experience that WIDESHIFT OFF works best. When you toggle between narrow and wide shifts, you are actually changing the resonant frequency of the filters inside the Controller. After you toggle the WIDESHIFT parameter, therefore, you will have to retune your receiver.

If you do not know the shift of a station, you can start with narrow shift and attempt to tune the in the station for the proper tuning indicator display. If you cannot obtain the proper display, the station is probably using a shift that is wider than the narrow shift filter. If this is the case, change WIDESHIFT to ON and retune the receiver for the proper display. If you still cannot obtain the proper indication, the station is probably not using Baudot. It could be using FAX or something similar.

After you have the station properly tuned in, the next step is to determine the correct baud rate. Start with RBAUD set to the lowest setting (45) and use the RB U command to increase the baud rate upward one step at a time until you reach 300 baud. (If you attempt to go higher, the monitor will display "BAD?".) If you cannot properly copy the station with any baud rate setting, the station may be using the opposite sideband. Instead of changing the Mode switch on the receiver, you can use RXREV T to toggle the setting of RXREV. After you do this, use the RB D command to decrease the baud rate one step at a time until you can copy the station. (If you attempt to go lower than 45, the monitor will display "BAD?".) If you still cannot properly copy the station, it is probably using encryption.

ASCII RTTY OPERATION

To enter the ASCII RTTY Mode, first make sure the Controller is in the Command Mode. Then type "ASCII" or "AS" followed by a <RETURN>. The Controller will respond with the previous mode:

OPMODE was BAUDOT
OPMODE now AXCII

The following front panel LEDs should now be lit:

STATUS LED: CMD

MODE LED: ASCII

Make sure ABAUD is set to 110. Also make sure RXREV, TXREV, and WIDESH are set to OFF.

ASCII is not generally used on the HF amateur bands or by commercial and broadcast stations. If you wish to operate ASCII on HF, however, follow the procedure listed under "Baudot Operation."

You will usually find ASCII used by many bulletin boards on VHF frequencies, especially 2 meters. These BBSs normally use either 110 or 300 baud. Some BBSs provide you with the option of starting at one speed and then increasing the speed to a higher value. The default setting of your Controller is 110 baud. If you access a BBS, start out at 110 baud and then increase to 300 baud. The ABAUD U command allows you to increase the baud rate in steps up to 300. Be sure to type a <CTRL-C> to make sure the Controller is in the Command Mode before you attempt to change the baud rate. You can then type a letter "K" to return the Controller to the Converse Mode.

Use the following keys to control your transmitter:

Type "X" to turn on your transmitter and enter the Converse mode.

Type <CTRL-D> to shut off your transmitter and return to the Command Mode, OR

Type <CTRL-F> to send your call sign in Morse, shut off your transmitter, and return to the Command Mode, OR

Type <CTRL-C> to return to the Command Mode, and then

Type "R" to immediately shut down your transmitter and end the contact.

TRANSMIT/RECEIVE FUNCTION KEYS

The following keys are active from the Command Mode:

"R" Switches system to the receive mode.

"X" Switches system to the transmit mode and forces immediate entry into the Converse mode.

Embedded in transmitted text:

<CTRL-D> immediately shuts off the transmitter.

<CTRL-F> sends your call sign in Morse and shuts off the transmitter.

<CTRL-O> sends a LETTERS character; <CTRL-N> sends a FIGURES character.

The Controller provides RTTY operation in ASCII code at 45, 50, 57, 75, 100, 110, 150, 200 and 300 bauds.

A TYPICAL ASCII RTTY CONTACT

There is no major difference between BAUDOT and ASCII operation other than the ability to type both upper- and lower-case characters in the ASCII code. You can also send certain control codes and special characters that do not exist in the Baudot/Murray code. Refer back to "A Typical Baudot RTTY Contact" for more operating suggestions.

BAUD RATE (SPEED) CHANGE

The ABAUD command allows you to change the ASCII baud rate.

To read the present baud rate, type "ABAUD <RETURN>" or "AB <RETURN>" to display the present baud rate. The Controller will respond with a message similar to:

ABAUD 110

Type "ABAUD" followed two or three digits and a <RETURN>. The Controller will respond with the old baud rate:

ABAUD was 110
ABAUD now XXX (whatever rate you selected)

The number you enter becomes the new data rate and replaces the value previously stored in the program. NOTE: "AB n" can be any of the following speed options: 45, 50, 57, 75, 100, 110, 150, 200, or 300 bauds.

You can also change the baud rate one step up or down one step at a time by typing "AB U" or "AB D" respectively. The Controller returns the previous data rate and adopts the new rate.

GENERAL USE OF THE CONTROL KEY FUNCTIONS

When you plan text files and messages for later transmission in the ASCII RTTY mode, you can include any of the "<CTRL-CHAR>" commands just as you would use them in most word processors. The Table on the following Page lists the ASCII codes that are available for control characters.

Dec	Hex	Control	Name	Function
0	$00	<CTRL-@>	NUL	Null or blank
1	$01	<CTRL-A>	SOH	Start of Heading
2	$02	<CTRL-B>	STX	Start of Text
3	$03	<CTRL-C>	ETX	End of Text
4	$04	<CTRL-D>	EOT	End of Transmission
5	$05	<CTRL-E>	ENQ	Enquiry
6	$06	<CTRL-F>	ACK	Acknowledge
7	$07	<CTRL-G>	BEL	Bell or Alarm
8	$08	<CTRL-H>	BS	Backspace
9	$09	<CTRL-I>	HT	Horizontal Tab
10	$0A	<CTRL-J>	LF	Line Feed
11	$0B	<CTRL-K>	VT	Vertical Tab
12	$0C	<CTRL-L>	FF	Form Feed
13	$0D	<CTRL-M>	CR	Carriage Return
14	$0E	<CTRL-N>	SO	Shift Out
15	$0F	<CTRL-O>	SI	Shift In
16	$10	<CTRL-P>	DLE	Data Link Escape
17	$11	<CTRL-Q>	DC1	Device Control 1
18	$12	<CTRL-R>	DC2	Device Control 2
19	$13	<CTRL-S>	DC3	Device Control 3
20	$14	<CTRL-T>	DC4	Device Control 4
21	$15	<CTRL-U>	NAK	Negative Acknowledge
22	$16	<CTRL-V>	SYN	Synchronous/Idle
23	$17	<CTRL-W>	ETB	End of Transmission Block
24	$18	<CTRL-X>	CAN	Cancel
25	$19	<CTRL-Y>	EM	End of Medium
26	$1A	<CTRL-Z>	SUB	Substitute Code
27	$1B	<CTRL-[>	ESC	Escape
28	$1C	<CTRL-\>	FS	File Separator
29	$1D	<CTRL-]>	GS	Group Separator
30	$1E	<CTRL-^>	RS	Record Separator
31	$1F	<CTRL-_>	US	United Separator
32	$20	<SPACE>	SP	Space
127	$7F	<DELETE>	DEL	Delete

AMTOR OPERATION

SELCAL (SELECTIVE SEQUENTIAL CALLING)

AMTOR operating modes require a SELCAL (Selective Sequential Calling) code. This unique character sequence must contain exactly four alphabetic characters that are normally derived from your call sign.

The SELCAL convention, originated by early European AMTOR pioneers and later adopted by amateurs around the world, was broadly based on the then most dommon "one-by-three" call signs. It was formed by the first and the last three letters of the call sign. With the recent changes and expansions of the call sign systems in many countries, however, some comment and explanation may be in order here.

Some call sign groupings currently in use are:

GROUP	CALL	SELCAL
1 by 2	W1XX	WWXX
1 by 3	W1XXX	WXXX
2 by 1	AA1X	AAAX
2 by 2	AA1XX	AAXX
2 by 3	KA1XXX	KXXX

For "1 by 2" call signs, the first letter is doubled. "N7ML", for example, becomes "NNML". This method should work in most cases.

Installing Your SELCAL

To load your SELCAL into the Controller for the first time, first make sure the Controller is in the Command Mode. Then type "MYSELCAL" or "MYS" as shown below:

cmd:myselcal nnml

The Controller will respond with:

MYSELCAL was
MYSELCAL now NNML

The "blank" response occurs the first time you use the Controller; there is no default SELCAL.

Type "MYS" to make sure your SELCAL is properly loaded:

cmd:mys

The Controller will respond with:

MYSELCAL NNML

Prevent Duplicate SELCALs

Since the same call sign sequences are assigned in ten districts, it is possible that your SELCAL could be the same as that used by another station. The standard convention for "N1ML", "N2ML", "N3ML", etc., would all derive the same SELCAL, "NNML". If you suspect a station in another call district or zone is also active on AMTOR and may be using the same SELCAL, you can substitute a letter for your call district number to derive your own unique SELCAL. Use the letter that corresponds to the call district number as it appears on the keys of a standard typewriter or Baudot RTTY keyboard.

If your call sign is N7ML, for example, and you discover that there is another station with the call sign N?ML, you can change your SELCAL to NUML, according to the following table:

1 = Q	4 = R	7 = U	0 = P
2 = W	5 = T	8 = I	
3 = E	6 = Y	9 = O	

To enter the AMTOR Mode, first make sure the Controller is in the Command Mode. Then type "AMTOR" or "AM" followed by a <RETURN>. The Controller will respond with the previous mode:

OPMODE was ASCII
OPMODE now AMTOR

NOTE: The ARQ <SELCAL>, FEC, and SELFEC <SELCAL> commands all force Converse Mode. There is no need to type <K> to enter the Converse Mode.

TRANSMIT/RECEIVE FUNCTION KEYS

The following keys are active from the Command Mode:

"ARQ <SELCAL>" starts Mode A selective call and forces the Converse Mode.

"FEC" starts Mode B transmission and forces the Converse Mode.

"SELFEC <SELCAL>" starts Selective Mode B transmission.

"R" stops transmission and forces AMTOR Standby.

"AM" stops transmission and forces AMTOR Standby.

"AL" forces resynchronization in the ALIST Mode (AMTOR Mode A Listen).

"L" forces the LETTERS case.

"X" is not used in AMTOR.

Embedded in transmitted text:

<CTRL-O> sends the LETTERS character.

<CTRL-N> sends the FIGURES character.

<CTRL-F> sends your call sign in Morse and shuts off the transmitter.

<CTRL-D> immediately shuts off the transmitter (after the <CTRL-D> is detected in the transmit buffer).

SPEED CHANGE IS NOT PERMITTED

In accordance with FCC Part 97.69 and international regulations, AMTOR is operated at one speed only — 100 bauds. The Controller does not permit AMTOR operation at any other speed.

MODE A (ARQ) CALL - STARTING THE CONTACT (ARQ COMMAND)

Type "ARQ (SELCAL)" to start the AMTOR selective calling sequence, or to answer a Mode B (FEC) CQ call from another station.

Type <CR> after you have typed the fourth letter **(a valid SELCAL must have four characters)**. Your transmitter will be keyed on and off in the typical ARQ three-character burst sequence.

After your Controller locks or synchronizes with the other station, you may begin your conversation.

LED Status and Mode Indicators

After you select AMTOR, the Controller displays the system status on its LEDs as shown below:

STATUS:	STBY lit
MODE:	STBY lit

Type "ARQ" followed by the SELCAL of the station you wish to work. The LEDs will change to:

STATUS:	SEND lit, PHASE lit, CON lit
MODE:	ARQ lit

These LEDs show that your transmitter is in the SEND condition, in the "phasing" part of an ARQ selective call. Your transmitter will key on and off and send the other station's SELCAL. As soon as your Controller synchronizes with the other station, the LEDs will change to:

STATUS:	SEND lit, TFC, CON, and IDLE light alternately with the data flow
MODE:	ARQ lit

Watch the display and type a few <RETURNs> to verify the link. Your traffic will now begin to flow as you type characters. If EAS is set to ON, your typed characters will be displayed as they are acknowledged by the other station. The IDLE and TFC LEDs will alternate when you pause in your typing.

If EAS is ON, the delay between your typing and the appearance of your characters on the screen very accurately indicates the quality of the radio link. The better the link between you and the other station, the faster your typed characters will scroll across your screen.

If your typing does not appear on your screen, the other station is not receiving valid data from you and the automatic error- detection and error-correction features of the AMTOR ARQ mode begin to control the link. Depending upon how band conditions affect the link, the ERROR and RQ LEDs may occasionally light. If errors occur on the link and the other station sends RQ (Request for Repeat), the LEDs will show:

STATUS	SEND lit, ERROR lit, CON lit, and/or RQ lit
MODE	ARQ lit
ERROR lit:	Your Controller has detected errors in the signals received from the other station
RQ lit:	Your Controller has received a "request for repeat" code from the other station

If the link fails and you lose synchronization with the other station, your Controller will automatically try to reestablish synchronization with the other station. The LEDs will change to show:

STATUS:	SEND lit, PHASE lit, ERROR and RQ alternately lit
MODE:	ARQ

Mode A (ARQ) Changeover (+? Command)

When you finish typing your comments or traffic to the other station and want the other station to transmit to you, **do not type "KKK" or anything like that.** Instead, type a plus sign immediately followed by a question mark (+?).

"+?" is a software changeover command that switches your system from "Information Sending Station" (ISS) to "Information Receiving Station" (IRS), and switches the other station's system from "Information Receiving Station" receive to "Information Sending Station". The other station operator will see the "+?" and begin typing comments or traffic.

NOTE: When this Manual describes ARQ operation, it uses the terms "Information Sending Station" and "Information Receiving Station" instead of "transmit" and "receive". During AMTOR ARQ operation, both stations rapidly switch between transmit and receive. When you send "information", the other station sends back "control" signals that inform your Controller how your signals are being received, and how the link is behaving.

Do not bother with multiple call signs and "over-to-you" routines that you use during Baudot and ASCII RTTY operation. In addition, do not bother with "KKK" at the end of your turn. The system does everything for you when you type "+?."

As with other modes of amateur radio operation, the FCC requires station identification once every ten minutes. It is sufficient to begin with "QRA (mycall)" or end your transmission with "QRA (mycall)" before the "+?" changeover code.

Mode A (ARQ) Break-in (ACHG Command)

In Mode A (ARQ), when you are the "Information Receiving Station," you can use the "ACHG" command to break or interrupt the other station's comments. ACHG is a software command that forces both systems to interchange the "Information Receiving" and "Information Sending" status at both ends of the ARQ link. As the "Information Receiving Station," you normally rely on the other station to send the "+?" command to do the changeover at the end of his comments.

Using this command can be disconcerting to the operator on the other end of the link. Use the ACHG command only when you really need to interrupt the other station.

End the Mode A (ARQ) Contact, Return to AMTOR Standby

When you have finished your "final finals" to the other station and both stations are ready to end the Mode A (ARQ) contact, you can use any one of the following methods to end the contact and terminate the link:

Type <CTRL-C> to return to the Command Mode. Then type "R" to break the link. The "R" command breaks the ARQ link and returns your system to AMTOR Standby. Your station can be accessed by another station's transmission of your SELCAL. You can also use "R" to stop sending a SELCAL while you are trying to access another station.

Type <CTRL-F> to break the link and send your Morse ID. Your Controller will switch to the Morse Mode, send your call sign at the speed set by MSPEED, and then shut off your transmitter.

Type <CTRL-D> to stop transmission after the <CNTRL-D> is detected in the transmit buffer.

<CTRL-D> and <CTRL-F> break the link and return your Controller to the Command Mode.

Type <CNTRL-C> and then the letter "R" if you need an "emergency shutdown," or in any case when you want to take your transmitter off the air immediately.

ARQ LISTEN MODE — START MONITORING (ALIST COMMAND)

Use the "ALIST" command to monitor ARQ traffic flowing between two other stations that are linked in an ARQ contact. Your Controller will attempt to synchronize with whichever of the two linked ARQ stations is the Information Sending Station at the moment.

Mode A Listen operation does not give you error detection or error correction; your Controller is not part of the synchronizing "handshake" between the other two stations that are locked to each other. If the other two stations are enjoying a good link, you will probably get good copy from that link.

If the stations you are monitoring are sending error codes and RQ codes and repeating blocks of characters across their link, your Controller will display the repeated character blocks. Your Controller will not print a block of data if that block contains the same information as the previous block. If the ISS (Information Sending Station) repeats the same block, it will not print twice, unless you receive an error. If the stations are having link problems, the data on your screen can look very strange indeed, although the two synchronized stations are obtaining error-free copy.

MODE B (FEC) CALL - STARTING THE CONTACT

After you select AMTOR from the Command Mode, type "FEC <RETURN>" to enter the AMTOR FEC mode. Your Controller will display:

OPMODE was XXXX
OPMODE now FEC

Type "FE" to turn on your transmitter..

Type <CTRL-D> to shut off your transmitter, OR

Type <CTRL-F> to send your call sign in Morse and shut off your transmitter, OR

Type <CTRL-C> to return to the Command Mode, and then

Type "R" to shut off your transmitter and end the contact.

Type "FEC" to start the AMTOR Mode B call or transmission, or answer a Mode B (FEC) CQ call from another station. Your transmitter will turn on and be kept on continuously, while it sends synchronous idle control characters.

NOTE: Mode B (FEC) is recommended for calling CQ in AMTOR.

Sending CQ in Mode A (ARQ) gives another station no clue as to who you are, or what your SELCAL might be. Refer Appendix D for comments by G3PLX.

Do not send long CQ calls with many lines of repeated call signs. FEC eliminates the need for long CQ calls. A simple "3 by 3" sequence is all you need in FEC. Here is one example:

```
CQ CQ CQ DE W2JUP W2JUP W2JUP (WJUP)
CQ CQ CQ DE W2JUP W2JUP W2JUP (WJUP)
CQ CQ CQ DE W2JUP W2JUP W2JUP (WJUP)
QRR ARQ/FEC SELCAL WJUP +?
```

IMPORTANT NOTES:

1. Wait several seconds before you begin to type your CQ call or traffic! The other station must receive several seconds of synchronous idle control characters to synchronize with your system. The other station cannot synchronize to your typed characters.

2. Do not start an FEC transmission with -"RYs" like you would with conventional RTTY. The other station cannot synchronize with RY characters.

The synchronous idle control signals are mark-to-space tone shifts which the other station can use for tuning.

LED Status and Mode Indicators

After you type FEC, your Controller displays system status on its LEDs:

STATUS: SEND lit, IDLE lit, and TFC lit only briefly

MODE: FEC lit

Your transmitter is now keyed and sending the FEC "idle" signals. While you type your comments or traffic, the IDLE LED extinguishes; the TFC LED is lit during the moments when your Controller is sending your data characters. Whenever you stop typing characters, the TFC LED will extinguish and the IDLE LED will be lit.

STATUS: SEND lit, TFC and IDLE light alternately with the data flow

MODE: FEC lit

Mode B (FEC) Changeover

FEC operation is very similar to conventional RTTY. You can type the same "K", "KN" or "BTU" signals to inform the operator at the other station that you are ready for him to send.

Except for the short delay in starting before you send your traffic, you can use the same typing and receiving techniques to operate FEC as you do in CW or conventional Baudot and ASCII RTTY. The FEC mode does not use interaction or "handshaking" between your station and the other station.

NOTE: The "+?" changeover command has no effect in FEC operation.

Ending the Mode B (FEC) Contact, and Returning to ARQ Standby

You can use any of the following methods to end an FEC contact:

Type <CTRL-C> to return to the Command Mode. Then type "R" to break the link. The "R" function stops the FEC transmission, turns off your transmitter, and returns your Controller to AMTOR Standby. Your station can then be accessed by any other station's transmission of your SELCAL.

Type <CTRL-F>, without returning to the Command Mode, to send your Morse ID and shut off your transmitter. Your Controller will switch to the Morse Mode, send your call sign at the speed set by MSPEED, and then shut off your transmitter.

Type CTRL-D, without returning to the Command Mode, to stop transmission. <CTRL-D> allows the remaining contents of the transmit buffer to be sent before your transmitter is turned off. The monitor will display "cmd:". Your Controller will now be in AMTOR Standby, ready for SELCAL access by any other station. Your monitor is ready to display any FEC signals received on the channel.

ECHO AS SENT (EAS)

EAS has special significance in AMTOR Mode A (ARQ). If EAS is ON, you will see the characters you type on your keyboard echoed on your screen only after the other station has validated (Ack'd) your block of three characters, no matter how fast you type them.

With EAS ON, the characters will appear on your screen or printer only as the other station acknowledges them, three at a time.

If the data scrolls across your monitor at a nice even rate, in rhythm with your typing speed, you can assume that you have a good ARQ link.

If the data hesitates or scrolls in "jerky" intermittent fashion, that is generally a sign that the radio link is not too good.

If the characters stop appearing on your monitor, the link is failing or has failed.

NOTE: To prevent the Controller's internal buffer from overflowing, use this mode if you transmit long messages from a buffer or disk drive.

AMTOR SWITCHING-TIME CONSIDERATIONS

For operation in AMTOR Mode A (ARQ), your transceiver or transmitter-receiver combination must be able to change between transmit and receive within 20 milliseconds. Most semiconductor- based radios can easily meet this specification. Even many older tube-type radios that use electromechanical relays operate very well in AMTOR Mode A (ARQ).

If the changeover from transmit to receive is too long, the minimum working distance is extended; the signal to the other station will arrive before the station has switched back to receive. If, however, the transmitting station is further away, the transmission time over the propagation path will delay the arrival of the signal until after the station has switched to receive.

If the receiving station's changeover from transmit to receive is too slow, the transmitting station delay between "PTT" and "data send" can be extended. Refer to the ADELAY command in the "List of Commands" section for information about changing the Controller's AMTOR timing characteristics to compensate for this effect.

AMTOR TRIAL OPERATING TECHNIQUES SUGGESTIONS

If you have trouble synchronizing with another AMTOR ARQ station, try some of the following operating tips before you decide that your radio equipment needs modifications:

1. Try to work the other station on Mode B (FEC) to establish that the other station's system is fully functional.

2. Do not use VOX control. Use the PTT line from your interface.

3. Turn off the receiver AGC circuit. Use the RF gain control to prevent the receiver from blocking on stronger signals.
4. Turn off all compression or other audio processing.

5. Keep the AFSK audio input level to the microphone circuit as low as possible. Avoid overdriving the audio input stages.

6. Disable the ALC circuit or reduce excessive ALC action. Use more effective RF antenna loading to adjust output power levels.

Appendix D was written by Peter Martinez, G3PLX, the "father" of AMTOR. Peter offers detailed operating hints for getting started on AMTOR. It is worth reading.

NOTE: Refer to the CODE command in the "List of Commands" section of this Manual for information about other alphabets.

Possible Areas for AMTOR Performance Improvement

If switching-time problems persist, you may have to make changes in the radio to eliminate excessive time delays. Some of these changes may include:

1. Removing large decoupling capacitors from the push-to-talk line to allow faster PTT (transmitter) activation;

2. Improving power supply decoupling, especially in audio stages.
3. Not using squelch.

NOTE: AMTOR Mode B (FEC) operation is similar to conventional RTTY in its duty cycle. The transmitter operates continuously without the on/off switching characteristic of AMTOR Mode A (ARQ).

FAX OPERATION

Weather Facsimile (WEFAX) is primarily transmitted throughout the shortwave radio spectrum to provide weather information to ships at sea and to weather forecasters. Some of the stations you may find broadcast weather maps that show current as well as predicted weather conditions, and satellite photographs that show the cloud cover over a large area.

News photographs from the wire services are also transmitted via facsimile. Many of the photographs you see in your local newspaper are distributed via facsimile, and some can be copied on your printer. Even though a dot-matrix printer does not have the resolution of an expensive facsimile receiver, it can display a reasonable amount of definition.

The facsimile mode, or simply FAX, is fairly straightforward. A little background on its format may help you understand it. A facsimile picture is usually sent by placing the original picture on the slowly-rotating drum of a facsimile transmitter, where it is scanned horizontally at a preset rate. The information from each horizontal scan is converted into an audio frequency between 1500 Hz and 2300 Hz as shown in Figure 6-1, where 1500 Hz represents pure black and 2300 Hz represents pure white. Between these two frequencies are varying shades of gray (often called "gray scale"). Figure 6-1 also shows a facsimile signal as it lies within the typical audio passband of an SSB receiver.

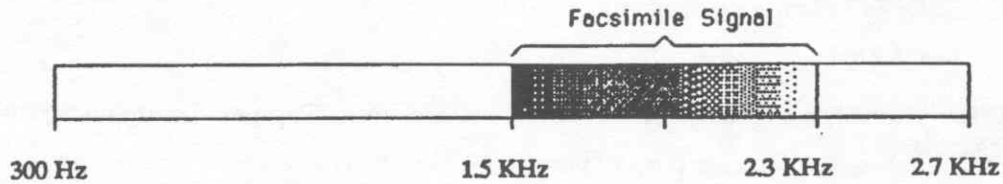


Figure 6-1

Unfortunately, dot-matrix printers and your Controller cannot resolve shades of gray, and therefore cannot print with photographic quality. The Controller uses its 1000 Hz wideshift filters, which have a center frequency of 1700 Hz, to copy facsimile transmissions. Since facsimile is transmitted using a maximum of only 800 Hz shift, a FAX signal is tuned in by "straddling" the 1700 Hz center frequency of the Controller's filters.

When you have facsimile signal tuned in, anything below 1700 Hz will produce a black dot on the paper, and anything above 1700 Hz will print nothing, leaving a white area as shown in Figure 6-2. In this way, the Controller decodes the gray scale of a transmitted facsimile picture and allows you to obtain reasonably good resolution from a dot-matrix printer. WEFAX maps, however, contain only black and white, and you should be able to reproduce excellent weather charts with a dot-matrix printer.

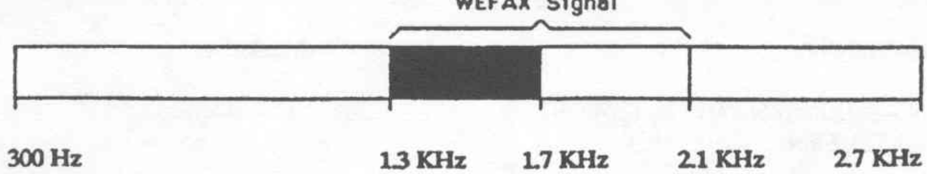


Figure 6-2

WHERE TO FIND FAX STATIONS

Some frequencies that seem to broadcast FAX on a regular schedule are shown below. A few of these stations transmit 24 hours a day. We suggest that you try the weather FAX frequencies listed below while you become familiar with the commands. After you print a few pages and have become accustomed to the sound of facsimile, you will be able to tune the bands in search of other frequencies where you may find different kinds of pictures.

Weather (USB)

3357.0 kHz	10,865.0 kHz
4268.0 kHz	12,125.0 kHz
4975.0 kHz	20,015 kHz
6946.0 kHz	

Photographs (LSB)

10,690.7 kHz

17,673.9 kHz

18,434.9 kHz

NOTE: The following frequencies were obtained from Popular Communications Magazine:

USB

4271.0 kHz, 9890.0 kHz, 13,510.0 kHz	Halifax, Canada
8502.0 kHz, 12,750.0 kHz	Boston, Mass.
9389.5 kHz, 11,035.0 kHz	Brentwood, N.Y.
4793.5 kHz, 10,185.0 kHz, 12,201.0 kHz, 14,671.5 kHz	Washington, DC
9157.5 kHz, 17,447.5 kHz	Mobile, Al.
8080.0 kHz, 10,854.0 kHz, 16,410.0 kHz	Norfolk, Va.
4802.5 kHz, 9440.0 kHz, 13,862.5 kHz	Hawaii
7770.0 kHz, 11,090.0 kHz, 13,627.5 kHz	Hawaii
8459.0 kHz	Alaska
4346.0 kHz, 8682.0 kHz, 12,730.0 kHz, 17,151.2 kHz	San Francisco
8646.0 kHz, 17,410.5 kHz	San Diego

SYSTEM SETUP

Connect your radio to either the Radio-1 or Radio-2 port on the rear of the Controller. If you wish to only receive FAX transmissions, you only need to connect the audio from your receiver. If you wish to transmit as well, however, follow the instructions that are provided in the "Installation" section of this Manual. NOTE: To transmit FAX with the correct 800 Hz shift, you will need to recalibrate the VHF transmit tones as described later.

You must use the special "Y" cable between the Controller, your terminal or computer, and a parallel printer. Connect the 25-pin connector that has only one cable coming from it to your terminal or computer, the 25-pin connector that has two cables coming from it to your Controller, and the 36-pin connector to a Centronics parallel printer that supports the Epson-compatible graphics standard. Refer to "Compatible Printers" to see if your printer can be used to print facsimile.

FACSIMILE TRANSMIT TONE RECALIBRATION

Since the Wideshift (1000 Hz) tones are used for VHF Packet, you should readjust them as described below only if you do not intend to use VHF Packet. This adjustment does not require any component changes, but is does require you to remove the Controller's cover.

With the cover removed, reconnect the power and terminal or computer cables, and then turn the Controller on. When you see the cmd: prompt, type CAL to enter the ASFK- tone calibration mode. Your monitor should now be continuously displaying the VHF mark tone (approximately 1200 Hz) followed by "R167", which indicates the control that adjusts this tone frequency. Locate control R167 on the right side of the main circuit board. Then use a small screwdriver to adjust control R167 until your monitor indicates 1300 Hz.

Press the <SPACE> bar and note that your monitor is now indicating the VHF space tone (approximately 2200 Hz) followed by "R165". Locate control R165 and adjust it until your monitor indicates 2100 Hz. Then type "Q" to exit the calibration routine.

The Wideshift transmit tones are now set for an 800 Hz shift for a FAX transmit operation. If you want to reset the tones to 1200 Hz and 2200 Hz (1000 Hz shift), all you need to do is repeat the above procedure to readjust controls R167 for 1200 Hz and R165 for 2200 Hz.

TUNING IN A FAX SIGNAL

You will usually find facsimile on upper sideband, and it sounds similar to an AMTOR QSO where both stations are equal in signal strength. Since the most-common facsimile signals are WEFAX, the default parameters in the Controller have been preset to copy weather charts and many satellite photographs. We recommend that you begin by tuning to one of the weather frequencies listed earlier.

When you tune a WEFAX signal, you will notice that the facsimile sound seems to repeat a rate of twice per second. This is the same horizontal scan frequency that was mentioned earlier, and allows you to distinguish different facsimile services by speed. Common horizontal scan rates are 2 lines-per-second, which is typically used in weather facsimile broadcasts, 1 line-per-second for photographs, and 4 lines-per-second for some foreign fcsimile stations. Remember these repetition rates and listen for them as you tune across the bands in search of new pictures to print.

The Controller uses the 1000 Hz wideshift filters, which have a frequency of 1700 Hz, for copying facsimile transmissions. As a result, you must tune 1700 Hz lower than the frequencies listed above when you use upper sideband. Similarly, in lower sideband, you must tune 1700 Hz higher.

Since facsimile is transmitted using a maximum of only 800 Hz shift, you must tune a FAX signal so it "straddles" the 1700 Hz center frequency of the Controller's filters. To do this, tune the facsimile signal so it is roughly centered on the Controller's bargraph as shown in the center drawing of Figure 6- 3. If the audio frequency is too low, the bargraph will look something like the left-most drawing. If the audio frequency is too high, it will look something like the right-most drawing. Tuning a facsimile signal is not especially critical when you copy WEFAX, but a properly tuned signal is necessary to produce an evenly-distributed gray-scale when you print facsimile photographs.

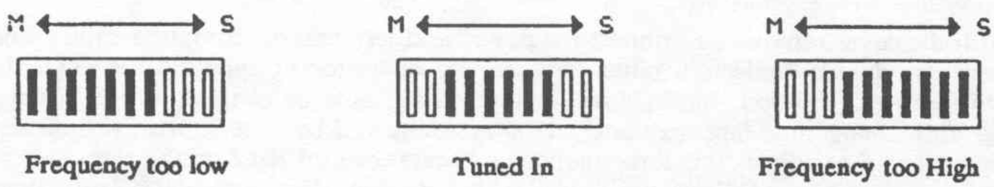


Figure 6-3

COMPATIBLE PRINTERS

Any printer that is compatible with Epson graphics will work with your Controller to print WEFAX. We have experienced no difficulty with most of the printers we have tried, but we have compiled the list of printers shown below that we know are WEFAX-compatible with the Controller. If your printer claims to support the Epson-graphics standard but does not appear in the list, hook it up and try it.

To determine whether your printer is Epson compatible, check your printer manual for the following two escape codes. The Escape-K command should set the printer to the single-density, 8-dot graphics image mode. The Escape-L command should set the printer to the double-density graphics image mode. If these two Escape codes are supported, there is an excellent chance that your printer will work with the Controller to print radio faxsimile.

Canon:	PW-1156A
Citizen:	MPS-25
Epson:	FX-80, FX-85, LQ-800, LX-80, MX-III, RX-80
Panasonic:	KX-P1091
Printers Plus:	NLQ
Qume:	
Seikosha:	1000A
Star Micronics:	Gemini 20X

GETTING STARTED WITH FAX

To begin receiving WEFAX broadcasts with you Controller and your Epson graphics-compatible printer, you must first inform the Controller that there is a parallel printer connected to it. To do this, enter the command mode and type "PRCON ON". The Controller will respond with:

PRCON was OFF

PRCON now ON

At this time, the following LEDs should be lit:

STATUS LED: STA, CON, and MULT

MODE LED: PKT and STBY

Refer to the PRTYPE command in the "List of Commands" section of this Manual. Then enter the proper parameter (PRTYPE 2, for example).

Now to enter the FAX Mode, make sure the Controller is in the Command Mode. Then type "FAX" or "FA" followed by a <RETURN>. The Controller will respond with:

OPMODE was AMTOR

OPMODE now FAX

The Controller is now in the facsimile standby-receive mode, which means that it is waiting for a synchronization signal from a facsimile transmitter to begin a new picture. To check this, enter the OPMODE command. The Controller should respond with:

OPMODE FAX STBY RCVE

Turn the THRESHOLD control fully clockwise.

If you do not want to wait for the beginning of a new picture, type "LOCK". This forces a synchronization lock and makes the printer start printing, regardless of what kind of signal you are tuned to. Since this synchronization lock was not sent by the transmitting station, the picture will probably not be correctly positioned on the paper. Instead, it is likely to be split in half, with the left half of the picture on the right half of the page and the right half of the picture on the left half of the page.

To correct this, you can use the JUSTIFY command that allows you to shift the entire image to the left in 1/2" increments. If the left edge of the picture, for example, appears roughly 4-1/2" away from the left edge of the paper, JUSTIFY 9 will shift the left edge of the picture to the left 4-1/2" (9 x 0.5"). This should correct the justification. The Controller will respond with:

JUSTIFY was 0

JUSTIFY now 9

The Controller always responds with "JUSTIFY was 0" when you enter a new justification parameter. The Controller always assumes that the left-hand margin of the picture has been set to zero inches. This procedure is not necessary if you allow the Controller to automatically sychronize with the transmitted facsimile signal.

To stop the printer, you can either exit from the facsimile mode by entering another mode or you can enter the RCVE command, which places the Controller back into facsimile standby receive. Standby receive works the same as if you just entered the FAX mode from another mode. The Controller will wait until it receives the synchronization signal from a facsimile station before it begins to print again.

Weather FAX, as well as most other facsimile, prints from left to right. Occasionally, however, you may find a station that is reversed. If you find one of these stations, you can simply issue the LEFTRITE OFF command to correct this. The Controller will respond with:

LEFTRITE was ON

LEFTRITE now OFF

Similarly, you may find a station that appears to be inverted; it is printing black where you expect white, leaving white where you expect black. You can correct for this by issuing the FAXNEG ON command. The Controller will respond with:

FAXNEG was OFF

FAXNEG now ON

This will reverse the black and white from the way they were printing.

The GRAPHICS command determines the way graphics will appear on your printer. There are seven graphics commands that provide horizontal dot densities from 480 dots to 1920 dots horizontally across the page. The default setting of 960 matches most Epson compatible graphics printers. Refer to the GRAPHICS command in the "Controller Commands" section of this Manual, beginning on Page 8-1, for more information about the GRAPHICS command.

PRINTING OTHER SERVICES

Most of the weather services, at least in the United States, use a facsimile scan speed of 2-lines per second. This corresponds to an FSPEED of 2 (default). Facsimile photographics often use 1- line per second, which is an FSPEED of 1. Some foreign services use speeds of 4-lines per second, which is an FSPEED of 4. Your Controller also supports speeds of 1.5 and 3-lines per second. Refer to the "Controller Commands" section, beginning on Page 8- 1, for more information about the FSPEED command.

When stations use different horizontal scan speeds, the number of lines per vertical inch can also vary. If you do not change the number of lines that are printed by the printer, the pictures may appear squashed or elongated. The ASPECT command resolves this problem by directing the Controller to print from 1 to 6 lines for every six lines that are received. The default setting of ASPECT 2 causes 2 lines out of every 6, or 1 out of every 3 horizontal lines to be printed. This is the most common setting you will use for WEFAX, but other services may require you to use other values to print pictures without aspect ratio distortions.

If your terminal program allows you to save non-ASCII files to disk for later transmission or printing, you can use the PRFAX command to route the facsimile data to the RS-232 port instead of to the parallel printer. When PRFAX is OFF, the Controller sends the Epson escape codes to the RS-232 port instead of the parallel printer. The Controller will respond with:

PRFAX was ON

PRFAX now OFF

When you route a facsimile signal to the RS-232 port, be sure you set AWLEN to 8, 8BITCONV to ON, PARity to 0, and ACRDISP to 0 before you turn on the file capture of your terminal program. If you enter the Transparent Mode before you turn the file capture of your terminal program on, you will only need to set AWLEN to 8. If you use the Transparent Mode, make sure TRFLOW and TXFLOW are both OFF. Hardware flow control is necessary when you transfer 8-bit files.

Some terminal programs do not allow you to capture 8-bit ASCII files. Make sure your program allows you to do this if you wish to successfully save the facsimile file. Also make sure your terminal program does not add carriage returns or line feeds to the captured file. After you save a file to disk, you should be able to print it or retransmit it.

TRANSMITTING FAX

Type an "X" from the Command Mode to place the Controller into the facsimile transmit mode. To correctly transfer a file that was previously saved on disk, set AWLEN to 8, PARITY to 0, PRFAX to OFF. Also make sure the Controller is in the Transparent Mode. TRFLOW and TXFLOW should both be OFF.

The Controller is set up for a 1000 Hz shift in transmit and receive, but commercial facsimile is sent with an 800 Hz shift as described earlier. You should recalibrate the VHF transmit tones for an 800 Hz (1300 Hz and 2100 Hz) as was described earlier in "Facsimile Transmit Tone Recalibration."

When you type an "X" amd begin to transmit, the Controller first sends a black tone for 5 seconds, and then a 300 Hz alteration of black and white tones for another 5 seconds. During this time, OPMODE will indicate:

OPMODE FAX STBY SEND

After 10 seconds pass, the Controller OPMODE will change from STBY SEND to SYNC SEND. At this time, the Controller will transmit 30 seconds of synchronization pulses at the proper rate that is determined by the FSPEED command. As soon as the sync pulses start, the Controller can accept dot graphics from the computer. Be sure to wait until OPMODE changes to SYNC SEND before you enter the Transparent Mode and send the facsimile graphics to the Controller.

Your terminal program should allow you to watch the progress of the facsimile data file you are sending to the Controller. When the file has been completely sent to the Controller, you can use one of the following three options to return to receive:

1. Type a <CTRL-D> to cause the Controller to send 5 seconds of alteration between black and white at a 450 Hz rate, to signify the end of the picture to the receiving station, and then return to receive.

2. <CTRL-F> does the same thing as <CTRL-D>, except it adds a CW ID before returning to receive.

3. Type and "R" from the Command Mode to force an immediate return to receive. NOTE: This does not send an end of picture signal or a CW ID.

IMPORTANT: You must identify every 10 minutes, regardless of the length of the picture you are sending. Use a higher FSPEED setting to help speed up transmission of facsimile pictures.

When the Controller is transmitting facsimile, it acts like an Epson printer and recognizes the following escape sequences and ignores all others:

<RETURN>	end of line
<LINEFEED>	transmit line
ESC "1"	set "7/72 inch" line spacing
ESC "A" 07	set "7/72 inch" line spacing
ESC "A" 08	set "8/72 inch" line spacing
ESC "J" n	set n/144 "or n/216" line spacing
ESC "K" m n	single density, 480 dots maximum
ESC "L" m n	double density, 960 dots maximum
ESC "Y" m n	fast double-density, 960 dots maximum
ESC "Z" m n	quadruple density, 1920 dots maximum
ESC "*" 00 m n	same as ESC-K
ESC "*" 01 m n	same as ESC-L
ESC "*" 02 m n	same as ESC-Y
ESC "*" 03 m n	same as ESC-Z
ESC "*" 04 m n	640 dots maximum
ESC "*" 05 m n	576 dots maximum
ESC "*" 06 m n	720 dots maximum

where the number of horizontal dots on a line is (m+(256*n))

In FAX transmit, the Controller ignores the setting of GRAPHICS and uses the escape codes to determine the dot density. The Controller ignores all escape codes that are not listed above in the facsimile transmit mode. The most significant bit of each graphics byte is closest to the top of the image, and is sent first.

ADDITIONAL INFORMATION

Not all combinations of parameters work with all printers, particularly slower printers (100 CPS). A combination of PRTYPE 2, FSPEED 4, GRAPHICS 1, and ASPECT 4, for example, require the printer to print a pattern of dots that is 8 x 960 every three seconds. This would cause trouble with a 100 CPS printer. A combination of PRTYPE 2, FSPEED 1, GRAPHICS 0, and ASPECT 2, however, will always work because it requires a pattern of dots that is 8 x 480 every 24 seconds.

Our experience shows that the following combinations cause trouble (S = sluggish response to commands, X = cannot work, disabled):

GRAPHICS	FSPEED, 8" width					FSPEED, 13" width				
Dot density	0	1	2	3	4	0	1	2	3	4
60 dpi	.	.	.	.	.	.	.	.	.	.
72 dpi	.	.	.	.	.	.	.	.	.	s
80 dpi	.	.	.	.	.	.	.	.	.	x
90 dpi	.	.	.	.	.	.	.	.	.	x
96 dpi	.	.	.	.	.	.	.	.	s	x
100 dpi	.	.	.	.	.	.	.	.	s	x
120 dpi	.	.	.	.	s	.	.	.	x	x
136 dpi	.	.	.	.	x	.	.	.	x	x
144 dpi	.	.	.	.	x	.	.	s	x	x
160 dpi	.	.	.	s	x	x	x	x	x	x
200 dpi	.	.	.	x	x	x	x	x	x	x
240 dpi	.	.	s	x	x	x	x	x	x	x

The Controller's modem is capable of resolving up to 2200 dots per second. The following list shows the maximum print densities that are worth using at various scan rates and carriage widths:

FSPEED	LPM	STANDARD CARRIAGE	WIDE CARRIAGE
0	90	183 dpi	113 dpi
1	60	275 dpi	169 dpi
2	120	138 dpi	85 dpi
3	180	92 dpi	56 dpi
4	240	69 dpi	42 dpi

IN CASE OF FAX DIFFICULTY

Problem: The printer appears to be printing two pictures side by side.

Solution: Reduce the FSPEED setting. You are probably trying to print a facsimile transmission that is being sent at 240 lines per minute with the FSPEED set to 120 line per minute. Similarly, the transmission may be at 120 lines per minute with the FSPEED set to 60 lines per minute.

Problem: The printer never prints.

Solution: Make sure PRCON is on, the THRESHOLD control is fully clockwise, and the DCD LED is lit.

Check OPMODE to make sure it is FAX SYNC RECEIVE. If it does not, type FAX to place the Controller into the FAX Mode. Then type LOCK to force a synchronization lock. If the printer does not begin to print within a minute or so, issue a PROUT ON command to cause all characters that are sent by the Controller to be echoed on the printer. If you now see the correct characters printing on the printer but still cannot get facsimile to print, you are probably using a printer that does not support Epson-compatible graphics.

Problem: Facsimile does not print straight down the page. It veers consistently toward the left or the right.

Solution: This problem indicates that the 4.000 MHz master oscillator has drifted off frequency and needs to be recalibrated. This is fairly easy to do either with or without a frequency counter as described below.

Without a Frequency Counter

Step 1: Remove the cover from the Controller.

Step 2: Reconnect the Controller to your radio, computer, printer, and power supply. Then turn the Controller on and allow it to warm up for at least 30 minutes.

Step 3: Tune in and start printing a strong facsimile signal.

Step 4: Refer to Figure 6-4 and use a small-blade screwdriver to adjust trimmer capacitor C53 no more than 1/8 turn in either direction.

Step 5: Observe the new printout and decide whether the adjustment you made improved things or made them worse. Then repeat Steps 4 and 5, making smaller and smaller adjustments to C53 until the facsimile prints vertically. NOTE: This may take several tries before you get the oscillator back on frequency.

With a Frequency Counter

Step 1: Remove the cover from the Controller.

Step 2: Reconnect the Controller to your radio, computer, printer, and power supply. Then turn the Controller on and allow it to warm up for at least 30 minutes.

Step 3: Refer to Figure 6-4 and connect a high-impedance probe of your frequency counter to integrated circuit U1 pin 6. Then use a small-blade screwdriver to adjust trimmer capacitor C53 until the frequency counter indicates 4.00000 MHz ±10 Hz.

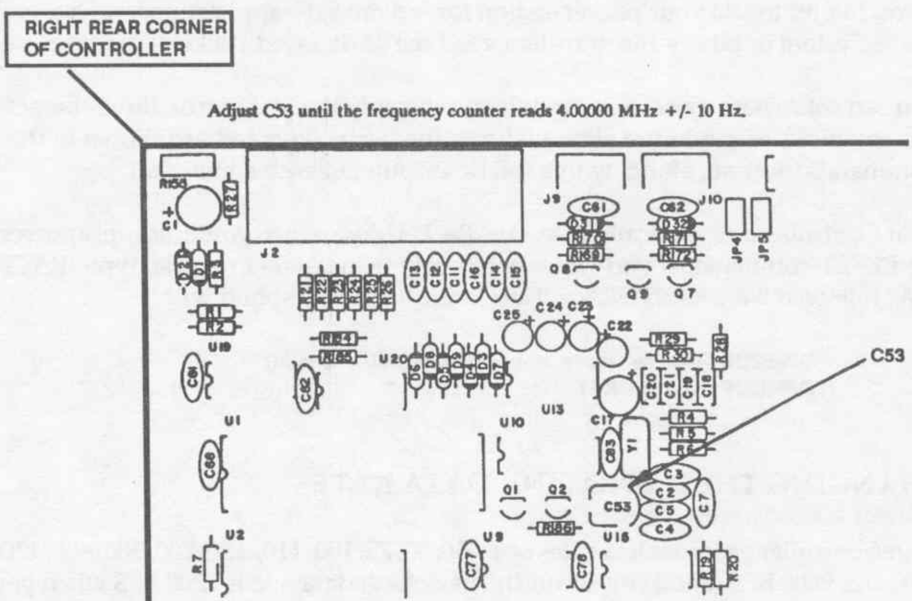


Figure 4: PK-232 circuit board layout showing the location of capacitor C53

MYCALL Required at System Start-Up

Figure 6-4

PACKET RADIO OPERATION

This section describes basic packet operation. You will learn quite a bit about your Controller's packet features and control operation without actually sending anything over the air. For your first packet practice, you will connect the Controller in a "loopback" circuit so that it will "talk to itself". You will have a chance to become familiar with packet operation before you actually go on the air.

The following paragraphs describe the commands you will use for everyday packet operations. These commands will get you ready for the section, "Your First Packet QSO." The "Special Input Characters" section contains information about editing from your keyboard and discusses other special characters that are used by the Controller.

If you intend to use your packet station for "advanced" applications, such as a Bulletin Board System or binary file transfers, read the "Advanced Packet Operation" section.

You can abbreviate most commands by typing only the first two or three characters. The "mnemonics", or minimum abbreviations, for each command are shown in the "List of Commands" section, along with a full description of each command.

Your Controller automatically enters the Packet Mode when you first apply power or type the RESET command. If you were previously using another mode, type "PACKET" or "PA" followed by a <RETURN>. The Controller will respond with:

OPMODE was (whatever mode the Controller was in)
OPMODE now PACKET

CHANGING THE RADIO LINK DATA RATE

Your Controller provides link rates of 45, 50, 57, 75, 100, 110, 150, 200, 300, 600, 1200, 2400, 4800 and 9600 BPS (baud per second). The default data rate is 1200 BPS when you apply power to your Controller for the first time.

Use the HBAUD command to read or change the packet link data rate. To read the present baud rate, type "HBAUD <RETURN>" or "HB <RETURN>". The Controller will respond with:

HBAUD 1200

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

HBAUD 300<RETURN>

The Controller 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 that was previously stored in the program. You can also type "HB U" or "HB D", respectively, to change the baud rate one step up or down one step at a time. The Controller returns the previous data rate and adopts the new rate.

STATION IDENTIFICATION

You must use the MYCALL command to store your station identification (call sign) in your Controller's memory (refer to the next paragraph). If you intend to operate more than one station with the same call sign, the stations must use some means of distinguishing between two operations under that same call sign. Two stations cannot hav e identical station identifications. If they do, packet protocol will fail.

MYCALL Required at System Start-Up

When you apply power to your Controller for the first time, the system is loaded from ROM. All system parameters and values are those loaded at time of manufacture. "MYCALL" is loaded with the default "HK232." **You must use the MYCALL command to enter your call sign into your Controller. You cannot operate in the Packet Mode until you do this.** If you try to connect to a station without entering your call sign, your Controller does not transmit, but instead displays the following error message:

```
?need MYCALL
```

Substation Identifiers (SSIDs)

You can identify additional stations with the "secondary station ID", or SSID. This is a number from 0 to 15 that is appended to the call sign by a dash:

```
cmd:MYCALL WX2BBB-1
```

If you do not specify the SSID extension, it will be "0" (zero) and will not be shown by your Controller. To connect to a station with an SSID other than 0, or use such a station as a digipeater, you must specify the SSID:

```
cmd:CONNECT WX3CCC-2
or
cmd:CONNECT WX1AAA VIA WB2BBB-2
```

Automatic Identification

Your Controller can send an automatic ID packet every 9-1/2 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:

```
WX2BBB-1>ID:WX2BBB digipeater
              or
WX2BBB-1<ID:(MYALIAS), WX2BBB digipeater
```

When you decide to turn your transmitter off, you can use the ID Command to force a final ID. The Controller sends these ID packets only if it has been digipeating.

SETTING UP THE LOOPBACK TEST CIRCUIT

To setup the loopback test circuit, perform the following steps:

1. Locate the shielded radio cable you set aside earlier.
2. Strip and tin the wires at the "radio" end of the cable.
3. Connect together the green and white wires coming from Pins 1 and 2.
4. Insert the plastic plug end of the cable into RADIO 2, plug J6, on the rear of the Controller. Be sure you insert the plug so the cable running downward.
5. Depress the front panel RADIO-1/RADIO-2 switch to enable the Radio 2 plug.

Your Controller's transmit audio output is now connected to its receive audio input. Your Controller can now "talk to itself" in a "loopback" arrangement.

THE "CONNECT" AND "DISCONNECT" COMMANDS

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, which are other packet stations that relay packets automatically from one station to another over a specified route. You will now "connect" your Controller to itself to see how this works. You have already setup the Controller up in a loopback arrangement. Your Controller, therefore, will receive all of the packets that it sends.

LED STATUS AND MODE INDICATORS

Your Controller's front-panel LEDs show the operating mode and system status at any moment. Each LED is marked with an abbreviated name. Note that some LEDs have two labels. All markings that refer to packet operation are below the LEDs. The Abbreviated name, its full name, and the meaning of each LED is shown below:

MULT	Multiple	Lights when multiple connections exist (blinks when the buffer is full).
SEND	Send	Lights when the PTT line is active.
CONV	Converse	Lights in the Converse Mode.
CMD	Command	Lights in the Command Mode.
TRANS	Transparent	Lights in the Transparent Mode.
PKT	Packet	Lights in the Packet Radio Mode.
DCD	Data Carrier	Lights when valid data signals are Detect received.

LEDs at System Start or RESET

At system start-up or after selecting packet, your Controller shows its status on the front-panel LEDs:

STATUS: CMD lit

MODE: PKT lit

SYSTEM QUICK-CHECK - LOOPBACK TEST CONNECTION

Try to connect to yourself using your own call sign. To do this, type "CONNECT (MYCALL)":

```
cmd:CONNECT (MYCALL)
```

If the connection occurred, you will see:

```
*** CONNECTED to (MYCALL)
```

The LEDs also change to show you that your Controller is in the Packet Mode, in a CONNECTED state, and in the CONVERSE Mode:

STATUS: CONV lit, CON lit

MODE: PKT lit

Your Controller sends special packets to set up a connection. These packets leave your Controller on J6 pin 2 and return on pin 1 without being transmitted over your radio.

The Connect Message

"*** CONNECTED to MYCALL" shows that the connection was established. The CON LED is now lit and the "cmd:" prompt no longer appears on the next line. Your Controller is now connected to itself in the Converse Mode, and is ready to start communicating. To try it, type "Hello, there.", followed by a <CR>. You should see the following:

Hello, there.
<u>**Hello, there.**</u> (Underscore here indicates received data)

Sending the Packet Character

<CR> causes your Controller to form your typed characters in a packet and transmit them. (The "List of Commands" section, beginning on Page 8-1, shows you how you can use a different character to send packets.) In the Converse Mode, everything you type is assembled into a packet that is addressed and sent to the station to which you are connected. If no connection (QSO) exists, the packet is addressed to "CQ", or whatever address you have previously entered into the "UNPROTO" field.

Your Controller automatically entered the Converse Mode when the connection was established. You can also directly command the Controller to move back and forth between the Command and Converse Modes.

Returning to the Command Mode

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

You can also use the <CTRL-BREAK> key to return to the Command Mode, if your keyboard has a <CTRL-BREAK> key. BREAK is a break in transmission (not an ASCII character).

If <CTRL-C> interferes with or stops your terminal program and you cannot send the BREAK signal, you can select another character that returns the Controller to the Command Mode. Refer to "COMMAND" in the "List of Commands" section, beginning on Page 8-1.

Returning to the Converse Mode

Type "CONVERSE" to return to the 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:
```

Terminating the Link - Disconnect

Type "DISCONNE" (or "D") to terminate the link or connection. Your Controller transmits a special packet that ends the contact and notifies you when the link is disconnected:

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

An actual QSO may be terminated by the other station. If this happens, you will see the ***** DISCONNECTED** (call sign) message without typing the command at your station.

You have now tried the following basic operations of a packet QSO:

1. You connected to the desired station to begin the QSO.

2. You sent and received messages.

3. You disconnected from that station at the end of the QSO.

YOUR FIRST PACKET QSO!

There are more features you should be familiar with for comfortable packet operation, but you are probably eager to get on the air and try your Controller. The following paragraphs will help you make your first QSO.

Try to arrange with an experienced packet operator to help you get started. Be sure that is station is close enough to ensure solid noise-free copy.

System Cable and Switch Check

Before you actually attempt your first connection (QSO), take one more minute to verify your system setup:

1. Remove the loopback test cable from the RADIO-2 connector.
2. Release the front-panel RADIO-1/RADIO-2 switch to select RADIO-1.
3. Use RADIO-1 jack J4 to connect your radio to your Controller.
4. Be sure you have adjusted your Controller and your radio as is described earlier in this Manual.

Starting the QSO

You are now ready to try to connect to another station. The following example uses WX2BBB in place of your call sign, and WX6FFF for the other station's call sign. Type <CTRL-C> to make sure that the Controller is in the Command Mode. Now type "CONNECT WX6FFF" after the CMD: prompt. After a moment you should see:

```
*** CONNECTED to WX6FFF
```

Both you and the other station are now automatically switched to the Converse Mode. The other station operator will see:

```
*** CONNECTED to WX2BBB
```

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. This will help you get a better idea of what is happening. Note that your radio is inactive most of the time, even while you are actually typing.

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

Your Controller notes that the packet was received correctly, but displays nothing on your screen. This is normal operation. If your system still had any unacknowledged packets outstanding, your Controller's "STA" (Status) LED would be lit. But in this case, there are no outstanding packets and the LED is extinguished. NOTE: Unless you set MONITOR to a value higher than "4", the Controller will not display the "ACK" frames.

What If....?

If you have trouble connecting, take a few minutes to verify that:

1. Your Controller's AFSK Output Level control, your microphone gain, and deviation are set properly was explained earlier.

2. All cables and connectors are properly installed.

3. The RADIO-1/RADIO-2 switch is set for your cable-to-radio setup.

4. Your radio's volume and squelch are set for local conditions.

5. Your Controller is in the Command Mode. (Type "<CTRL-C>" to confirm this. You must see the "cmd:" prompt.) NOTE: If the "cmd:" prompt does not appear, release the Controller's POWER and then depress it again. You should get the normal sign-on message.

6. Your Controller is in the Packet Mode. Type "OP" to confirm this.

7. "HB" is "1200" if you are using VHF; "300" for HF.

8. "VHF" is "ON" if you are using VHF; "OFF" for HF.

9. "CFROM" is set to ALL.

NOTE: Use an unused channel for any "on-the-air" testing (simplex FM!).

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

If only one station is "hearing" properly, concentrate on the modulator and transmitter of that station, and the demodulator and receiver of the other station.

Experiment with the TXDELAY timing parameter for the sending TNC. Set TXDELAY to 64 for a long delay. If this solves the problem, decrease TXDELAY to the smallest value that works all of the time.

AUTOMATIC OPERATION

Your Controller offers a variety of automatic operating features including beacon operation, digipeater function, and auto-answer messages.

Your packet station can act as a digipeater for relaying packets to a more remote destination. Functions like the "connect message" take care of situations that are not readily solved in modes other than packet. Refer to the "List of Commands" section for more information about your Controller's commands.

Beacon Operation

Your Controller can send an automatic "Beacon" message at specified time intervals. A beacon can send special announcements, or send 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. To use the beacon feature:

1. Use the BTEXT command to set your beacon text.
2. Use the BEACON EVERY or BEACON AFTER command to set the beacon timing interval.

To transmit your beacon at 15-minute (15 X 60 seconds) intervals, for example, 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 time interval without any packet activity on the channel.

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

Proper beacon timing avoids cluttering a busy channel with unnecessary transmissions. In the early days of packet radio, the beacon was very useful to show your presence on the empty packet channels. With the growth of packet radio, many users feel that beacons have outlived their usefulness and may 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 is too short. Your beacon may be bothering other channel users, and it needs your attention.

Will You Accept Connections?

CFROM determines if call requests are accepted or rejected, as well as which are accepted and which are rejected. CFROM works with four arguments: "all", "none", "yes" and "no".

"ALL" and "NONE" are used alone and work this way:

ALL	Your Controller accepts connect requests from all callers.
NONE	Your Controller rejects connect requests from all callers.

"YES" and "NO" also work with 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". This means that your Controller will normally accept connect requests from any station that sends you a connect request.

Type "CFROM NONE" to reject connect requests from all stations. If your Controller receives a connect request when CFROM is set to NONE, your monitor displays:

```
*** Connect request: <call sign>
```

Your Controller sends the calling station a DM packet, or "busy signal", and the caller sees:

```
*** <call sign> 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 call signs). Connect requests will be accepted only from those call signs in the list.

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 call signs in the list.

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 the mnemonic:

```
cmd:cfrom
CFROM          all
cmd:cf
CFROM          yes WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

If you wish, you can include SSIDs as "-n" after the call sign. If CFROM is set to "no W2JUP" or "yes W2JUP", any combination of W2JUP, W2JUP-1,...W2JUP-15, will be matched and processed. If CFROM is set to "yes W2JUP-1" or "no W2JUP-1", however, only W2JUP-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 the argument.

Some examples of error messages that could result from invalid commands are:

```
cmd:cfrom all w2jup
?too many (calls not allowed with ALL or NONE)

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

cmd:cfrom w2jup
?need ALL/NONE/YES/NO (Calls must follow YES or NO)
```

Are You Available to Chat?

Set CMSG ON (default is OFF) and use the CTEXT command to enter the type of a message you might put in a telephone answering machine. If you are not available to answer connect requests, your Controller 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). For example:

cmd:CTEXT Sorry, I can't talk right now.<CTRL-V><CR>
I'll 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 before this message is sent to stations connecting to you.

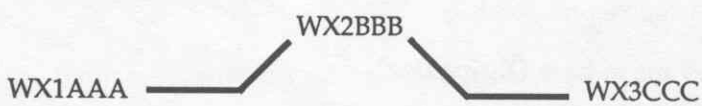
Do You Want to Transmit?

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 to OFF. In this case, you would probably want to set CFROM to NONE as well.

Type "XMITOK OFF"
Type "CFROM NONE"

Digipeater Details

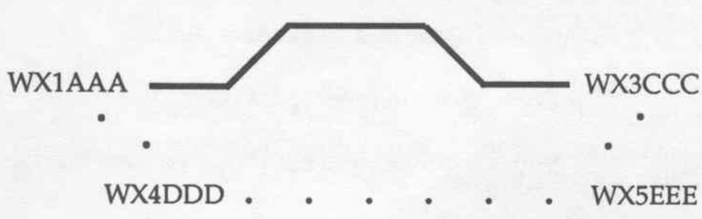
You may wish to connect to a packet station that is beyond your direct radio range. If a third packet station is on the air and both you and the station you want to talk to are in range of that third station, the third station can relay or "digipeat" your packets. To do this you set up the "digipeater"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



Assume that you are station WX1AAA and you want to have a packet QSO with WX3CCC, but there is a mountain between you and WX3CCC. You are out of simplex range of each other. You know, however, that there is a packet station located on the ridge (WX2BBB) which is in range of you and WX3CCC.

Instruct your Controller to set up a connection to WX3CCC by using WX2BBB as an intermediate digipeater. After the "cmd:" prompt, type: "CONNECT WX3CCC VIA WX2BBB."

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



In this example, assume that WX2BBB has turned off his station, but you can still contact WX3CCC by going around the mountain through WX4DDD and WX5EEE. This time, type the connect command like this:

cmd:CONNECT WX3CCC VIA WX4DDD,WX5EEE

Type the digipeaters' call signs in the exact order of the path you intend to use between your station and the station with which you wish to connect.

Are You a Digipeater?

Your packet station can be a digipeater for other stations. You do not have to "do" anything; your Controller will automatically digipeat other stations, unless you tell it not to! (Refer to the DFROM command in the "List of Commands" section.)

The default argument of DFROM is "all". If you notice your transmitter being keyed when you are not using it, or during lulls in your own conversations, your station is being used as a digipeater by other stations. This does not bother your chat with another station.

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

If MRPT is ON (default), you will also see your call sign in the packet header, showing the exact digipeater path in which your station is included. The call sign of the station whose packet is being decoded is flagged with as asterisk. The following example was taken with Monitor 4 (default), MDIGI ON, and MRPT ON:

```
W2HPM*>W2JUP-2>W2PEE:
What time is the meeting?
W2PEE*>W2JUP-2>W2HPM <RR>
```

Do You Want to be a Digipeater?

Many packeteers allow (and even encourage) the use of their stations as digipeaters to provide a simple form of "networking" for the area's packet community. If local circumstances prevent you from being a digipeater, you can disable the digipeat function.

DFROM's default argument is "all". This means that your Controller will normally repeat packets from any station that includes your station's call sign in their digipeat path.

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", "yes (list)", and "no (list)".

"ALL" and "NONE" are used alone and work this way:

ALL	Your Controller will repeat packets from any station.
NONE	Your Controller 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 from those call signs in the list.

To block packets from one or more specific stations, type DFROM NO (plus a list of call signs). Packets will not be repeated only 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 WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

You can add SSIDs as "-n" after the call sign. If DFROM is set to "no N7ML" or "yes N7ML", for example, any combination of N7ML, N7ML-1,...N7ML-15 will be matched and processed. If DFROM is set to "yes N7ML-1" or "no N7ML-1", however, then only N7ML-1 will match and be processed.

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

Here are some error messages that will result from invalid commands:

```
cmd:dfrom all w2jup
?too many                    (calls not allowed with ALL or NONE)

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

cmd:dfrom w2jup
?need ALL/NONE/YES/NO        (Calls must follow YES or NO)
```

UNSUCCESSFUL CONNECTIONS AND RETRIES

Sometimes your connect request cannot be completed. The desired station may not be on the air, it might be out of range, or you may have mistyped the other station's call sign. If your Controller does not obtain a response to its first connect request packet, it will try again.

Use the RETRY command to control the number of times your Controller will repeat the connect request. The default value is 10. If your Controller does not receive an ACK after that number of repeats, it stops trying and displays:

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

Retries While Connected

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

Sometimes a packet will not be received correctly by the other station, due to collisions with packet signals from other stations, or due to channel noise. If your Controller does not receive 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 Controller disconnects and displays:

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

The automatic disconnect feature avoids excessive retransmission of useless packets. If, for example, the other operator turns off his station without disconnecting, your path is through a digipeater that becomes shut down, or the RF channel deteriorates to the point of being unusable, the disconnect prevents a "hopeless" condition from tying up the channel.

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 retry attempt is not limited.

MONITORING ACTIVITY ON THE CHANNEL

In addition to displaying data from the station to which you are connected, you can monitor all packet activity on the channel, referred to as "reading the mail," by displaying packets "flying" between other stations. Your Controller will also keep track of stations heard on the channel. This following paragraphs describe the monitor functions.

Monitoring Other Stations

Use the MONITOR parameter to determine how monitoring is to be done. In other words, what stations will or will not be monitored and the type and amount of information to be shown by the monitor.

"MONITOR" accepts a numerical value between "0" (zero) and "6." Each higher number adds more detail to your monitoring. As the value of MONITOR settings increases, additional functions are included in the monitoring sequences. The meanings of the MONITOR numbers are shown as follows:

0 Monitoring is disabled.

1 Only unnumbered, "unconnected" frames are displayed. Use this for an "unproto", roundtable type of QSO. 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 the 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 along with the headers.

4 This is your Controller's default value. Unnumbered acknowledgment (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 you attempt the following steps, verify that your loopback test cable is connected to the Controller's RADIO-2 rear panel receptacle, and that the front panel RADIO-1/RADIO-2 switch is depressed to enable RADIO-2.

Type "<CTRL-C> D <RETURN>" to make sure your Controller is DISCONNEC-TED.

Type "MONITOR 4". Your Controller will respond with "**MONITOR was 4.**"

Type "CONVERSE", then type "This is a test packet." Your monitor will now show:

MYCALL>CQ:This is a test packet.

Since the "UNPROTO" parameter is defaulted to the address "CQ", your packets are sent to "CQ" because your station is not connected to any other station. Your packet was received by your Controller and displayed with the packet header containing the sending station's call sign and the destination.

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. You might, for example, see the following:

WX1AAA*>WX2BBB>WX3CCC:Hello, Bill!

This packet went from WX1AAA via WX2BBB to WX3CCC. The "*" shows you which station you actually heard. If your Controller had decoded the packet from WX2BBB, the display would have shown:

WX1AAA>WX2BBB*>WX3CCC: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 to ON:

WX1AAA*>WX2BBB>WX3CCC:
Hello, Bill!

NOTE: When MRPT is OFF, digipeater paths will not appear in connect request, connect, and disconnect monitor functions.

Monitoring Other Stations While Connected

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

Your Controller'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 the interruption and confusion caused by the mixture of everyone else's packets and those of the station you are connected to.

You might use MCON set to 1 to monitor the "mail list" beacons from a PBBS while you hold connected conversations with other stations on the channel. Whenever a beacon is sent, that message is displayed while your station is connected to another station. (Refer to the previous sections.)

SELECTIVE MONITORING

The MFROM, MTO, and MONITOR commands provide monitor features that were not previously available. You can use these commands in combination to display or mask traffic to and from any stations or combination of stations as you require. One example would be to inhibit display of a busy PBBS while you are monitoring other conversations.

The MFROM Command

MFROM uses arguments to determine how your Controller monitors packet channels and displays information. In other words, which stations' packets will be displayed and which stations' packets will be masked or hidden.

MFROM is set to "all" when you apply power to your Controller 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 the mnemonic:

```
cmd:mfrom
MFROM all

cmd:mf
MFROM yes WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

To stop all packets from being displayed, type MFROM NONE. This has the same effect as setting MONITOR to 0 (zero).

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 in the list following YES will be displayed.

To hide or mask packets from only one or more specific stations, type MFROM NO (followed by a list of call signs). Only packets from stations whose call signs are in the list following NO will not be displayed.

You can add optional SSIDs specified as "-n" after the call sign. If MFROM is set to "no N6IA" or "yes N6IA", any combination of N6IA, N6IA-1,...N6IA-15 will be matched and processed. If MFROM is set to "yes N6IA-1" or "no N6IA-1", only N6IA-1 will match and be processed.

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

ALL, NO list, YES list, NONE

Clear the MFROM field with "%", "&", or "OFF" as the argument.

Here are some error messages that you will get from invalid commands:

```
cmd:mfrom all w2jup
?too many                    (Calls not allowed with ALL or NONE)

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

cmd:mfrom w2jup
?need ALL/NONE/YES/NO        (Calls must follow YES or NO)
```

The MTO Command

MTO uses arguments to determine how your Controller monitors the packet channels and displays information. In other words, which stations' packets will be displayed and which stations' packets will be masked or hidden. MTO is set to "none" when you apply power to your Controller for the first time.

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

```
cmd:mto
MTO        all

cmd:mt
MTO        yes WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

To stop packets addressed to all stations from being displayed, type MTO ALL.

To display packets addressed to only one or more specific stations, type MTO (YES followed by a list of call signs). Only packets addressed to stations whose call signs are in the list following YES will be displayed.

To hide or mask packets addressed to one or more specific stations, type MTO (NO followed by a list of call signs). Only packets addressed to stations whose call signs are in the list following NO will be hidden or masked.

You can add optional SSIDs specified as "-n" after the call sign. If MTO is set to "no WB9FLW" or "yes WB9FLW", any combination of WB9FLW, WB9FLW-1,...WB9FLW-15 will be matched and processed. If MTO is set to "yes WB9FLW-1" or "no WB9FLW-1", then only WB9FLW-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.

Here are some error messages that you will get from invalid commands:

cmd:mto all w2jup	
?too many	(Calls not allowed with ALL or NONE)
cmd:mto no	
?not enough	(NO and YES require call sign list)
cmd:mto w2jup	
?need ALL/NONE/YES/NO	(Calls must follow YES or NO)

The MCON Command

Use the MCON command for selective monitoring of other traffic on the channel while your station is connected to another station. Use this feature to direct your Controller to "listen" for a specific station while you are connected to and conversing with 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 your station is connected to another station. As MCON settings increase, more functions are added in monitoring sequences. The meanings of the parameter values are identical to those shown under the MONITOR command.

The MFILTER Command

Use the MFILTER command to "filter" selected characters from received packets. You can, for example, command your Controller system to filter out form feeds, bell characters, or extra <LFs> 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 hex or decimal. Some typical examples follow:

1. To prevent a <CTRL-L> character from clearing your screen, set MFILTER to 12.

2. To eliminate <CTRL-Z> characters, which some computers interpret as end-of-file markers, set MFILTER to 26.

3. 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

The MHEARD Monitor Buffer

Use the MHEARD command to display a list of stations heard since the last time your Controller was powered up, or since the last time you cleared the MHEARD buffer.

NOTE: Stations in the list that were received directly are marked with a "*". Stations received through a digipeater are not marked.

To clear the MHEARD buffer, type a "percent sign" (%), an ampersand (&), "N", "NO", "NONE", or "OFF" after the command word.

Entries in the "heard" report are also time stamped if you have set the date and time. The Controller's time updates continuously as long as it is powered.

MSTAMP — The Monitor Time-Stamp Command

Monitored packets can be time-stamped if you set DAYTIME. To enable this function, set MSTAMP ON. The CONSTAMP ON command allows you to also time-stamp connect and disconnect messages.

NOTE: 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.

DAYTIME — Setting the Real-Time Clock

Use the DAYTIME command to set the Controller's real-time clock. After you set the clock, you can type "DAYTIME" to display the time.

When power is applied to the Controller, the DAYTIME command will display the following error message:

?clock not set

You must reset DAYTIME each time you apply power to the Controller. If you do not reset DAYTIME, CONSTAMP and MSTAMP will not "stamp" the time. If you type DAYTIME without a parameter, the Controller displays current date and time information. The format of the display is dd-mm-yy hh:mm:ss as shown below:

DAYTIME 08-Jul-87 06:57:33

The format for entering the date and time is "yymmddhhmm", 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)

For example: cmd:daytime 87 07 08 06 59

If you wish, you can insert separators or delimiters such as SPACE, "/", ":", ";". The Controller will echo the new setting to confirm that you have successfully entered the date and time.

PACKET FORMATTING

The Controller uses some 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 you and your computer. Most of the special input characters are active in both Command and Converse modes; any exceptions will be noted.

Some of your Controller's command parameters affect how your packets are formatted, or how your typing appears to the rest of the world. Other commands let you correct typing errors before your packet is sent; cancel lines, cancel entire packets if necessary.

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

Refer to the "Controller Commands" section for more information about defining these formatting and control features and commands.

PACLEN — Long or Short?

PACLEN sets the maximum length of your packet. In other words, 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>), your Controller will send a maximum-length packet.

In the Transparent Mode, a packet is sent if you type the maximum number of characters before the delay that is set by PACTIME forces a packet to be sent.

NOTE: Some other packet systems may not be able to accept packets longer than 128 characters.

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. <BACKSPACE> is more common than <DELETE> on personal computers. If you are not sure what your rubout key does, try both settings of the DELETE command to see which works.

When you rub out typing errors, your Controller 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. Your Controller will not correct the display, but will indicate the rub-out with a "\" character (<BACKSLASH>). Set BKONDEL ON to restore the display correction.

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 your Controller is in the 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?
```

Redisplay

If you erase and retype several characters, you may want to see "fresh" input, especially if BKONDEL is OFF. Type <CTRL-R> to display the line you are entering as shown below:

```
cmd:CONNECT KB7\\\WA7<CTRL-R>\
[You mis-typed the call sign.]
cmd:CONNECT WA7GXD
```

In this example, the station operator mistyped the first letters of the call and then rubbed them out. The Controller displayed "\" for each letter that was erased. He then retyped the call and redisplayed the characters on the new line.

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 Controller to your computer.

The PASS Character

You may want to include a special input character in a packet. To send several lines in the same packet, for example, you must include a <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 wasn't at the meeting.<CTRL-V><CR>
What happened?

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

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 station.

If you set the send-packet character to a nonprinting 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.

You can add a <LF> after the <CR> in your packets by setting ALFPACK ON. If the other station operator 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 in the "Controller Commands" section.

MULTIPLE CONNECTIONS

Multiple-connection capability is a very powerful addition to your Controller that can be very useful for traffic net operation, multi-user bulletin board and host computer systems, path checking, and ordinary "roundtable" ragchews.

Multiple connects work with "Logical channels." These channels are created or simulated by computer logic and do not really exist in the same way that a "radio channel" exists.

Multiple connects do not effect your radio's performance. Use your radio equipment normally on only one channel.

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

Your Controller has ten "channels" that allow you do perform multiple connections. You could, for example, attempt to connect to a station on channel 1, connect to a different station on channel 2, and accept a connect on channel 3. The setting of the USERS command (explained later) determines how many channels are available.

Default Multiple-Connect Conditions

When power is applied to your Controller, and until you change it, your Controller defaults to the following multiple-connect conditions:

CONPERM OFF
CHCALL OFF
CHDOUBLE OFF

CHSWITCH $00
USERS 1

These defaults set your Controller to the same as a TNC without the multiple-connect feature. USER-1 is the key to setting "normal" operation.

Multiple-Connect Active - The USERS Command

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 your Controller.

USERS 1 is the normal setting that does not allow multiple connects. When USERS is set to 1 and you already have a connect on another channel, the Controller sends a packet to the calling station that indicates you are busy.

A numerical value "n" from 0 to 10 specifies the number of active simultaneous connections that can you can establish with your Controller. 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, 2, and so on, through USERS 10.

Selecting the CHSWITCH Character

The CHSWITCH command selects the character that is used to indicate when 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 one of the channel numbers (0 to 9). Your Controller's default value for CHSWITCH is $00, which disables the function. This default was chosen to prevent conflicts with the characters frequently found in packet network maps. If you are using your Controller as the TNC for a Packet Bulletin Board System (PBBS), we recommend the default value of $00.

To change from one channel to another, all you need to do is issue the CHSWITCH character followed by a channel number. The CHSWITCH character should be something you do not use during everyday conversations. An uncommon character helps reduce the chance of accidently changing channels during a QSO. If you choose the letter A as your CHSWITCH character and then send a phrase like "Mike is an A1 class operator", the Controller would interpret the "A1" as a command to switch to channel 1. In addition, if another station happens to send a letter A without a number between 0 and 9 in this example, your monitor would display "?CHANNEL MUST BE 0-9." The CHSWITCH character is active in both the Converse and Command Modes, which eliminates the necessity to return to the Command Mode to change channels.

To select the "@" sign as your CHSWITCH character, for example, first look up the hexadecimal or decimal number that corresponds to @ (in this case, @ is $40 in hex and 64 in decimal). You would now type "CHSWITCH $40" to change the default.

After you have CHSWITCH set to $40 (or 64 decimal), anytime you type a @ followed by a number between 0 and 9, the Controller will change channels.

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

CSTATUS is a direct command that allows you to determine which channel you are currently using. In addition, it also shows you the status of all other channels. If you are connected to KZ7G on channel 0 and try to connect to N7BTI on channel 1 right after you issue a disconnect from N7ML on channel 3, for example, issuing the CSTATUS command will display:

CH 0 -	CONNECTED TO KZ7G; V2; 3 UNACKED
CH 1 -	CONNECT in PROGRESS
CH 2 -	DISCONNECTED
CH 3 -	I/O DISCONNECT IN PROGRESS
CH 4 -	DISCONNECTED
CH 5 -	DISCONNECTED
CH 6 -	DISCONNECTED
CH 7 -	DISCONNECTED
CH 8 -	DISCONNECTED
CH 9 -	DISCONNECTED

The channel 0 entry indicates that the Controller is connected to KZ7G and version 2 protocol is being used. It also shows that there are 3 unacknowledged packets outstanding. Channel 1 indicates that there is a connection in progress, and channel 3 indicates that a disconnect is in progress. The "I/O" in the channel 3 entry shows that you are currently on channel 3 (this is where input/output is occuring).

The MULT LED will light to indicate whenever you are involved in a multiple-connect condition. This indicator will light when you establish a second connection, or when another station connects to you while you are already connected to another station on another channel (assuming USERS has been set to allow more than one connection). If USERS is set to 1 and you are already connected to another station, the Controller will send a "busy" packet to any other station that attempts to connect to you. NOTE: You can still, however, originate a connect request on a second channel. The USERS parameter only affects incoming connection requests.

The MULT LED will blink if the Controller's receive buffer is full. This can happen if your computer is not connected to the Controller, or if for some reason your communication program no longer can accept any more inbound data. The blinking effect is not related to multiple-connect operation.

Display Multiple-Connect Call Signs - The CHCALL Command

CHCALL displays the call sign of the "connected-to" station after the channel identifier. CHCALL is especially useful when you operate with multiple connections. CHCALL is similar to MRPT in the way it shows digipeat paths when you monitor the channel.

Set CHCALL to ON if you intend to operate multiple connections.

Display Doubled Characters - The CHDOUBLE Command

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

Set CHDOUBLE to ON when you operate with multiple connections so you can distinguish between CHSWITCH characters received from other stations and CHSWITCH characters that are generated by your Controller.

General Hints About Multiple-connect Operation

Here are some general suggestions concerning multi-connect operation:

1. Use the "equal" sign (=) as your switch character. Type "CHSWITCH $3D" to enter the equals sign. Type "CHSWITCH"<CR> to verify that it was accepted. Your monitor will display: **CHSWITCH $3D =**.

2. To see the call signs of the stations with whom your station is connected, type "CHCALL ON".

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

4. Assume you want to connect to WX1AAA and WX2BBB. From the Command Mode, type:

   =0 CONNECT WX1AAA
   and
   =1 CONNECT WX2BBB

5. After your station is connected, the channel is indicated in each packet so you can easily tell who is talking to you:

   =0:WX1AAA: Hi Ralph.
   =1:WX2BBB: Long time no see!

6. To chat with WX1AAA in the Converse mode, type:

   =0 Hi Chuck!

   To chat with WX2BBB, do the same thing for his channel:

   =1 Hello Bert.

7. To disconnect from WX1AAA, type: <CTRL-C>=0DISCONNECT.

UNDERSTANDING MONITOR LEVEL 6

When you have MONITOR set to 6, your Controller displays all packet frames that it receives. MONITOR 6 provides information that you can frequently use to identify the exact nature of any packet communication in progress and help diagnose link problems. Packet frame identifiers are displayed at the end of each packet header that the Controller receives and decodes. The identifier letters are enclosed in either < > or [ ] brackets. <C>, for example, indicates a connect command that was received with AX25L2V2 set to OFF. [C] indicates a connect command that was received with AX25L2V2 set to ON. In any case, the <> or [] brackets indicate the version of the protocol that is in use by the station you are receiving.

When you set the Monitor parameter to 6, the Controller will monitor all of the packet frames that are being sent. The ten different types of frames that can be sent are:

C	Connect command (also known as an SABM frame)
D	Disconnect command
I	Information command and response
UA	Unnumbered acknowledgement response
UI	Unnumbered information frame
RR	Receive ready command and response
RJ	Reject command and response
RNR	Receive not ready command and response
FRMR	Frame reject response
DM	Disconnected mode response

The following information shows you how these frame identifiers appear in various packet link situations. Assume that stations KZ7G and N7BTI are working these links.

The <C> Connect Command (SABM frame)

Assume that KZ7G has AX25L2V2 set to OFF and that he has typed a "C N7BTI" connect command. His Controller sends a connect command frame to N7BTI, which would appear like this:

KZ7G>N7BTI <C,P>

The < > brackets indicate that V2 (version 2) is OFF. The "C" indicates this is a connect request frame (SABM frame), and the "P" indicates a poll bit is set and that a final bit is expecting a response.

The <UA> Unnumbered Acknowledgement Frame

If N7BTI's system is available, it will acknowledge the connect request with:

N7BTI>KZ7G <UA,F>

At this time, N7BTI will see a **"***CONNECTED TO KZ7G"** on his monitor. UA indicates an unconnected acknowledge frame with a final bit as the proper response the poll bit. When KZ7G receives the unconnected acknowledge frame, his Controller will display **"***CONNECTED TO N7BTI"**.

Both systems are now connected together and ready to send and receive data.

The <I> Information Frame

If KZ7G types "HI JOHN!" and N7BTI's HEADERLN is set to ON, the frame would appear as:

KZ7G>N7BTI <I;O,O>
HI JOHN!

The I indicates that this is an information frame. The numbers following the "I" are the frame count numbers. The first number shows the frame number that KZ7G expects N7BTI to send to him, while the second number is the number of the particular frame that KZ7G is sending to N7BTI. When KZ7G sends the next frame, it would appear as:

KZ7G>N7BTI <I;0,1>
"TEXT OR INFORMATION"

If N7BTI now sends an information frame to KZ7G, it would appear as:

N7BTI>KZ7G <I;2,0>:
"TEXT OR INFORMATION"

This shows that N7BTI has sent an information frame to KZ7G. The numbers in the frame show that N7BTI expects KZ7G's next information frame to be number 2, while this frame from N7BTI is number 0. N7BTI's next information frame would be:

N7BTI>KZ7G <I;2,1>:
"TEXT OR INFORMATION"

The <RR> Receive Ready (Acknowledgement) Frame

The <RR> receive ready frame acknowledges that a frame has been received correctly. If the frame was not correctly received, the receiving station does nothing. The sending station waits for a set time interval until it decides that the last frame was not received and sends it again. This will repeat until the frame is acknowledged or until the sending system "times out" after excessive retries.

To acknowledge a frame, the receiving station system sends an "RR" frame, including the number of the next frame it expects to receive. Continuing with the above example:

N7BTI>KZ7G <I;2,1>:
"TEXT OR INFORMATION"

KZ7G's system would acknowledge this frame with:

KZ7G>N7BTI <RR;2>

This shows that KZ7G acknowledges frame number 1 from N7BTI and is "Ready to Receive" his next frame as number 2. When N7BTI sends his frame number 2, KZ7G would acknowledge it with:

KZ7G>N7BTI <RR,3>

The <RJ> Reject Command Frame

If another station sends a packet that collides with KZ7G's acknowledge frame, causing N7BTI to miss the acknowledgment, N7BTI would resend the packet until he does receive an acknowledgment. This time, however, the frame would appear as:

N7BTI>KZ7G <I;2,2>
"TEXT OR INFORMATION"

Since KZ7G actually did receive this frame correctly the first time (only the acknowledgment was collided with), and he is ready to receive the next frame, KZ7G would send a reject frame and a number to N7BTI to indicate what frame he expects to see next. This ReJect frame would appear as:

KZ7G>N7BTI <RJ,3>

As before, the 3 indicates that KZ7G is expecting to receive frame number 3.

The <DM> Disconnected Mode Frame

Assume that during the above example N7BTI receives a connect request from N7ML, but N7BTI has his USERS parameter is set to 1. Since N7BTI cannot receive any more connections while USERS is set to 1, his Controller would send the following busy packet to N7ML:

N7BTI>N7ML <DM>

This indicates to N7ML that N7BTI is busy and will not allow the connect.

The <D> Disconnect Command Frame

When KZ7G and N7BTI complete their QSO, they must disconnect. If KZ7G is the station that originates the disconnect packet, it would appear as:

KZ7G>N7BTI <D,P>

Note that you again see the poll bit with the disconnect frame. N7BTI would see "***DISCONNECTED: KZ7G" on his screen and, at the same time, his controller would send the following unconnected acknowledge frame:

N7BTI>KZ7G <UA,F>

This frame directs KZ7G's controller to disconnect and you will again see the final bit. When KZ7G receives this frame, he would see "***DISCONNECTED N7BTI".

The <UI> Unnumbered Information Frame

The <UI> frame is unique to amateur radio. It provides a way to send beacons and other information without protocol.

If N7BTI wishes to call CQ after the disconnect process completes, he must first enter the Conversation Mode. The letter "K" will cause the Controller to enter the Conversation Mode. After N7BTI enters the Conversation Mode, he could then type a short CQ message such as "CQ de John". This would cause the following message would appear on the screen:

N7BTI>CQ <UI>
CQ de John

ADVANCED PACKET OPERATION

This section describes special aspects and advanced concepts that are not used in everyday conversational packet operation. Read this section carefully if you intend to use your Controller for any of the following:

A packet bulletin board system (PBBS).

Binary file transfers.

A "host" program.

HF or OSCAR operation.

Special timing or other requirements needed by your particular radio.

USING HEX NOTATION

If you reassign parameter values in hexadecimal numbers, you must observe some simple rules. Be sure to begin the number with a "$". The "digits" of a hex number represent multiples of powers of 16, and the values 10 through 15 are represented by the letters A through F. The letters can be entered in either uppercase or lowercase. For example:

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

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 try to deal with this by providing data buffers that store incoming data until the program is ready for it. This merely postpones the problem, however, because all buffers have size limitations.

To make sure data is not lost, the computer controls data flow by signaling the other device to stop sending data until the computer can empty its buffer. When the computer's buffer becomes empty and is again available, the computer directs the other device to resume sending data. If you use a personal computer, you are probably already familiar with flow control that allows you to stop the output from the computer while you read the data; then restart the output when you are ready for more.

TYPE-IN FLOW CONTROL

Type-in flow control (set by the FLOW command) is a display feature. When FLOW is set to ON, your Controller cannot interrupt you with incoming packets while you are entering a command word or an outgoing packet.

As soon as you type the first character of a word (except for echoing your typing), your Controller "holds" output towards the computer. This "hold" remains in effect until you enter a <CR> to end the command or a send-packet character to mark the end of a packet, or until you erase or redisplay the line you started to type.

Some computers have difficulty simultaneously sending and receiving characters over the serial port. This is most common when you use a computer that contains "software UARTs." Type-in flow control improves the operation of such computers with your Controller..

DATA FLOW CONTROL

In the Command Mode, your Controller's input buffer may fill up if you try to type a command that is too long. In the Converse Mode, however, the buffer may fill up for any of several reasons: you may be using a faster serial port baud rate than the radio data rate, radio data transmission may have slowed down due to noise or other users on the channel, or the other person or computer may have stopped output from that system.

Your Controller signals the computer to stop sending data when there is room remaining for about 80 characters in the buffer. When the buffer completely fills up, data will be lost. When the buffer empties to the point where there is room for at least 270 characters, your Controller signals the computer to again start sending data.

A computer file transfer program may be unable to process data fast enough to keep up with the output of your Controller. A 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 your Controller to stop sending data.

Your Controller provides two methods of flow control:

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

Hardware flow control requires both computers to use the CTS (Clear To Send) and RTS (Request To Send) lines of the RS-232C standard.

Some commonly used file transfer and terminal programs for home computers do not provide flow control in software; many 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 your Controller seems to lose data during file transfers, flow control is probably the problem.

XON/XOFF (Software) Flow Control

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

The special flow control characters have been preset to <CTRL-S> and <CTRL-Q>, but you can change them. The XON and XOFF commands define the characters that your Controller sends to the computer, while the START and STOP commands define the characters that are sent to your Controller by the computer.

After the Controller sends a STOP character, your computer may still receive as many as four characters. This happens because some characters may already be "enroute" through serial I/O devices.

If you send a STOP/START character to your Controller while it has already been stopped or started, it ignores them. If the STOP and START characters are identical, that character "toggles" the output by turning it off when it is on and on when it is off.

You can set the appropriate flow control characters to 0 (zero) to disable XON/XOFF flow control in only one direction. Your Controller automatically uses CTS flow control to stop input from the computer.

XON/XOFF flow control is normally disabled in the Transparent Mode; 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 your Controller to the terminal).

Set TRFLOW ON to activate the START and STOP characters (the commands to your Controller from the terminal) in the Transparent Mode. Note that this mode is no longer truly "transparent" when you enable the flow-control feature.

Hardware Flow Control

RS-232 RTS and CTS lines are normally used for flow control signals in the Transparent Mode. Hardware flow control is usually less dependent upon the way a given communication terminal program is written.

The XFLOW OFF command activates hardware flow control in the Converse Mode and the Command Mode. Your computer may receive as many as two characters after it signals your Controller to stop sending. This happens because some characters may already be "enroute" through serial I/O devices. Refer to your Technical Manual for hardware flow control interface requirements.

DATA TRANSFER MODES

To enter a data transfer mode from the Command Mode, first type "CONVERS" (or just "K") to enter the Converse Mode. Then type "TRANS" (or just "T") to enter the Transparent Mode.

If the Controller is in the Command Mode when another station connects to your station, it will automatically switch to a data transfer mode. Use the CONMODE command to specify the data transfer mode you desire at automatic entry.

NOTES:

1. CONMODE TRANS automatically selects the Transparent Mode.

2. CONMODE CONVERS returns to the default choice of the Converse Mode.

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

If your Controller receives and accepts a connect request, your system always enters the data transfer mode at the moment it sends the connect acknowledgment (ACK) and displays the "*** CONNECTED to <call sign>" message. Your Controller always switches to the data transfer mode at the moment of connection unless NOMODE is set to ON. Any text sent to your Controller is queued into packets waiting for a successful connection before they are sent. If the connect attempt fails, your system returns to the Command Mode. The system also automatically returns to the Command Mode when either station disconnects and ends the QSO.

COMMANDS THAT AFFECT PROTOCOL

Certain commands affect the operation of the packet protocol. A full copy of the AX.25 protocol appears in the Technical Manual.

AX25L2V2 — ON OR OFF?

Your Controller uses the AX.25 Level 2 protocol, the rules by which it 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 that uses an older TNC.

The CHECK command controls a timing function that depends upon the protocol version selected.

UNPROTO WHO?

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

cmd:UNPROTO QST VIA NK6K

If you set UNPROTO to "QST", for example, other stations will see your beacon like this:

MYCALL>QST

NOTE: The default address for unconnected packets is CQ.

PASSALL - THE "JUNK MODE"

PASSALL is sometimes referred to as the "garbage" mode. PASSALL is useful when you diagnose connection failures and protocol problems. It is not very useful in ordinary packet operations.

If PASSALL is "ON", your Controller ignores error-checking. That function of the protocol is disabled for all packets being monitored. If you set PASSALL 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 8-bit bytes, up to 330 bytes.

PACKET TIMING FUNCTIONS

Your Controller obeys a series of timing instructions that are built into the protocol. Timing is adjustable to compensate for variable conditions and local circumstances. You can change the default values of these instructions at any time for experimentation, and then return them to their original values if you find it necessary.

Do not be afraid to try other values in these parameters. You cannot harm your Controller by changing timing values. Actually, you may improve your packet performance.

TXDELAY Command

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

1. Time delay between the moment that your Controller keys your transmitter's PTT line and your transmitter delivers power to your antenna.

2. Time required for the other station's receiver to recover full sensitivity and overcome squelch/AGC rise-time characteristics.

3. Transmitter and receiver phase-lock-loop settling times at both ends of the link.

If your Controller starts to send data before your transmitter is up to power, or before your receiver has recovered from transmitting and locked to the incoming signal, the packet will not be received properly by the other station.

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

TXDELAY controls the delay between your transmitter's key-up and the moment your Controller starts sending data. During the period your Controller holds the PTT active but not sending data, it transmits a series of contiguous synchronizing signals (flags).

AXDELAY and AXHANG Commands

You may require a longer key-up delay when you send packets through an audio repeater than is normally needed for direct communications. The extra key-up delay, however, is not required if the repeater has not had time to "drop" since the last transmission.

The AXDELAY command adds more key-up delay in your Controller so that the repeater receiver and transmitter have time to lock up.

The AXHANG command sets the time your Controller uses to allow the repeater to drop.

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

TXDELAY, AXDELAY, and AXHANG set times in increments of 10 milliseconds. If AXDELAY is in effect the total key-up delay is:

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

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

Key-up delay = TXDELAY x 10 milliseconds.

FRACK and RETRY Commands

The AX.25 protocol calls for retransmission of packets when an acknowledgment is not received from the other end of the link within a specified period of time. A packet might not be acknowledged due to channel noise or "collision" with another packet transmission. If other stations are using the same channel, the receiving station may not be able to acknowledge the received packet immediately.

The FRACK command (FRame ACKnowledge time) sets the time lapse that is allowed before the originating station retransmits the packet.

The RETRY command 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 your Controller 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.

DWAIT Command

Digipeated packets require an end-to-end acknowledgment; they do not acknowledge the packets they relay. If a link includes several digipeaters, the chances of loss of either the original packet or the acknowledgment increase drastically.

To help alleviate this problem, an automatic wait time can be imposed on any station that does not transmit a digipeated packet. Stations waiting for a clear channel before they transmit packets wait for this time interval, after the channel clears, before they transmit. 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.

The DWAIT command sets your Controller'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.

To minimize unnecessary retries, the Controller applies a collision-avoidance strategy to all packets except those being digipeated. On the second and subsequent transmissions of a given packet, your Controller waits an additional random time after it detects 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 your Controller'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 between 0 and 15. The longest amount of time added randomly, therefore, is 0.094 x TXDELAY seconds. For the default value of TXDELAY = 30, the longest time added is 2.8 seconds.

MAXFRAME Command

The AX.25 protocol allows you to transmit several packets without waiting for an acknowledgment. The number of packets that can be sent before acknowledgment is referred to as the "window." The window concept permits more efficient channel use if large amounts of data are being transferred.

The MAXFRAME command sets the maximum number of packets which your Controller will send before it waits for an acknowledgment. (This does not mean that your Controller will wait until you have typed several packets before they are transmitted.)

MAXFRAME, in combination with the PACLEN command (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.

CHECK Command

The CHECK command sets a connection timeout specified in multiples of ten-second intervals. This timeout function prevents your Controller from remaining connected to another station when the other station disappears for longer than the specified time. Your Controller uses this time somewhat differently, depending on the setting of AX25L2V2.

If AX25L2V2 is OFF (a pre-Version 2.0 connection), the link is preserved by initiating a reconnect call. The Controller will return to the "connect-in-progress" state and send connect request (SABM) frames. In addition, the Controller adds a random time of up to 30 seconds each time CHECK occurs in a given connection.

RESPTIME Command

The RESPTIME command sets a delay between the receipt of a packet and the transmission of the acknowledgment packet. This delay is helps prevent collision between an acknowledgment and another packet from the sending station. RESPTIME is mainly necessary in file transfers. For normal service, it is best if the station sending the file sets RESPTIME to 0 (zero).

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

PACTIME Command

The PACTIME command 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 type 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 command to enable PACTIME in the Converse Mode.

PACKET BULLETIN BOARD PROGRAM COMPATIBILITY

Your Controller will successfully operate with PBBS (Packet Bulletin Board) programs that are written for PC/MS-DOS computers by W0RLI, VE3GYO, WA7MBL, and KA2BQE. Please contact these authors directly for information about using your Controller with their PBBS programs. Heath Company's Customer Service Department cannot provide information about these applications.

We recommend the following default parameters for PBBS operation:

8BITCONV	ON
ACRDISP	0
ALFDISP	OFF
AWLEN	8
AX25L2V2	ON
CHSWITCH	$00
DCDCONN	ON*
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

* WA7MBL's Version 3.12 PBBS code requires that pin 8, DCD (Data Carrier Detect), be connected between the computer and the Controller. In addition, DCDCONN must be ON to force pin 8 to follow the Controller's connect status. NOMODE must also be set to ON.

CONTROLLER COMMANDS

This section of the Manual provides you with detailed information about all of the Controller's commands. It first describes the correct way to enter commands, and then how the Controller may respond. In addition, a complete alphabetic listing of the commands is provided along with a description about their proper use.

Commands are either keywords or mnemonics (special abbreviations that jog your memory) that are made up of single or multiple characters you type in on your computer's keyboard. Certain commands affect the Controller's performance under specific conditions, and others specify the values of parameters you desire during it's general operation.

All command names are printed in UPPERCASE in this section, while lowercase is used to explain them.

NOTE: Your Controller is a "command-driven" system; it does not use "menus".

HOW TO USE THE CONTROLLER

ENTERING COMMANDS

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

Many parameters have already been set to their most-commonly-used value, and they will default to these values whenever all power is removed (including the memory backup battery). You have maximum flexibility, however, to change the parameters so you can adapt the Controller to your local environment and operating conditions.

You should always enter commands after the Command Mode prompt shown below:

cmd:

Use the following procedure to enter a command:

1. Use either uppercase (capital letters) or lowercase (small letters).
2. End the command with a carriage return <CR>. NOTE: Carriage returns are not shown in the examples which follow.
3. Correct your typing mistakes or cancel the line completely before you type the final <CR> of your command.

COMMAND RESPONSES

Whenever the Controller accepts a command that changes a value, it responds with the previously stored value and the newly-assigned value. If "XFLOW" is currently "ON" (for example) and you type "XFLOW OFF", you will see the following on the display:

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

This message indicates that you have successfully changed the value.

ERROR MESSAGES

If your Controller cannot understand what you have typed, it will produce an error message (in English) that shows the nature of the error.

If you type a command your Controller cannot understand at all, it will display:

```
?What?
```

If you type a correct command word with an incorrect argument, it will display:

```
?bad
```

If you type a numerical value outside a particular parameter's range, it will display:

```
?range
```

If you set the BEACON timing too short for busy channels, it will display:

```
WARNING: BEACON too often
```

If you type an improper SELCAL, it will display:

```
?call sign
```

Here are some typical incorrect entries, the error messages that were produced, and what was wrong with each entry.

cmd:ASDFASDF— This is not a command.
?What?

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 Controller's clock.
cmd:x ?not while in PACKET	—	Command is invalid for the mode in use.
cmd:C N6IA ?not while in MORSE	—	Command is invalid for the mode in use.
cmd:C N6IA ?not while in ASCII	—	Command is invalid for the mode in use.
cmd:C N6IA ?not while in BAUDOT	—	Command is invalid for the mode in use.

COMMAND LIST

Commands are listed alphabetically toward the rear of this section. Each command entry contains the following:

Command name

Command abbreviation or mnemonic

Default value

Parameters

COMMAND NAMES

The abbreviation (mnemonic) at the beginning of the description (in larger print) is the short form of the command that you can use instead of the full word. Next to the abbreviation (also in larger print) is the full command name. You can type out the entire command word, or any abbreviation that is longer than the minimum abbreviation. You can simply type "MY", for example, to enter the command MYCALL. NOTE: DO NOT type the "quotation marks"; these are shown for clarity in identifying the letters you will type.

The abbreviation "M" is not sufficient (and will be interpreted as a different command), but "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.

A letter "n", for example, means the command takes a numerical parameter value.

DEFAULT VALUES

Some commands have initial default, or "used most often", values.

These defaults are stored in EPROM and loaded into RAM whenever you first turn the Controller on, or when you type the RESET command.

PARAMETERS, ARGUMENTS, AND VALUES

Some commands need additional information before they can be executed. This type of command has "parameters" or requires "arguments." A command such as FULLDUP, for example, has a Boolean parameter. When you type "FULLDUP ON", FULLDUP is the command and ON is its argument (the value you want the Controller to use to execute the command FULLDUP). The values that fill this particular parameter are either ON or OFF.

Immediate commands such as "ID" have no parameters. You need to only type "ID" to cause the Controller to execute the command.

Some commands such as "CONNECT" have optional parameters. If you type "CONNECT" without an argument, the Controller displays the current status of the link. If, however, you type "CONNECT N7ML", the Controller issues the connect request and tries to establish the link to N7ML.

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 of these are legal commands.

PARAMETERS

Parameters can be Boolean, numeric, or text (or string). These are each described separately in the following paragraphs.

Boolean Parameters

Boolean parameters are restricted to only two possible values, such as ON or OFF, YES or NO, or EVERY or AFTER. They can also be toggled with an argument of "TOGGLE" or "T". This is useful, for example, in the case of RXREV and TXREV.

When a parameter is Boolean, its two possible choices are shown separated by a fraction bar (/).

Numeric Parameters

A parameter designated as "n" is a numeric value. You can enter these values by typing familiar decimal numbers, or optionally as hexadecimal numbers.

When you use hexadecimal notation, you must prefix the number with a "$" character.

The Controller displays some numeric parameters (those which set special characters) in hexadecimal format. The "digits" of a hex number represent powers of 16 in the same manner as the powers of10 are 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 between 0 and 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 baud rate. This is especially useful when you wish to change RBAUD and ABAUD during RTTY reception.

Text or String Parameters

You can type a text parameter such as the "message" for BTEXT (your "beacon" message) or CTEXT (your "connect" message) in either upper- or lowercase. This parameter is accepted exactly as you type it and can include numbers, spaces, and punctuation.

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

A call sign can also include a substation identifier (SSID), which are decimal numbers between 0 and 15, to distinguish between two or more stations on the air with the same call (such as a base station and a remote "digipeater").

The call sign and SSID are typed in and displayed as "call-n" (such as "K0PFX-3"). If an SSID is not entered, the system assumes it is 0 (zero). NOTE: SSID "0" is not normally displayed by the Controller.

Some commands have parameters made up of lists of call signs. The CFROM command, for example, allows you to specify from one to eight call signs for selective monitoring. You must use a blank space or a comma to separate multiple call signs.

The following examples will help you understand how this works.

Example 1: BEACON EVERY/AFTER "n"

The BEACON command requires you to specify either EVERY or AFTER (abbreviated to E or A), followed by an argument "n" which you may choose from a range of values.

A typical entry would be BEACON EVERY 180. This causes a beacon to be sent every 180 times 10 seconds (every 1800 seconds, or 30 minutes). Another typical entry would be BEACON EVERY 0. This turns the beacon off.

Example 2: 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:

Example 3: C WX1AAA V WX2BBB,WX3CCC

USING COMMANDS WITHOUT ARGUMENTS

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

cmd:VHF Y	—	Sets the value to YES (ON).
VHF was OFF	—	Displays the previous value.
VHF now ON		
cmd:VHF	—	Command with no arguments.
VHF ON	—	displays the present value.

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

CONTROLLER MESSAGES

This section describes your Controller's messages and the circumstances under which they can appear.

GENERAL INFORMATION

SIGN-ON MESSAGE

The following sign-on message appears when you turn your Controller on, or when you type "RESET":

```
Heathkit HK-232 Multi-Mode TNC
Copyright (C) 1986, 1987 by
Heath Company and AEA, Inc.
Release DD-MMM-YY
Checksum $nn
cmd:
```

The release number shows the version of the firmware in your particular Controller. The checksum is a hex number which you can compare against the correct checksum available from the Heath Company, for the firmware version you are using.

The message "HK232 is using default values" appears in addition to the sign-on message if the bbRAM checksum verification fails at power-up. This failure causes the Controller to load the default parameters from ROM. (This also occurs the first time you turn your Controller on.)

This message also appears if the Controller loads the defaults in response to the RESET command.

When the following Command Mode prompt appears, the Controller waits for you to enter a command:

cmd:

Anything you type after this prompt, up to and including the first <CR>, is interpreted as a command by the Controller. If a monitored packet has been displayed, the prompt may not be visible, even though your Controller is in the Command Mode. You can type the redisplay-line character (set by REDISPLA) to make the prompt reappear.

Whenever you change one of the Controller's parameters, both the previous value and the new value will be displayed after the words:

was
now

This shows you that the Controller properly interpreted your command, and reminds you of what you have done.

The following message appears in response to a CONVERS or TRANS command, under special circumstances:

too many packets outstanding

This message would appear, for example, if you have already typed packet data and filled the outgoing buffer in the Converse Mode or the Transparent Mode, and then tried to return to the Command Mode. You will be allowed to enter one of these modes, however, when some of the packets have been successfully transmitted.

COMMAND MODE ERROR MESSAGES

An error message like the one shown below appears if you make a mistake when you type a command to the Controller.

?bad

This message shows that you typed a command correctly, but the remainder of the command line could not be interpreted.

If you type a call sign that does not meet the Controller's call sign requirements, it will display:

?callsign

A call sign may be any string of numbers and letters, while punctuation and spaces are not allowed. The SSID, if given, must be a decimal number between 0 and 15, separated from the call by a hyphen.

If you type the command DAYTIME to display the date and time but you have not yet set the clock, you will see:

?clock not set

DAYTIME sets the clock if it you enter it with daytime parameters, and just displays the date and time if it is given without parameters.

If your first entry is not a command or a command abbreviation, the Controller will display the following message to indicate that it does not understand your instructions:

?What?

When you enter a command that requires several parameters but you do not enter the required number, the Controller will display:

?not enough

An example of this would be: **"CONNECT W2JUP VIA."**

Any attempt to change MYCALL or AX25L2V2 while the Controller is connected, or is attempting to connect, to another station will cause the Controller to display:

?not while connected

If you type a numeric argument too large or too small for that specific command, you will see:

?range

The Controller indicates a line that is too long with:

?too long

If you try to type too long a BTEXT or CTEXT message, for example, you will see this message. When the Controller displays this specific error message, the new line is ignored and the previous text entry is not changed.

If you enter too many parameters for a command that requires parameters, the Controller will display:

?too many

MFILTER, for example, can have up to four arguments. The following example shows you what happens if you enter five arguments:

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

If you type more than one call sign for the CONNECT or UNPROTO commands without the required VIA keyword, you will see:

?VIA

The following message indicates that you tried to set CONPERM while the Controller is disconnected from another station:

?not while disconnected

If you enter an invalid channel character after the CHSWITCH character, the Controller will display:

?channel must be 0-9

An attempt to CONNECT to a station to which you are already connected shows:

?already connected

If you try to CONNECT to more than one station on the same logical channel, you will see:

?different connectees

LINK STATUS MESSAGES

Link status messages show you the status of any AX.25 connections in which your Controller may be involved.

You can type the CONNECT command by itself at any time while the Controller is in the Command Mode to check link status.

If you attempt a connection when your Controller is already in a connected state, your monitor displays the link status and takes no other action.

The following messages appear in response to the CONNECT command:

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

This shows that your station is connected to another station. If there are any digipeaters involved in the particular connection, the path will also be shown. The call signs are in the same sequence you would use to initiate the connection.

Link state is: CONNECTED to call1; v2; 2 unACKed
[VIA call2[,call3...,call9]]

This shows that your station is connected to a station using Version 2, and that two frames remain unacknowledged.

Link state is: DISCONNECTED

This shows that no link or connection exists right now. You may use a CONNECT command to initiate a connection.

Link state is: CONNECT in progress

This indicates that you have already typed a connect request, but an acknowledgment from the other station has not been received.

If you type the DISCONNE command, the connect process will be canceled.

Link state is: DISCONNECT in progress

This shows that you have entered a disconnect request, but the acknowledgment from the other station has not been received. If you type a second DISCONNE command, the Controller will immediately change to the disconnected state.

Link state is: FRMR in progress

This shows that your Controller is connected to another station, but a protocol error has occurred. This should never happen when two Heathkit AX.25 systems are connected. An improper implementation of the AX.25 protocol could cause this condition.

Your Controller will attempt to resynchronize frame numbers with the controller on the other end, but a disconnect may result.

Connections are not valid while the Controller is in this state, but a DISCONNE command will begin the disconnect process.

Your Controller will advise you whenever the link status changes.

It may change, for example, in response to a command you have entered (CONNECT or DISCONNE), a connect or a disconnect request packet from another station, an automatic disconnect because the retry count was exceeded, an automatic time-out disconnect (CHECK), or a protocol error.

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

This message appears when your Controller changes from a "disconnected" or "connect in progress" state to a connected state. The connection may be the result of a CONNECT command that you have typed, or a connect request packet received from another station.

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

This message indicates that your Controller has received, but has not accepted, a connect request from another station. This can happen when you set CFROM to NONE, or if you are already connected to another station.

When your Controller displays this message, it also sends a DM packet (busy signal) to the station that initiated the connect request. If your Controller rejects a connect request because you have set CFROM to NONE or OFF, you can still issue your own connect request to the other station.

***** DISCONNECTED: (call sign)**

This message indicates that your controller has changed to the disconnected state from some other link state. This message may be preceded by a message explaining the reason for the disconnect, such as the one shown below:

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

In this case, the message shows you that the Controller has been disconnected due to a retry failure, rather than a disconnect request from another station.

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

This indicates that your connect request was rejected by a DM packet (busy signal) from another station. Similarly, your Controller 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

This message shows that your Controller is connected, but a protocol error has occurred. Your Controller has transmitted a special FRMR packet and is trying to resynchronize frame numbers with the other station's packet system. The string xxxxxx is replaced with the hex codes for the three bytes sent in the information part of the FRMR frame. NOTE: This message will not appear if your Controller is in the Transparent Mode.

FRMR rcvd: xx xx xx

This indicates that your Controller has received an FRMR (protocol error as described above). It is followed by a display of the FRMR packet in hexadecimal format. NOTE: This message will not appear if your Controller is in the Transparent Mode.

SPECIAL KEYBOARD CONTROL CODES

Each mode, except packet, uses specific characters for special functions. These functions vary with the mode as described below and, unless noted, are entered from the Command Mode.

Morse Code

From the Command Mode:

"L" Locks to the speed of the received signal.

"MO" Unlocks from the speed of received signal.

"R" Switches the system to the receive mode, unlocks the received speed, and forces the received speed to equal the transmit speed.

"X" Switches the system to the transmit mode and forces the Converse mode.

Embedded in transmitted text:

<CTRL-D> Immediately turns the transmitter off and returns the Controller to the Command Mode.

Baudot and ASCII RTTY

From the Command Mode:

"L" Forces LETTERS case (Baudot only).

"R" Switches the system to the receive mode and forces LETTERS case (Baudot only).

"X" Switches the system to the transmit mode and forces the Converse mode.

Embedded in transmitted text in Baudot only:

<CTRL-0> Sends LETTERS character.
<CTRL-N> Sends FIGURES character.
<CTRL-D> Immediately turns the transmitter off.
<CTRL-F> Sends the call sign in Morse code and turns the transmitter off.

AMTOR Mode

From the Command Mode:

"L" Forces LETTERS case.

"R" Stops the transmission in progress and forces AMTOR Stand-by.

"AM" Stops the transmission in progress and forces AMTOR Stand-by.

"AL" Forces resynchronization in ALIST (AMTOR Mode A Listen).

"ARQ <SELCAL>" Starts Mode A selective call and forces the Converse mode.

"FEC" Starts Mode B transmission and forces the Converse mode.

"SELFEC <SELCAL>" Starts selective Mode B transmission.

"X" Not used in AMTOR.

Embedded in transmitted text:

<CTRL-O> Sends LETTERS character.
<CTRL-N> Sends FIGURES character.
<CTRL-F> Sends the call sign in Morse code and turns the transmitter off.
<CTRL-D> Stops sending when the transmit buffer is empty.

FAX Mode

From the Command Mode:

"L" Starts printing the received signal, regardless of whether sync pulses have been detected.

"R" Turns off FAX reception. Waits for sync pulse before printing a new image. From the transmit mode, this command forces an immediate return to the receive mode.

"X"	Switches the system to the transmit mode.
<CTRL-D>	Sends 5 seconds of alternation between black and white at a 450 Hz rate and turns off the transmitter.
<CTRL-F>	Same as <CTRL-D> but also sends the call sign in Morse before turning off the transmitter.

CLEAR STRING COMMANDS

When the Controller is in the Command Mode, you can clear the commands listed below by typing the command word followed by a single percent sign (%), an ampersand (&), "N", "NO", "NONE", or "OFF" as the command's argument:

BTEXT	MHEARD	DFROM
CTEXT	MFROM	
MBX	MTO	
MYALIAS	CFROM	

SPECIFIC COMMANDS

The following "List of Commands" contains detailed descriptions about the meaning, use, effects of each command, its parameters, default values, and arguments. Examples of command usage are also included.

LIST OF COMMANDS

8B 8BITCONV ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON The high-order bit **IS NOT** stripped in the Converse Mode.

OFF The high-order bit **IS** stripped in the 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.

NOTE: 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 do not want all of the features of the Transparent Mode, set 8BITCONV ON and AWLEN to 8. This may be desirable if you are using a special non-ASCII character set.

Since commands require only the standard seven-bit ASCII character set, bit seven is always removed in the Command Mode.

AA AAB text *Default: HK-232*

Modes: Baudot, ASCII, and AMTOR.

Parameter:

text Any combination of characters and spaces up to a maximum of 17 characters.

Use the AAB command to enter an acknowledgment text in the ANSWERBACK section of the Controller's memory. AAB sends automatic confirmation in Baudot, ASCII, and AMTOR operation in response to another station's WRU? command, AAB is not related to the CTEXT and BTEXT messages that are used only in the packet mode. Set WRU ON to activate your answerback.

Type "AAB <17-character text>" to store your answerback in memory.

AB **ABAUD "n"** *Default: 110 bauds*

Mode: ASCII

Parameter:

"n" Specifies the data rate or signaling speed in bauds between the Controller and your radio.

The available "n" ASCII data rates are 45, 50, 57, 75, 100, 110, 150, 200 and 300 bauds. NOTE: Higher ASCII rates are available (up to 9600 baud), but RXREV and TXREV are available only up to 300. TXREV ON causes a continuous space tone at rates higher than 300.

Example: ABAUD 300

ABAUD sets the radio ("on-air") baud rate only in the ASCII operating mode. This value has **no relationship** to your computer or terminal program's baud rate.

ASCII RTTY operation requires you to use the same data rate that is used by the other station.

In general, the higher the baud rate, the greater the probability of data errors caused by interference and noise. You can usually obtain the best results in worst-case conditions by using a lower baud rate.

NOTE: Modern commercial and amateur radio operations no longer always refer to the operating speeds or data rates in WPM. The term "bauds" is now accepted for FSK and AFSK operations that use monobit data. In these cases, the terms "bauds" and "bits per second" mean the same thing and may be used interchangeably.

AC **ACHG** *Immediate Command*

Mode: AMTOR

ACHG is an immediate command used in AMTOR by the **receiving** station to interrupt the the sending station's transmissions.

This software command forces a changeover from receive to transmit, if needed, to interrupt the sending station's transmission.

As the receiving station, you usually rely on the other station (your partner in the ARQ "handshake") to send the "+?" command to do the changeover. In ARQ (Mode A), however, you can use the ACHG command to "break in" on the sending station's transmission.

NOTE: Use the ACHG command with care, and only in situations where it is essential to do so.

There are inherent reasons why recovery from such an interruption can result in garbled copy at one end of the contact, in particular in "FIGS" garble. If possible, wait until the other station is **idling** before you break in.

If the other station breaks into your transmission, you can use the "TCLEAR" command to cancel transmission of any unsent text which may be inappropriate to the new context of the break-in.

ACRD ACRDISP "n" *Default: 80*

Modes: All

Parameters:

"n"	0 to 255 specifies the screen or printer width, in the number of columns or characters.
0 (zero)	Disables the function.

The numerical value sets the proper terminal output format for your specific needs. The Controller 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.

NOTE: If your computer or terminal automatically formats output lines, set ACRDISP to "0" (zero) to avoid conflict between the two formats.

ACRP ACRPACK ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON	The send-packet character, normally <CR>, **IS** added to all packets sent in the Converse Mode.
OFF	The send-packet character **IS NOT** added to packets.

When ACRPACK is ON, all packets sent in the 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 your Controller, not as data to be included in the packet; the character is not echoed to the terminal.

NOTE: Set ACRPACK ON and SENDPAC to $0D to produce a natural conversational mode.

Each line is sent when you enter a <CR>, and arrives at its destination with a <CR> at the end of the line.

NOTE: If the other station reports overprinting of lines on his display, set ALFPACK ON, or ask the other station to set ALFDISP ON.

ACRR **ACRRTTY "n"** *Default: 71 (69 in AMTOR)*

Modes: Baudot and ASCII RTTY

Parameters:

"n" 0 to 255 specifies the number of characters on a line after which a carriage return <CR> is automatically inserted in your transmitted text. This insertion occurs after the last space character before "n" columns across the screen or page.

0 (zero) Disables the function.

When you are sending Baudot or ASCII RTTY, the ACRRTTY feature automatically inserts and sends a carriage return at the first space character following the "nth" character or column.

After the line ending sequence is sent, the character counter is reset to zero (0) and the count starts again.

NOTE: Use this option when you are handtyping into the transmit buffer and do not want to watch the screen or worry about line length, or wish to see when you are coming to the end of a line.

One case when you **should not** use this option is while you are retransmitting text that was received from another station. An example of this is ARRL RTTY bulletins.

The received text already contains the necessary line-ending sequence characters. If this option is enabled, your transmission will have double, perhaps even triple, line feeds and will look very strange at the other station.

Many stations using older electromechanical teleprinter and Teletype machines habitually send a traditional line-ending sequence consisting of CR CR LF LTRS, which was needed to allow the older, slow machines to return to the left margin. The double CR routine will produce a double line if you select this option ON by setting the value of "n" greater than zero length.

The same ACRRTTY function is used in AMTOR, except that AMTOR, like SITOR, is limited by telex practices to a maximum of 69 characters per line. (If ACRRTTY is set to 71, in AMTOR, the automatic carriage return function operates after 69 characters.)

AD **ADELAY "n"** *Default: 4 (40 msec.)*

Mode: AMTOR

Parameter:

"n" 1 to 9 specifies transmitter key-up delay in ten-millisecond intervals.

ADELAY is the length of time in milliseconds between the instant when the Controller activates the transmitter's PTT line, and when the ARQ data begins to flow to the transmitter. Some delay is necessary with any radio transmitter.

NOTE: All transmitters need some finite amount of time to switch from receive to transmit, and to develop their nominal power output.

The ADELAY command allows you to adjust a variable delay, from 10 to 90 milliseconds, introduced by the Controller in handling the PTT (Push-to-Talk) line activation and data flow in the AMTOR mode.

NOTES:

1. A default value of 4 times 10 (40) milliseconds will be adequate for most of the popular HF transmitters.

2. If necessary, you can reset other values with the ADELAY command.

As an indication that adjustment is required, you may observe symptoms of periodic errors caused by loss of phasing, shown by rephase cycles in the middle of an ARQ contact. This will occur in spite of strong signals and low QRM levels.

NOTES:

1. Be sure that errors and rephasing effects are not provoked by the other station before you change your defaults.

2. If changing your ADELAY values does not improve link performance, reinstall your original or default values.

Since the ARQ mode allows 170 milliseconds for the signal to travel to the other station and then return, increasing ADELAY will reduce the maximum working distance. At 300 kilometers per millisecond, the maximum theoretical range of an ARQ contact is limited to about 25,500 kilometers. Using some of that time as transmit delay leaves less time for signal propagation. The maximum distance available, therefore, is restricted — the signal cannot cover as great a distance.

NOTE: Even the shortest possible ADELAY may not allow ARQ (Mode A) AMTOR to work very well over very short distances (one or two miles). ARQ should not be necessary in very short distance communications to achieve error-free copy.

ALFD ALFDISP ON/OFF *Default: ON*

Modes: All

Parameters:

ON A line feed character <LF> **IS** sent to the terminal after each carriage return character <CR>. Each line feed that is received is ignored.

OFF A <LF> **IS NOT** sent to the terminal after each <CR>.

ALFDISP controls the display of carriage return characters that are received in packets as well as echoing those that are typed in.

When ALFDISP is ON, the Controller adds a line feed <LF> to each carriage return <CR> that is received **if needed**. If a line feed was received either immediately before or after a carriage return, ALFDISP will not add another line feed. Use the Controller's sign-on message to determine how carriage returns are being displayed.

NOTES:

1. Set ALFDISP ON if the Controller's sign-on message lines are typed on top of each other.

2. Set ALFDISP OFF if the Controller's sign-on message is double spaced.

ALFDISP is set correctly when the Controller's sign-on message is single spaced. ALFDISP only affects your local display. It does not affect the data sent in any mode.

Use the ALFPACK command if you want to add line feed characters to out-going packets.

ALFP ALFPACK ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON	A <LF> character **IS** added to outgoing packets following each <CR> transmitted in the packet.
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.

NOTE: If the station you are talking to reports overprinting of packets from your station, set ALFPACK ON. Character insertion is disabled in the Transparent Mode.

ALFR ALFRTTY ON/OFF *Default: ON*

Modes: Baudot and ASCII RTTY

Parameters:

ON	A line feed character <LF> IS sent after each carriage return character <CR>.
OFF	A <LF> IS NOT sent after each <CR>.

If ALFRTTY is set ON when you transmit in Baudot or ASCII RTTY, a line feed character is added and transmitted automatically after each <CR> character you type.

NOTE: Use this option when you are handtyping into the transmit buffer and do not want to watch the screen or worry about line length, or wish to see when you are coming to the end of a line.

There are several cases in which you should NOT use this option. For example, you should not use it while you are retransmitting text received from another station. An example of this is ARRL RTTY Bulletins.

The received text already contains the necessary line-ending sequence characters. If this option is enabled, your transmission will have double, perhaps even triple, line feeds and will look very strange at the other station.

Many stations using the older electromechanical teleprinter and Teletype machines habitually send a traditional line-ending sequence consisting of CR CR LF LTRS, which was needed to allow the older, slow machines to return to the left margin. The double CR routine will produce a double line if this option is selected ON by setting the value of "n" greater than zero length.

NOTE: ALFRTTY has no effect in AMTOR; a line feed is automatically added after each carriage return.

AL ALIST *Immediate Command*

Mode: AMTOR

ALIST is an immediate command that switches your Controller into the ARQ Listen mode.

You can usually monitor a contact between two linked stations by using the ARQ Listen mode (also called Mode L). This mode may need a few seconds to phase or acquire synchronization with the other stations.

Your ability to successfully synchronize with the master station depends upon operating conditions, such as noise and interference.

If the linked stations that you are monitoring experience ARQ errors and retries, your monitor will display all of the retries.

Type ALIST (or AL) repeatedly if you lose synchronization.

AM AMTOR *Immediate Command*

Mode: Command

AMTOR is an immediate command that switches your Controller into the AMTOR mode. The Controller is automatically placed in an ARQ Standby condition.

Your station is then available for automatic access by and response to any AMTOR station that sends your SELCAL.

Your monitor will now display any inbound FEC (Mode B) transmissions on the received channel without any additional action on your part.

You must set MYSELCAL before the Controller will allow you to use the AMTOR command.

AR **ARQ aaaa** *Immediate Command*

Mode: AMTOR

Parameter:

aaaa The other station's SELective CALling code.

ARQ is an immediate command that starts an AMTOR Mode A (ARQ) SELCAL (SELective CALl) to another station.

Example: ARQ NNML

The SELCAL started by the ARQ command is the proper way to respond to another station's Mode B (FEC) CQ call.

To begin the Mode A (ARQ) selective call, type "ARQ" followed by the other station's four-character SELCAL.

The other station's SELCAL code is normally seen as part of the his/her CQ call sequence.

As soon you type a <CR>, the Controller will begin keying your transmitter in the three-character AMTOR ARQ burst sequence. If the other station receives and decodes your selective call successfully, the two AMTOR systems synchronize and begin the Mode A (ARQ) AMTOR "handshaking" process.

NOTE: See "SELCAL" for information on the derivation and structure of the selective calling code.

You do not have to type the SELCAL a second time if you intend to call the same station again right away.

ARQT **ARQTMO** *Default: 90*

Mode: AMTOR

Parameter:

"n" 0 to 250 specifies the number of seconds to send an ARQ SELCAL before automatic transmitter shutdown.

ARQTMO sets the length of time during which your ARQ SELCAL call will be sent (how long your station will call another station before the transmitter automatically turns off). In general, if you cannot activate another station within the 90 second default time, you can assume that the other station cannot copy your transmission.

AS ASCII *Immediate Command*

Mode: Command

ASCII is an immediate command that switches your Controller into the ASCII RTTY mode.

ASCII is the proper mode to use if you wish to use RTTY to transmit text, data or other information that contains lowercase and special characters not present in the Baudot/ Murray and ITA #2 telegraph alphabets or character sets.

Because the ASCII character set requires a minimum of seven bits to define the identity of each transmitted or received character, under worst-case conditions ASCII is sometimes more subject to data errors and garbled text than Baudot/ITA#2 at the same data rate.

ASP ASPECT "n" *Default:* 2

Mode: FAX

Parameter:

"n" 1 to 6 specifies the number of FAX lines the Controller prints out of every 6 lines received.

ASPECT controls the aspect ratio, which is the ratio of the length to the width of a FAX image. On most weather charts, the ASPECT default value of 2 keeps the received shapes in the right proportion. On some other transmissions, you may want more vertical resolution. To stretch the image down the page, increase the value of "n" to 4.

The Index of Cooperation (IOC) is an international measure of the aspect ratio as shown by the following equation:

$$\frac{(\text{vertical scan line density}) \times (\text{horizontal width})}{3.14159}$$

The IEEE Index of Cooperation is expressed by:

(vertical scan line density) x (horizontal width)

The following chart shows the relationship between the acceptable values of ASPECT and their corresponding IOCs for standard printer carriage widths (PRTYPE is even), assuming a vertical dot density of 72 dpi:

ASPECT	CCITT IOC	USED FOR
1	1152	
2	576	Weather charts
3	384	Wirephotos
4	288	WEFAX satellite
5	230	
6	192	

Weather charts are transmitted at a nominal CCITT IOC of 576. ASPECT 2 is close enough to this IOC that the charts print with no noticeable distortion.

The following chart shows the same relationship for wide printer carriages (PRTYPE is odd):

ASPECT	CCITT IOC	USED FOR
1	1728	
2	864	
3	576	Weather charts
4	432	
5	346	Wirephotos
6	288	WEFAX satellite

In receive, ASPECT 2 causes the Controller to sample two out of every six lines that are received, while ASPECT 4 makes it sample four out of every six lines.

In transmit, ASPECT 2 causes the Controller to send every line three times, while ASPECT 4 causes it to send even lines twice and odd lines once. When you send an image from one Model HK-232 to another, we recommend that both units set ASPECT to the same number. Setting ASPECT to 1, 2, 3, or 6 will provide symmetrical repetition patterns. Other settings may cause the receiving unit to miss lines, and double lines it does receive.

NOTE: High settings of ASPECT, such as 6, may generate data too often for your printer to handle.

AW AWLEN "n" *Default: 8*

Mode: All

Parameter:

"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.

NOTE: Set AWLEN to 7 for most packet operations, such as conversation, bulletin board operation, and transmission of ASCII files.

If eight-bit words are sent to the Controller 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.

NOTE: Set AWLEN to 8 and use the Transparent Mode.

You can also use the Converse Mode and set AWLEN to 8 and 8BITCONV ON. You must, however, precede the Converse Mode special characters with the PASS character in the data you send.

A AX25L2V2 ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON The Controller uses AX.25 Level 2 Version 2.0 protocol.

OFF The Controller uses AX.25 Level 2 Version 1.0 protocol.

Some implementations of the earlier version of AX.25 protocol will not properly digipeat Version 2.0 AX.25 packets. This command exists to provide compatibility with these other TNCs until their software has been updated.

For best results during this transition period, set AX25L2V2 OFF.

After your local area TNCs have been updated to the newer protocol version, set AX25L2V2 ON.

AXD AXDELAY "n" *Default: 0 (00 msec.)*

Mode: Packet

Parameter:

"n" 0 to 180 specifies a key-up delay for voice repeater operation in ten-millisecond intervals.

AXDELAY specifies the period of time the Controller will wait, in addition to the normal delay set by TXDELAY, after keying the transmitter and before data is sent.

Packet groups using a standard "voice" repeater to extend the range of the local area network may need to use this feature.

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 use a repeater that has not previously been used for packet operations, 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.

AXH **AXHANG "n"** *Default: 0 (000 msec.)*

Mode: Packet

Parameter:

"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 Controller has heard a packet sent within the hang period, it does not add the repeater key-up delay (AXDELAY) to the keyup time.

If you use a repeater that has not previously been used for packet operations, 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.

BA **BAUDOT** *Immediate Command*

Mode: Command

BAUDOT is an immediate command that switches your Controller into the Baudot RTTY mode.

Baudot operation is still the most common form of RTTY operation in use around the world, and is the basis of the worldwide telex network and most radio press and weather services.

The Baudot/Murray and ITA#2 character sets do not contain lowercase and special punctuation formatting and control characters found in the ASCII character set.

Since the Baudot/ITA#2 code requires only five information bits to define the identity of each transmitted or received character, under worst-case conditions, Baudot RTTY will generally suffer fewer errors than ASCII code at the same data rate.

B BEACON EVERY/AFTER "n" *Default: EVERY 0*

Mode: Packet

Parameters:

EVERY	Send the beacon at regular intervals.
AFTER	Send the beacon once after the specified time interval of no packet activity.
"n"	0 to 250 specifies beacon timing in 10-second intervals.
0 (zero)	Turns off the beacon.

The BEACON command sets the conditions under which your packet beacon will be transmitted.

NOTES:

1. A beacon frame contains the text that you have typed into the BTEXT message in a packet addressed to "CQ" or other UNPROTO address.

2. A beacon frame may be sent directly, or 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 **with no** packet activity.

NOTE: The beacon is sent only once until further activity is detected.

You can use this mode to send announcements or test messages only when packet stations are on the air.

NOTE: Proper choice of "n" avoids cluttering a busy channel with lots of unnecessary transmissions.

You can monitor beacon frames from other packet stations by setting MONITOR in the range 1-6.

NOTE: If you set the BEACON timing at less than "90", a value judged by many authoritative sources as too small for busy channels, you will see the message:

WARNING: BEACON too often

The warning message appears in the Command Mode each time a new command is typed.

BI BITINV "n" *Default: $00*

Mode: Baudot RTTY

Parameter:

"n" $00 to $1F, or 0 to 31, determines the bit pattern that is exculsive-ORed with every received Baudot character.

Some commercial stations use bit inversion to prevent the casual listener from reading the content of some Baudot transmissions. Usually either 2 or 3 bits of each 5-bit Baudot character are inverted to produce the appearance of an encrypted transmission. Try different BITINV settings on an unknown signal after you have determined the baud rate and signal class.

BITINV $00 refers to no inversion at all. This is the plain text setting.

Use BITINV UP (BI U) to increase the value of BITINV by 1, or use BITINV DOWN (BI D) to decrease the value of BITINV by 1. This is especially useful when you are trying various combinations RBAUD, RXREV, and BITINV to decode an unknown Baudot signal.

BK BKONDEL ON/OFF *Default: ON*

Mode: All

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 the Command or Converse Modes.

The <BACKSPACE><SPACE><BACKSPACE> sequence updates the video display screen.

NOTE: 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 overtyped text.

NOTE: Set BKONDEL OFF if you have a paper-output display, or if your terminal does not respond to the <BACKSPACE> character <CTRL-H>.

The Controller displays a <BACKSLASH> for each character you delete. You can get a display of the corrected input by typing the redisplay- line character that you can set with the REDISPLAY command.

BT **BTEXT text** *Default: Empty (Null String)*

Mode: Packet

Parameter:

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).

NOTE: 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. To insert <CR>, type the PASS character before the <CR>.

NOTE: 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

A packet bulletin board (PBBS) program may set the beacon text to a message like this, updating the text after each connection:

MAIL for: WB9FLW AD7I K9NG N7ML W2JUP WB2MNF WA7MBL W0RLI WA7GXD

NOTE: Use a "%", "&", "N", "NO", "NONE", or OFF as the first characters in the text to clear the BTEXT text without issuing the RESET command.

Although the subject of beacons is controversial in packet circles, the following four suggestions will help you use the feature intelligently and benefit the packet community:

1. Do not type your call sign in BTEXT. The normal packet header shows it for you.
2. Do not fill your BTEXT with screen graphics such as asterisks, parentheses, colons and semicolons, etc. Use BTEXT for some significant information.
3. Do not use BTEXT to tell the world that your "DIGIPEAT IS ON" and "BUFFER SAVE TO DISK IS ENABLED". Put this information in your CTEXT message so that it is seen by any station that connects to you – the only one who can make use of the information.
4. After you have beaconed for a week or two and the packet community has learned who and where you are, follow the practice used by more experienced packeteers: SET BEACON EVERY 0!

CAL **CALIBRATE** *Immediate Command*

Mode: Command

CALIBRATE is an immediate command that starts the modem calibration routine.

The Controller provides a continuous on-screen display of AFSK generator tone frequencies in Hertz. The frequency is displayed in vertical "scroll" fashion approximately twice per second, with the circuit component number of the control that is associated with that tone.

You can check the calibration at any time without altering the state of the existing link. The time-of-day clock (DAYTIME), however, will not advance until you quit the calibration routine.

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.
H	Toggles the transmitted audio tones between wide shift (1200 Hz) and narrow shift (200 Hz).

Calibration of the modem tones and adjustment of the Controller's tone output levels for proper transmitter modulation are described earlier in this Manual.

NOTE: Set "D" OFF to transmit a continuous mark or space tone.

CAN **CANLINE "n"** *Default: $18 <CTRL-X>*

Mode: Packet

Parameter:

"n" 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

CANLINE changes the CANCEL-LINE input editing command character.

The parameter "n" is the ASCII code for the character you want to use to cancel an input line.

The following examples show how to enter the code in hex and decimal:

CANLINE $15 (hex)

CANLINE 21 (decimal)

Either method sets the cancel-line character to <CTRL- U>.

When you use the CANLINE character to cancel an input line in the Command Mode, the line is terminated with a <BACKSLASH> character and new prompt (cmd:) appears.

When you cancel a line in the Converse Mode, only the <BACKSLASH> and a new line appear.

NOTES:

1. You can cancel only the line you are currently typing.

2. Once you type a <CR>, you cannot use the cancel-line character to cancel an input line.

3. Use the CANPAC character to cancel the entire packet.

4. If your send-packet character is not <CR>, the cancel-line character cancels only the last line of a multi-line packet.

Like all other input editing features, line cancellation is disabled in the Transparent Mode.

CANP **CANPAC "n"** *Default: $19 <CTRL-Y>*

Mode: Packet

Parameter:

"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.

NOTE: You can enter the code in either hex or decimal.

When you cancel a packet in the Converse Mode, the line is terminated with a <BACKSLASH> character and a new line.

NOTE: You can only cancel the packet that you are currently entering.

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 the Transparent Mode.

The CANCEL-PACKET character also cancels the display output in the Command Mode. If the Controller is in the Command Mode and you type the CANCEL-PACKET character, any characters that would be typed on the screen (except those echoed) are "discarded" by the Controller.

NOTES:

1. Typing the cancel-output character a second time restores normal output.

2. To see how this works, type DISPLAY followed by a <CTRL-Y>.

The command list display will stop and you will not see any response from the Controller 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 Controller to generate large amounts of output to the terminal, such as entering the DISPLAY command or setting TRACE ON.

NOTE: If the Controller is in the Converse or Transparent Mode and you want to cancel display output, you must exit to the Command Mode before you type the CANCEL-PACKET character.

CAS CASEDISP "N" *Default 0 (as is)*

Mode: Packet

Parameters:

"n" 0 to 2 specifies the way your Controller sends to your terminal.

CASEDISP allows you to set the case of the characters your Controller sends to your terminal.

CASEDISP offers three possible modes:

CASEDISP 0 "As is" — characters are not changed.

CASEDISP 1 "Lower" — characters are displayed only in lowercase.

CASEDISP 2 "Upper" — characters are displayed only in uppercase.

CASEDISP does not effect your transmitted data.

CB CBELL ON/OFF *Default: OFF*

Mode: Packet

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.

NOTES:

1. Set CBELL ON if you want to be notified audibly whenever someone connects to your station.

2. 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 the Controller is in the Packet Mode.

CC CCITT ON/OFF *Default: ON*

Mode: Baudot RTTY

Parameters:

ON Characters typed on the keyboard or loaded from disk files are translated into CCITT International Telegraph Alphabet #2 before they are sent.

OFF Characters sent to the Controller are not translated into CCITT ITA #2, but remain in the American standard Baudot format (typically Western Union).

NOTE: CCITT is useful only if CODE is set 0:

CODE	CCITT	MEANING
0	ON	ITA #2
0	OFF	US teleprinter
1	X	US teleprinter
2	X	Cyrillic
3	X	Transliterated Cyrillic

Your computer or terminal will probably send a full ASCII character set to the Controller. Although there is no absolute standard, the following keyboard is typical of the IBM PC and compatibles.

LOWERCASE SET	UPPERCASE SET
1234567890-=	!@#$%^&*()_+
qwertyuiop[]	QWERTYUIOP{}
asdfghjkl;'	ASDFGHJKL:"
zxcvbnm,./	ZXCVBNM<>?

If you set CCITT OFF, the Controller transmits the following character set in the Baudot Mode (see the "Important Note" which follows):

LOWERCASE	SET UPPERCASE SET
1234567890-	!#$&()
QWERTYUIOP	QWERTYUIOP
ASDFGHJKL;'	ASDFGHJKL:"
ZXCVBNM,./	ZXCVBNM,.?

If you set CCITT ON, the Controller sends the International Telegraph Alphabet #2 character set in the Baudot and AMTOR modes:

LOWERCASE SET	UPPERCASE SET
1234567890-=	???????()?+
QWERTYUIOP??	QWERTYUIOP?
ASDFGHJKL?'	ASDFGHJKL:?
ZXCVBNM,./	ZXCVBNM,.?

IMPORTANT NOTE: FCC Part 97.69(b)(1) calls for the use of International Telegraph Alphabet Number 2 (commonly known as Baudot), which uses a single channel, five-unit (start-stop) teleprinter code and all letters and numerals (including the slant sign or fraction bar), etc. The characters "$", "#", and "&" are NOT permitted in **international** Baudot RTTY, and are specifically prohibited in international telex traffic.

CF CFROM all, none, yes/no call1[,call2..] *Default: all*

Mode: Packet

Parameter:

call All, none, YES list, NO list. The list can contain up to eight call signs, separated by commas.

CFROM uses arguments to determine how your Controller responds to connect requests (which calls are accepted and which calls are rejected). CFROM is set to "all" when you turn your Controller on for the first time.

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 entire or the abbreviated command form as shown below:

```
cmd:cfrom
CFROM all

cmd:cf
CFROM yes WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

To reject all call requests, type CFROM NONE. This will cause your Controller to send the calling station a DM packet, or "busy signal." The caller sees the following:

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

Your Controller notifies you of these call requests with:

```
*** Connect request: WX1AAA
```

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 specified as "-n" after the call sign. If CFROM is set to "no W2JUP" or "yes W2JUP", any combination W2JUP, W2JUP-1, ...W2JUP-15 will be matched and processed. If CFROM is set to "yes W2JUP-1" or "no W2JUP-1", then only W2JUP-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 a "%", "&", or "OFF" as the argument.

CHC CHCALL ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON Call sign of the other station **IS** displayed in multiple connection operation.

OFF Call sign of the other 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 you are operating with multiple connections. Using CHCALL is similar to using MRPT to show digipeat paths when you are monitoring the channel.

Examples:

1. When CHCALL is OFF, the monitored activity looks like this:

:0hi howie
hello ted how goes it?
:1* CONNECTED to WA7GXD**
:1must be a dx record. ge lyle
:01UNreal ted! fl-az no digis!
:1big band opening...ge

2. When CHCALL is ON, the same activity looks like the following. The additional information shown as a result of setting CHCALL ON is underlined.

:0: <u>K4NTA</u>: hi howie
hello ted how goes it?
:1: <u>WA7GXD</u>: * CONNECTED to WA7GXD**
:1must be a dx record. ge lyle
:01unreal ted! fl-az no digis!
:1: <u>WA7GXD</u>: big band opening...ge

With CHCALL ON, ":1" becomes ":1:<call sign>:"

NOTE: To switch channels during your multiconnect conversations, type CHSWITCH characters ":0" and ":1" without a ":" after them.

CHD CHDOUBLE ON/OFF *Default: OFF*

Mode: Packet

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.

NOTE: Set CHDOUBLE ON when you operate with multiple connections so you can tell the difference between CHSWITCH characters received from other stations and CHSWITCH characters generated by your Controller.

NOTE: CHSWITCH characters **must not** be one of the channel numbers (0 to 9).

CH CHECK "n" *Default: 30 (300 msec.)*

Mode: Packet

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 upon the setting of AX25L2V2.

Without the CHECK feature, if your Controller was linked or "connected" to another station and the other station seemed to "disappear", your Controller 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 other station are connected "via" that digipeater.

Your Controller tries to prevent this sort of "lockup" from occurring by sending a **new connect request** packet when the specified time elapses without any packets being received from the other TNC.

If a pre-Version 2 link is inactive for CHECK times ten seconds, your Controller tries to save the link by starting a **reconnect sequence**. The Controller enters the "connect in progress" state and sends SABM (Connect Request) frames. In addition, the Controller adds a random time of up to 30 seconds each time CHECK is used.

NOTE: If AX25L2V2 is ON and packets have not been received from the other station for "n" times 10 seconds, your Controller 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 other station's TNC to see if it is still connected. If the other station's TNC is still connected, it sends an appropriate response packet.

If your Controller initiates the "check" and does not obtain an answer after RETRY+1 attempts, your Controller starts a reconnect sequence just as if you had typed the CONNECT command.

NOTE: If AX25L2V2 is OFF and the other station has not been received for "n" times 10 seconds, your Controller does not test the link to the other station. Instead, your Controller sends a reconnect packet just as if you had typed the CONNECT command.

CHS CHSWITCH "n" *Default: $00*

Mode: Packet

Parameter:

"n" 0 to $FF (0 to 255 decimal) specifies an ASCII character code.

CHSWITCH selects the characters used by both the Controller 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.

NOTES:

1. You cannot change the outgoing channel while the Controller is active or "online" in the TRANSPARENT mode.
2. To switch channels, ESCAPE to the Command Mode. Then enter the Converse Mode to use the CHSWITCH command.
3. If you use your Controller as the TNC for a PBBS (Packet Bulletin Board System), change the CHSWITCH character to $00 to avoid possible conflict or problems with characters that are frequently found in packet network maps.

Refer to CHDOUBLE and CHCALL for further use of CHSWITCH.

CM CMDTIME "n" *Default: 10 (1000 msec.)*

Mode: Packet

Parameter:

"n" 0 to 250 specifies timeout value in 100-millisecond intervals while the Controller is in the Transparent Mode.

If "n" is 0 (zero), you will have to send the BREAK signal or interrupt power to the Controller to exit from the Transparent Mode.

CMDTIME sets the timeout value in the Transparent Mode. A guard time of "n" seconds allows escape to the Command Mode from the Transparent Mode, while permitting any character to be sent as data.

The same Command Mode entry character (default <CTRL-C>) that is used to exit from the Converse Mode is also used to exit the Transparent Mode, although the procedure is different.

NOTES:

1. The Command Mode entry character is set by COMMAND.

2. 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 you typed.

3. After a final delay of "n" seconds, the Controller exits the Transparent Mode and enters the Command Mode.

4. You will then see the normal Command Mode prompt:

   cmd:

The following diagram illustrates this timing:

```
last        first          second         third                    HK-232
terminal    command        command        command                  now in
input       mode           mode           mode                     Command
|           entry          entry          entry                    Mode
|           character      character      character                   |
|           |              |              |                           |
|           |              |              |                           |
|<-- longer ---->| <-- shorter ----->| <---- shorter ---->| <--------------- n ---------------->|
    than "n"        than "n"              than "n"
```

CMS CMSG ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON The recorded CTEXT message is sent as the first packet after a connection is established by a connect request from another station.

OFF The text message is not sent at all.

CMSG enables or disables automatic transmission of the CTEXT message when your Controller accepts a connect request from another station.

NOTES:

1. Set CMSG ON to tell callers that you are not available to answer calls manually when they connect to your Controller.

2. Set CMSG OFF when you are available to operate or answer calls manually.

COD CODE "n" *Default: 0 (International)*

Modes: Morse, Baudot RTTY, and AMTOR

Parameters:

"n" 0 to 5 set the type of alphabet.

Your Controller can receive Japanese Katakana Morse, Cyrillic (Russian) Morse, and Baudot codes. The CODE command allows you to set the alphabet.

You can receive, but not transmit some of the alphabets that are accessible by the CODE command. The following table shows you which alphabets you can receive and transmit for each of the operating modes. RX indicates receive and TX indicates transmit. If RX or TX is missing, the Controller uses CODE 0 (International) instead of the indicated code.

CODE	MEANING	MORSE	BAUDOT	AMTOR
0	International	RX/TX	RX/TX	RX/TX
1	US teleprinter	-	RX/TX	-
2	Cyrillic	RX	RX	RX
3	Transliterated Cyrillic	RX	RX	RX
4	Katakana	RX/TX	-	-
5	Transliterated Katakana	RX	-	-

CODE 0: International

In the Morse Mode, this refers to the International or Continental Morse Code. For Baudot and AMTOR, this refers to the ITA #2 teleprinter code, which is internationally recommended for Baudot and TOR communications.

CODE 1: US Teleprinter

This code has no effect in the Morse Mode; the Controller will use the International Morse Code (not American Morse). Code 1 also has no effect in the AMTOR Mode; the Controller will still use ITA #2. In Baudot, the Controller will use the US teleprinter code. The differences between ITA, the #2, and the teleprinter codes, are:

CHARACTER	ITA #2	US
FIGS-D	WRU	$
FIGS-H		#
FIGS-J	Bell	'
FIGS-S	'	Bell
FIGS-V	=	;
FIGS-Z	+	"

CODE 2: Cyrillic

This code causes a translation to an artificially extended version of ASCII, so that all received characters are converted to single ASCII characters. The extended characters are:

ASCII	ENGLISH PRONUNCIATION
$40 @	E (RTTY only)
$5B[	YA
$5C \	CH (Morse only)
$5D]	YU
$5E ^	SH

In Morse, the four characters that are displayed as double characters in International, are shown as single ASCII in Cyrillic:

CHARACTER	CODE 0	CODE 2
. - . -	aa	$5B [
- - - .	oe	$5C \
. . - -	ue	$5D]
- - - -	ch	$5E ^

In Baudot and AMTOR, Russian transmitters use a third register to transmit Cyrillic characters in addition to LTRS and FIGS. They use LTRS to transmit the Roman alphabet. As the LTRS and FIGS characters are used to access the first and second registers, they use the BLK and NUL character (00) to access the third register. The Controller displays third-register characters as if they were in the LTRS case, and all FIGS characters, as in Code 0, with the following exceptions:

CHARACTER	CODE 2	ENGLISH PRONUNCIATION
FIGS-G	$5E ^	SH
FIGS-H	$51 Q	SHCH
FIGS-F	$40 @	E
FIGS-J	$5D]	YU
3rd-Q	$5B [	YA

If you note that several words in a transmission end in "OJ", OW", or "OGO", the transmission is most likely in Russian.

There is no separate Baudot combination for the CH character. The Russians use a "4" because the Cyrillic character for CH resembles a "4". You must determine the actual intended character from the context.

You can safely leave CODE set to 2 if you are not sure which alphabet the transmitting station is using. You will be able to see the message in either alphabet with minimal garbling, and you can then set CODE to either 0 or 3.

CODE 3: Transliterated Cyrillic

This Code is similar to CODE 2, except that some characters are transliterated into English phonetic equivalents for easier reading.

CODE 2	CODE 3	
W	V	
V	ZH	
H	KH	
C	TS	
\	CH	(Morse only)
^	SH	
Q	SHCH	
X	'	
@	E	(RTTY only)
]	YU	
[	YA	

CODE 4: Katakana

Katakana is the phonetic character set that is used in Japan for spelling out words of foreign (to Japan) origin. The Japanese also use Katakana for Morse and some computer communication. There are about 50 Katakana characters. CODE 4 translates the Katakana Morse Code into an 8-bit extended version of ASCII. The characters displayed generally range between $A0 and $DF, except for numerals and punctuation.

If you use CODE 4, be sure to set AWLEN to 8, PARITY to 0, and 8BITCONV to ON.

CODE 5: Transliterated Katakana

This Code is similar to CODE 4, except that the extended ASCII is transliterated into English equivalents for easier reading. the Morse characters are translated into 2- and 3-letter syllables.

COM COMMAND "n" *Default $03 <CTRL-C>*

Mode: All

Parameter:

"n" 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

COMMAND us used to change the Command Mode entry character. You can enter the code in either hex or decimal.

Type the COMMAND character to enter the Command Mode from the Converse Mode. You will not see a response if you type the Command Mode entry character while the Controller is already in the Command Mode.

To enter the Converse Mode type: CONVERSE

Now, all characters typed on the keyboard and characters sent from a disk or tape file are transmitted as packet data.

To return to the Command Mode, type <CTRL-C>. The Command Mode prompt appears to indicate a successful exit to the Command Mode. The display might look like this:

```
cmd:CONVERSE
Hello World! I'm on the air on packet radio! [type <CTRL-C>]
cmd:
```

Refer to CMDTIME or the discussion of the Transparent Mode for instructions about the Command Mode entry character that is required to escape from the Transparent Mode.

CONM CONMODE CONVERS/TRANS *Default: CONVERS*

Mode: Packet

Parameters:

CONVERSE Your Controller automatically enters the **Converse Mode** when a connection is established.

TRANS Your Controller automatically enters the **Transparent Mode** when a connection is established.

CONMODE selects the mode your Controller uses after entering the CONNECTED state.

The connection may result either from a connect request received from another station, or a connection initiated by a CONNECT command that you have typed.

NOTES:

1. Set CONMODE to CONVERS for most packet operations.
2. Set CONMODE to TRANS if you are using the Transparent Mode for a bulletin board program, so that the correct mode will be entered when your bulletin board receives a connect request.
3. If the Controller is already in the Converse or Transparent Mode when the connection is completed, the mode will not be changed.

C CONNECT call1 [VIA call2[,call3...,call9]] *Immediate Command*

Mode: Packet

Parameters:

call1 Call sign of the other station to which you wish to be connected.

call2 Optional call sign(s) of up to eight digipeaters via which you want to be repeated to reach the other station.

CONNECT sends a connect request to station "call1," directly or via one or more digipeaters. Each call sign can include an optional SSID "n", immediately after the call sign.

The part of the command line shown below in brackets is optional. The double-bracketed text ",call3...,call9" is also optional and is used only when "VIA call2" is used, that is, when you are connecting through one or more digipeaters. (The brackets and quotation marks are used in this text only for clarity. Do not type them!)

VIA call2[, call3...,call9]

NOTE: Type the digipeater fields in the exact sequence you wish to use to route your packets to the destination station "call1."

If you type CONNECT while your Controller is already connected, or trying to connect to or disconnect from another station, your monitor will display:

Link state is: CONNECT in progress

If the other station does not "ack" your connect request after the number of tries specified by RETRY, the CONNECT command is canceled and your monitor displays:

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

To connect directly to WX1AAA, you would type:

CONNECT WX1AAA (or C WX1AAA)

To connect to WX1AAA using WX2BBB (with whom you can easily connect) and WX3CCC (who is near AAA) as digipeaters, type:

CONNECT WX1AAA VIA WX2BBB,WX3CCC

Type CONNECT or "C" without arguments to see the link status and the number of unacknowledged, outstanding packets.

CONP CONPERM ON/OFF *Default: OFF*

Mode: Packet

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 it is ON, CONPERM forces the Controller to maintain the current connection, even when frames to the other station exceed RETRY attempts for an acknowledgment. RESTART and power off/on cycling do not affect this connected state.

CONPERM works only when a connection is established. It 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 it is used under conditions such as:

Certain networking applications.

Meteor scatter.

Other noisy, less reliable links.

CONPERM ON may be advantageous when you use full-duplex continuous mail forwarding or traffic links.

CONS CONSTAMP ON/OFF *Default: OFF*

Mode: Packet

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 Controller's internal clock) is set, date and time information generated in the Controller is available for bulletin board 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 Controller, a connect and disconnect sequence appears as follows:

```
cmd:connect w2jup
cmd:10:55:23 *** CONNECTED to W2JUP
cmd:disconnect
cmd:10:55:59 *** DISCONNECTED: W2JUP
```

The CONNECT and DISCONNECT command can be abbreviated as shown below. The results are identical.

```
cmd:c w2jup
cmd:10:56:22 *** CONNECTED to W2JUP
cmd:d
cmd:10:56:32 *** DISCONNECTED: W2JUP
```

CONV or K **CONVERSE** *Immediate Command*

Mode: All

CONVERSE is an immediate command that causes the Controller to change from the Command Mode to the Converse Mode.

NOTE: Link connections in packet or AMTOR modes are not affected.

In the packet AMTOR modes, once the Controller is in the Converse Mode, all characters typed from the keyboard or sent from a disk file are processed and transmitted by your radio.

NOTE: To return the Controller to the Command Mode from the Converse Mode, type the Command Mode entry character (default is <CTRL-C>).

CP **CPACTIME ON/OFF** *Default: OFF*

Mode: Packet

Parameters:

ON Packet transmit timer **IS** used in the Converse Mode.

OFF Packet transmit timer **IS NOT** used in the Converse Mode.

CPACTIME activates automatic, periodic transmission of packets while the Controller is in the Converse Mode.

CPACTIME may be used for several types of computer communications such as bulletin board or host computer operation when you do not want the full Transparent Mode features.

NOTES:

1. When CPACTIME is ON, characters are packetized and transmitted periodically like they are in the Transparent Mode. Local keyboard editing and display features of the Converse Mode are available; software flow control can be used.

2. Refer to the PACTIME command, (which controls the rate and mode of packet assembly) for a discussion of how periodic packetizing works.

3. 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.

4. To include <CR> characters in transmitted packets, set SENDPAC to a character not normally used (e.g., <CTRL-P>); the Controller then treats a <CR> as an ordinary character.

5. Set CPACTIME ON for a mode of 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; long delays are eliminated while long packets are being typed.

CRA CRADD ON/OFF *Default: OFF*

Mode: Baudot RTTY

Parameters:

ON Send <CR CR LF> in Baudot RTTY.

OFF Send <CR LF> in Baudot RTTY.

The CRADD command permits you to set the Controller's "newline" sequence so that an additional carriage return is automatically ADDed at the end of each typed line. When CRADD is set ON, the line-end sequence is <CR><CR><LF>. When CRADD is set to OFF, the line-end sequence is <CR><LF>. The double carriage return is required in some RTTY services, including MARS operation.

CRADD has no effect on received data.

CS CSTATUS *Immediate Command*

Mode: Packet

CSTATUS is an immediate command that is used during multiple connections. When you type CSTATUS, your monitor displays:

The number of each logical channel.

The link state of all ten logical channels.

The current input/output channel - the one you are using.

Whether each channel connection is "permanent." (Refer to CONPERM.)

Depending upon your use of multiple connections and the USERS command, CSTATUS will display the following:

NOT CONNECTED TO ANY STATION		CONNECTED TO ONLY 1 STATION	
cmd:cs		cmd:cs	
Ch. 0 - IO	DISCONNECTED	Ch. 0 - IO	CONNECTED to WX1AAA
Ch. 1 -	DISCONNECTED	Ch. 1 -	DISCONNECTED
Ch. 2 -	DISCONNECT	Ch. 2 -	DISCONNECTED
Ch. 3 -	DISCONNECTED	Ch. 3 -	DISCONNECTED
Ch. 4 -	DISCONNECTED	Ch. 4 -	DISCONNECTED
Ch. 5 -	DISCONNECTED	Ch. 5 -	DISCONNECTED
Ch. 6 -	DISCONNECTED	Ch. 6 -	DISCONNECTED
Ch. 7 -	DISCONNECTED	Ch. 7 -	DISCONNECTED
Ch. 8 -	DISCONNECTED	Ch. 8 -	DISCONNECTED
Ch. 9 -	DISCONNECTED	Ch. 9 -	DISCONNECTED

If you are connected to several stations, the CSTATUS command shows your connect status as follows:

CONNECTED TO SEVERAL STATIONS	
cmd:cs	
Ch. 0 - IO	CONNECTED to WX1AAA
Ch. 1 -	CONNECTED to WX2BBB P
Ch. 2 -	CONNECTED to WX3CCC
Ch. 3 -	CONNECTED to WX4DDD
Ch. 4 -	CONNECT in progress
Ch. 5 -	DISCONNECTED
Ch. 6 -	DISCONNECTED
Ch. 7 -	CONNECTED to WX5EEE via WX6FFF
Ch. 8 -	DISCONNECTED
Ch. 9 -	DISCONNECTED

This sample display shows that:

CHANNEL 0 has the input and output channels - you are using it!

CHANNEL 1 is connected to WX2BBB "permanently."

All other channels' states are shown as they might appear with multiple connections.

CT **CTEXT text** *Default: See sample*

Mode: Packet

Parameter:

text Any combination of characters and spaces up to a maximum of 120 characters.

CTEXT is the "automatic answer" text you type into a special section in the Controller's memory.

The default text says: **"Heathkit HK-232 Auto Answer - -
Please leave a message, then disconnect."**

If CMSG is set to 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 (refer to the PASS command).

A typical CTEXT message might be:

"I'm not available right now <CTRL-V> <CR>
Please leave your message, then disconnect <CR>

NOTE: If you enter a text string longer than 120 characters, the following 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.

CW CWID "n" *Default: $06 (<CTRL-F>)*

Modes: Baudot or ASCII RTTY, and AMTOR

The CWID command lets you change the "send CWID" control character that you type at the end of your Baudot and ASCII RTTY keyboard dialogue, or text file stored on disk.

When the Controller reads this specific character embedded at the end of the text or keyboard input, it switches to the Morse Mode and sends your call sign, in Morse code, at the keying speed set by the MSPEED command.

As soon as your call sign has been sent in Morse, the Controller turns off your transmitter and returns to Baudot or ASCII RTTY receive in the Command Mode.

Type "CWID" (or just "CW") to display the current value of the CWID command:

```
cmd:cwid            cmd:cw
CWID $06 CTRL-F     CWID $06 CTRL-F
cmd:                cmd:
```

Type "CWID" followed by either the decimal or hexadecimal value of the new character you wish to use as the CWID trigger command.

```
cmd:cwid 27
CWID was $06 CTRL-F
cmd:
```

Type "CWID or "CW" again to verify the new command character:

```
cmd:cwid
CWID $1B CTRL-[
```

You can type the following to return to the original or default value at any time:

```
cmd:cwid $06
CWID was $1B CTRL-[
```

You can also use the command "CWID ON" or "CWID OFF" to activate or deactivate the function. In either case, your Controller responds with the previous state:

```
cmd:cwid on
CWID was $00
```

DA DAYTIME date & time *Default: not set*

Modes: All

Parameters:

date&time Current DATE and TIME to set.

DAYTIME sets the Controller's internal clock current date and time. The date&time parameter is used in the 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 Controller time updates continuously, as long as power is applied.

The clock is not set when the Controller is first turned on, and the DAYTIME command will display the following error message:

```
cmd:day
?clock not set
```

NOTE: You must reset date and time each time you turn on the Controller. Otherwise CONSTAMP and MSTAMP will not "stamp" the time.

If you type DAYTIME without a parameter, the Controller displays current date and time information. The format of the display is:

```
dd-mm-yy hh:mm:ss
cmd:day
DAYTIME 09-Mar-87 06:57:33
```

The format for entering the date&time is:

```
yymmddhhmm
cmd:daytime 8703090659
```

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; all codes must be exactly two digits. Delimiters such as <SPACE>, "/", ":", and ";" can be used. The Controller will echo the new setting to confirm a successful entry.

Pay particular attention to the month when you set the date. The Controller does not check for the correct number of days in a month.

DAYS DAYSTAMP ON/OFF *Default: OFF*

Modes: All

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.

DC DCDCONN ON/OFF *Default: OFF*

Mode: Packet and AMTOR

Parameters:

ON RS-232 cable pin 8 follows the state of the CON LED.

OFF RS-232 cable pin 8 is permanently set high (active).

DCDCONN defines the way the DCD (Data Carrier Detect) signal affects pin 8 in the RS-232 interface to your computer or terminal.

Some applications programs require the DCD signal on pin 8 to follow the Controller's connect status.

WA7ML's Version 3.12 PBBS program, for example, does not work properly with your computer unless DCDCONN is set to ON.

Set DCDCONN ON to emulate the DCD interface in the TAPR TNC-2, AEA PK-80, and equivalent TNC/DCE systems.

DEL DELETE ON/OFF *Default: OFF*

Modes: All

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 Controller indicates deletion.

To see a corrected display of the current line after deleting characters, type the redisplay-line character, which is set by the REDISPLAY command.

DF DFROM all, none, yes/no call1[,call2..] *Default: all*

Mode: Packet

Parameter:

call All, none, YES list, NO list. The list can contain up to eight call signs, separated by commas.

DFROM uses arguments to determine how your Controller 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 apply power to your Controller for the first time.

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 the mnemonic:

cmd:dfrom
DFROM all
cmd:df
DFROM yes WX1AAA,WX2BBB,WX3CCC,WX4DDD

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 digpeated** only from stations whose call signs are listed.

To prevent one or more specific stations to digipeat through your station, type DFROM NO (followed by a list of call signs). Packets **will not be digipeated** only from stations whose call signs are listed.

You can include optional SSIDs specified as "-n" after the call sign. If DFROM is set to "no NK6K" or "yes NK6K", any combination NK6K, NK6K-1,...NK6K-15 will be matched and processed. If DFROM is set to "yes NK6K-1" or "no NK6K-1", then **only** NK6K-1 will match and be processed.

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

DIG DIGIPEAT ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON Works the same way as DFROM ALL (digipeats normally).
OFF Works the same way as DFROM NONE (does not digipeat).

This command allows you to use your Controller with BBS systems that were written for TAPR-type TNCs. The DFROM command must not contain any callsigns in its list.

D DISCONNECT *Immediate Command*

Mode: Packet

DISCONNECT is an immediate command that initiates a disconnect request to the other 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.

NOTES:

1. If the retry count is exceeded while you are waiting for the other station to acknowledge your disconnect command, your Controller automatically switches to the disconnected state.

2. If another disconnect command is entered while your Controller 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 your Controller is in the Transparent Mode.

DISP **DISPLAY [class]** *Immediate Command*

Mode: Command

Parameters:

class Optional parameter identifier, one of the following:

(A)sync	display asynchronous port parameters.
(C)haracter	display special characters.
(F)ax	display FAX parameters.
(I)d	display ID parameters.
(L)ink	display link parameters.
(M)onitor	display monitor parameters.
(R)tty	display Baudot/ASCII RTTY, AMTOR, and Morse parameters.
(T)iming	display timing parameters.
(Z)	display the entire command/parameter list.

DISPLAY is an immediate command.

If you type DISPLAY **without** a parameter, the Controller responds with:

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

You can type the letter "DISP Z" to display all of the system parameters, or you can type DISP with one of the other optional parameter identifiers to display a subgroup of related parameters as shown below:

```
cmd: disp a
8BITCONV OFF
ACRDISP 80
ALFDISP OFF
AWLEN 7
ECHO ON
ESCAPE OFF
FLOW ON
LCOK ON
NUCR OFF
NULF OFF
NULLS 0
PARITY 3
TRFLOW OFF
TXFLOW OFF
XFLOW ON
cmd:
```

You can display individual system parameter values by entering the parameter name without options.

cmd: mycall	cmd: frack	cmd: dwait	cmd: mys
MYCALL WX1AAA	FRACK 3	DWAIT 16	MYSELCAL WJUP

DW **DWAIT "n"** *Default: 16 (160 msec.)*

Mode: Packet

Parameter:

"n" 0 to 250 specifies default wait time in ten-millisecond intervals.

DWAIT helps avoid collisions with digipeated packets.

Unless the Controller is waiting to transmit digipeated packets, DWAIT forces it to pause after last receiving 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 upon 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 msec)	DWAIT VALUE
Digipeaters	0	0
Local keyboards	160	16 (default)
PBBSs, Hosts	320	32
File transfers	480	48

EAS **EAS ON/OFF** *Default: OFF*

Modes: Baudot/ASCII RTTY, AMTOR, and Morse

Parameters:

ON Display characters as actually sent on the air by the Controller.

OFF Display characters as sent to the Controller by the computer.

The ECHO-AS-SENT (EAS) command functions in all modes **except** packet. EAS permits you to choose the type of data displayed on your monitor screen or printer.

To display your typing exactly as you are typing the keyboard characters or sending from a disk file, set EAS "OFF."

To see the actual data being sent from your Controller to your radio and transmitted on the air, set EAS "ON."

EAS is convenient when you operate Morse and Baudot RTTY. These modes do not use lowercase characters. You can operate in a relaxed and normal manner, typing entirely in lowercase if that is easier for you. Your Controller translates your lowercase typing into uppercase Morse or Baudot/CCITT characters.

When EAS is on, you will see only UPPERCASE characters on your screen, representing the data actually transmitted to the other station.

EAS has special significance in AMTOR Mode A (ARQ). If EAS is on, no matter how fast you type characters on your keyboard, you will see them echoed on your screen only **after** the other station (your partner in the AMTOR link) has validated (Ack'd) your block of three characters.

With EAS ON, the characters will appear on your screen or printer **only** as the other station acknowledges them, three at a time.

If the data scrolls across your monitor at a nice even rate, in rhythm with your typing speed, you can assume that you have a good ARQ link.

If the data hesitates or scrolls in a "jerky" intermittent fashion, that is generally a sign that the radio link is not too good.

If the characters stop appearing on your monitor, the link is failing or has failed.

E ECHO ON/OFF *Default: ON*

Modes: All

Parameters:

ON Characters received from the computer or terminal ARE echoed by the Controller.

OFF Characters ARE NOT echoed.

The ECHO command controls local echoing by the Controller when it is in the Command or Converse Mode. Local echoing is disabled in the 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.

ES **ESCAPE ON/OFF** *Default: OFF*

Modes: All

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 andterminal emulators interpret the <ESCAPE> character as a special command prefix. Such terminals may alter their displays depending upon the characters following the <ESCAPE>.

Set ESCAPE ON if you have such a terminal to avoid unexpected text strings from other packeteers.

Refer to the MFILTER command for information about character stripping (rather than character translation) in monitored packets.

FA **FAX** *Immediate Command*

Mode: Command

Use the FAX command to switch your Controller into the FAX receive mode from any other operating mode.

The Controller starts out in FAX standby and waits to detect sync pulses, which start a frame.

FAXN **FAXNEG ON/OFF** *Default: OFF*

Mode: FAX

Parameters:

ON The white and black senses are reversed.

OFF The white and black senses are normal.

Set FAXNEG to ON when you are receiving an image that is mostly black, such as a satellite photo. This will help save wear and tear on the printer's ribbon and may accentuate features like cloud cover.

NOTE: FAXNEG ON is NOT the same as RXREV ON. RXREV reverses the entire signal, including the sync pulses. FAXNEG retains the sync pulses so that the Controller can recognize them, but reverses the image data.

Some stations transmit an inverted signal. We recommend that you change sidebands when you receive these stations, instead of using RXREV ON. This will cause the white level to have the higher pitch and appear toward the left side of the bargraph.

FE FEC *Immediate Command*

Mode: AMTOR Mode B

FEC is an immediate command that starts an AMTOR FEC (Mode B) transmission. Use FEC for all roundtable contacts.

Use FEC for CQ calls. Other stations **cannot identify you** in an ARQ CQ call.

Use FEC if the desired range is longer than 22,000 miles, such as in "long path" contacts or high-orbit satellite contacts.

Include your SELCAL code in your CQ message so that the other station can call you back in ARQ with your SELCAL. If you want replies only on FEC, (for example, for contacts via a long path), include that information in your CQ call.

Do not start typing right away! Let your Controller begin each transmission with three to five seconds of idling. Under poor conditions, this may help the other station tune in your signal.

Avoid the RTTY practice of transmitting a line of RYRYRY to allow the other station to tune in — this is wrong on FEC. Other stations must receive the automatically-sent idle sync characters from your Controller. Other stations cannot synchronize until the end of the RYRY sequence. The normal FEC idle signal can be used for tuning.

To aid formatting of the other station's screen and printer copy, always start an FEC transmission with a new line sequence by sending a <CR>.

You can signify the end of your FEC transmission by typing the ARQ changeover sign "+?", internationally recognized as the RTTY equivalent of "KKK". In FEC, however, "+?" is **not** a software command. You still have to unkey your transmitter manually as you would in conventional RTTY.

You can terminate your FEC transmission by typing the RCVE (R) command, typing the AMTOR (AM) command, or inserting the RECEIVE command (default <CTRL-D>) character in your typing or disk file.

F FLOW ON/OFF *Default: ON*

Modes: All

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 the output from the Controller to the terminal to stop until any of the following conditions exist:

A packet is forced (in the Converse Mode).

A line is completed (in the Command Mode).

The packet length (See PACLEN) is exceeded.

The terminal output buffer fills up.

Canceling the current command or packet or typing the redisplay-line character also causes output to resume. Type-in flow control is not used in the 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 packet bulletin board programs (PBBS) may work best with FLOW set to OFF.

Some 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.

FR **FRACK "n"** *Default: 3 (3 sec.)*

Mode: Packet

Parameter:

"n" 1 to 15, specifying frame acknowledgment time-out in one-second intervals.

FRACK is the FRame ACKnowledgment time in seconds that your Controller will wait for acknowledgment of the last-sent protocol frame before resending or "retrying" that frame.

After sending a packet requiring acknowledgment, the Controller 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.

FS FSPEED "n" *Default: 2 (lines/sec)*

Mode: FAX

Parameter:

"n"	0 to 4 sets the FAX horizontal scan rate in lines-per-second.

You can determine the scan rate by listening to the signal. Most weather charts are sent at 120 LPM (or 2 lines-per-second). Some Japanese news, however, is sent at 60 LPM (1 line-per-second), and satellite photographs are often sent at 240 LPM (4 lines-per-second).

The meaning of the values of the parameters are:

1	1 line-per-second, or 60 lines-per-minute.
2	2 lines-per-second, or 120 lines-per-minute.
3	3 lines-per-second, or 180 lines-per-minute.
4	4 lines-per-second, or 240 lines-per-minute.
0	1.5 lines-per-second, or 90 lines-per-minute.

FU FULLDUP ON/OFF *Default: OFF*

Modes: All

Parameters:

ON	Full duplex mode is ENABLED.
OFF	Full duplex mode is DISABLED.

When full-duplex mode is disabled, the Controller makes use of the DCD (Data Carrier Detect) signal from its modem to avoid collisions; the Controller acknow-ledges multiple packets in a single transmission with a single acknowledgment.

When full-duplex mode is enabled, the Controller ignores the DCD signal and acknowledges packets individually.

Full-duplex operation is useful for full-duplex radio operation, such as through OSCAR 10. It should not be used unless both your station and the other 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.

The actual density in dots-per-inch depends upon the combination of the GRAPHICS and PRTYPE settings as shown below:

	GRAPHICS						
PRTYPE	0	1	2	3	4	5	6
0—3	60	120	120	240	80	72	90
4—7	60	120	120	240	80	72	90
8—9	60	120	144	200	80	72	100
12—19	136	120	144	160	80	72	96
20—21	60	60	60	60	60	72	100
24—27	60	120	144	240	60	72	.
28—29	60	120	.	.	.	.	.
32—35	60	120	120	240	80	72	90
36	60	60	60	60	60	60	60
40—43	72	144	144	72	72	72	72
48—51	80	160	80	80	80	80	80

For Epson printers (PRTYPE 0—3), not all GRAPHICS settings are implemented on each model:

GRAPHICS:	0	1	2	3	4	5	6
dots/inch:	60	120	120	240	80	72	90
FX-80:	yes	yes	yes	yes	yes	yes	yes
RX-80:	yes	yes	yes	yes	yes	.	yes

For Radio Shack printers (PRTYPE 8 or 9):

GRAPHICS:	0	1	2	3	4	5	6
dots/inch:	60	120	144	200	80	72	100
LP VII:	yes	.	.	.	.	.	.
LP VIII:	yes	.	.	.	.	.	.
DMP-100:	yes	.	.	.	.	.	.
DMP-105:	yes	.	.	.	.	yes	.
DMP-110:	.	yes	.	.	.	.	.
DMP-120:	.	yes	.	yes	.	.	.
DMP-130:	yes	.	.	.	.	.	.
DMP-200:	.	yes	yes	yes	.	.	.
DMP-400:	yes	.	.	.	.	yes	yes
DMP-420:	yes	.	.	.	.	yes	yes
DMP-500:	yes	.	.	.	.	yes	yes
DMP-2100:	yes	.	.	.	.	.	.
CGP-220:	.	.	.	.	yes	.	.

For Okidata printers:

GRAPHICS:	0	1	2	3	4	5	6
dots/inch:	60	120	144	240	60	72	100
Okidata 82A:	yes	.	.	.	yes	.	yes
Okidata 83A:	yes	.	.	.	yes	.	yes
Okidata 92:	yes	.	.	.	yes	yes	.
Okidata 93:	yes	.	.	.	yes	yes	.
Okidata 192:	yes	yes	yes	yes	yes	yes	.
Okidata 192:	yes	yes	yes	yes	yes	yes	.

GR **GRAPHICS "n"** *Default: 1 (120 dots per inch)*

Mode: FAX

Parameter:

"n" 0 to 6 determine the horizontal print density of the parallel printer.

Changing the GRAPHICS setting in the middle of an image will cause the Controller to print a few lines of garbage while it adjusts. One exception is when you change between GRAPHICS 1 and 2. These are smooth changes because they reflect the same number of dots across the paper (960).

GRAPHICS 2 is a special case of double density in which two consecutive black dots cannot be printed, but it is easier on the printer's ribbon.

GRAPHICS 1 provides better resolution.

HB **HBAUD "n"** *Default: 1200 bauds*

Mode: Packet

Parameter:

"n" values specifying the rate or signaling speed in bauds from the Controller 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.

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 other station.

NOTE: Modern commercial and amateur terminology no longer always refer to the speeds or data rates in "WPM". The term "bauds" is now 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.

HEA HEADERLN ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON The header for a monitored packet is printed on a separate line from the packet text.

OFF The header and packet 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:

```
WX1AAA>WX2BBB: 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:

```
WX1AAA>WX2BBB:
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.

HE HELP *Immediate Command*

Mode: Command

While in the Command Mode, type the command "H" to read the abbreviated on-line HELP file.

Your monitor displays the following brief list:

```
cmd:help
HELP:
AMTOR       PACKET      ASCII
ARQ         CONNECT     BAUDOT
ALIST       DISCONNE    MORSE
FEC         MHEARD      DISPLAY
ACHG        CSTATUS     CALIBRAT
FAX         SIGNAL
CONVERSE    TRANS
XMIT        RCVE
RESTART     RESET
TCLEAR
cmd:
```

You can exit from your present operating mode and enter the Command Mode at any time to list the HELP text. This does not affect AMTOR or Packet operation.

HI HID ON/OFF *Default: OFF*

Mode: Packet

Parameter:

ON Your Controller sends HDLC identification as a digipeater.

OFF Your Controller does not send HDLC identification.

The HID command activates or disables your Controller's automatic periodic transmission of identification packets when it is 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 your Controller to send an ID packet every 9.5 minutes when it is being used as a digipeater.

Set HID OFF to stop your Controller from sending any ID packets.

The HID identification packet is addressed to the "CQ" address set by the UNPROTO command.

Your station identification is the call sign you have set with the MYCALL command, with "digipeater" appended.

NOTE: You cannot change the 9.5-minute automatic interval timing.

HOST HOST *Default: OFF*

Modes: All

Parameters:

ON The Controller operates with a host computer or other special application program.

OFF The Controller operates as a normal TNC.

The HOST command permits the Controller to operate in the Host Mode, a "computer-friendly" communications mode, over the link between the Controller and a host computer.

In the Host Mode, the Controller sends data to the computer only when the computer requests data. The data is prefaced with a special header that identifies the type of information being sent.

To cancel HOST mode, send a Break or type <CTRL-A> O H O N <CTRL-W>.

Refer to the Technical Manual for more information about the Host Mode.

HP **HPOLL** *Default: ON*

Modes: All

Parameters:

ON Causes the host to poll for everything.

OFF Causes the Controller to send all blocks to the host computer when they are formed, and the data poll ($4F G G) is not needed.

The HPOLL command determines whether the host computer must constantly poll the Controller.

In communications modes other than packet, received data is formed into blocks, one character at a time, for a total of four bytes per block (SOH, CTL, data, and ETB).

Refer to the Technical Manual for more information about the Host Mode.

I **ID** *Immediate Command*

Mode: Packet

ID is an immediate command that sends a special identification packet. The ID command allows you to send a final identification packet when you are taking your station off the air. Note that HID must be set to ON. ID forces a final identification packet to be sent when a digipeater station is being 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 have 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.

```
W2JUP-9*>ID <UI>        W2JUP-9*>ID <UI>
W2JUP digipeater        BHTC, W2JUP digipeater
```

IL ILFPACK ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON Causes the Controller to ignore all line feed characters it receives from the computer or terminal.

OFF Causes the Controller to transmit all line feed characters it receives from the computer or terminal.

The ILFPACK command allows you to control the way the Control handles line feed characters that it receives from your computer.

This feature is especially useful when you send certain types of computer programs in test form.

IO INPUT/OUTPUT

Mode: Special.

Refer to the Technical Manual for more information about this command.

JU JUSTIFY "n" *Default: 0*

Mode: FAX

Parameter:

"n" 0 to 25 moves the image closer to the edge of the paper by n half inches.

0 to 25 are in half-inch units, or 1/16 of the paper width. LEFTRITE is ON for normal weather charts, so entering a JUSTIFY 1 will move the image 1/2 inch to the left. If LEFTRITE is OFF, JUSTIFY moves the image to the right n half inches.

You will normally want to use JUSTIFY after you have used the L command to manually start printing; the image will almost never be lined up with the edge of the paper. Estimate the number of inches to the left by 2. We recommend that you actually enter a number that is one less than the calculated value to compensate for error. If the image still requires some adjusting, type JUSTIFY 1 until it reaches the edge.

NOTE: Higher JUSTIFY numbers will cause the Controller to take longer to move the image, and more lines of garbage will be printed.

KI **KISS ON/OFF** *Default: OFF*

Mode: Packet.

Parameters:

ON Causes the Controller to operate as a KISS TNC.

OFF Causes the Controller to operate as a normal AX.25 Level 2 TNC.

The KISS TNC protocol allows more efficient use of your Controller with host computers. The Controller converts synchronous HDLC that is used on the half-duplex radio channel to and from a special asynchronous, full-duplex frame format as spoken on the host/Controller link. Each frame that is received on the HDLC link passes intact to the host after it is translated to the asynchronous format. Asynchronous frames from the host are similarly transmitted on the radio channel after they have been converted to the HDLC format.

Normal Controller software was written for use by humans and is not efficient for use by host computers, especially multi-user servers such as bulletin boards. Experimentation with new link-level protocols is greatly hampered because there may be no way to send or receive frames in the desired format without reprogramming the Controller.

The KISS function solves the problems caused by software that is written for use by humans by eliminating much of the Controller software. This gives the host complete control of the contents of the HDLC frames that are sent and received over the air.

AX.25, or other protocols, must be executed in the host computer. Complete details about the KISS TNC protocol are contained in the Technical Manual.

LE **LEFTRITE ON/OFF** *Default: ON*

Mode: FAX

Parameters:

ON The Controller scans the signal from left to right.

OFF The Controller scans the signal from right to left.

If you see an image that is obviously backwards, you can use LEFTRITE TOG to toggle this parameter until the image is correct.

L **LOCK** *Immediate Command*

Mode: Morse, Baudot, FAX, and AMTOR

LOCK is an immediate command that instructs the Controller to measure the speed of received Morse code signals and lock its timing to the speed of the incoming signals. LOCK also forces LETTERS shift in the Baudot and AMTOR modes.

The LOCK command may improve the Controller's ability to decode CW signals in the presence of high noise levels.

During FAX operation, LOCK causes the Controller to start printing regardless of whether or not the facsimile sync pulses have been detected.

LOCK is a manual start command for FAX. Normally, the transmitting station begins a FAX image with sync pulses so that the receiver can line up the image pulses so that the receiver can line up the image with the edge of the paper. These sync pulses consist of lines that are 5% white and 95% black, with the beginning of the white pulse signifying the left edge of the following image. The Controller detects the sync pulses on a good signal and lines up the image accordingly. If you tune in a signal too late, or if there is enough noise to prevent the Controller from detecting the sync pulses, the LOCK command allows you to manually start the printer. Whenever you ussue a LOCK command, you will probably need to use the JUSTIFY command to properly align the image with the paper.

MAR MARSDISP ON/OFF Default: OFF

Modes: Baudot and AMTOR.

Parameters:

ON Changes every LTRS character into a CTRL-O and every FIGS character into a CTRL-N in the receive mode.

OFF Passes the LTRS and FIGS character normally.

The MARSDISP command allows you to store (either on disk or in RAM) Baudot and AMTOR text, including the LETTERS and FIGURES commands for later retransmission.

LETTERS characters are stored as CTRL-O ($0F), and FIGURES characters are stored as CTRL-N ($0E).

MAX MAXFRAME "n" *Default: 4*

Mode: Packet

Parameters:

"n" 1 to 7 signifies a number of packet frames.

MAXFRAME sets an upper limit on the unacknowledged packets your Controller permits on the radio link at any one time. MAXFRAME also sets the maximum number of contiguous packets your Controller 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 upon your local channel conditions. In most cases of keyboard-to-keyboard direct or local operation (links that do not require going through digipeaters), you can use the default value MAXFRAME 4.

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 actually **improve** your throughput by **reducing** MAXFRAME.

If packet traffic is heavy or the path is poor, reduce MAXFRAME to 3 or 2.

If you are sharing the channel with several PBBSs and digipeaters, or when you are working a PBBSs or other types of host computers, reduce MAXFRAME to 1.

If the radio link is good, an optimal relationship exists between the parameters set by these commands, so that the maximum number of characters outstanding does not exceed the receive buffer space of the TNC receiving the data.

Set MAXFRAME to 1 for the best results on HF packet.

MBE MBELL ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON Packet frames are monitored FROM and TO all. If the callsigns in the monitored packet headers match the MFROM and MTO lists, the Controller sends three BELL characters to the terminal.

OFF Packet frames are monitored according to the MFROM and MTO lists.

MBELL ON may be used to alert the operator to the presence of a particular station.

NOTES:

1. To detect when N7ML is present, for example, set MBELL ON, MONITOR 4, MFROM yes N7ML, and MTO none.
2. To detect a beacon or CQ, set MBELL ON, MONITOR 4, MFROM none, and MTO yes CQ,BEACON.
3. To return to normal operation, set MBELL OFF, MONITOR 4, MFROM all, and MTO none.

If MBX is active and MBELL is ON, the Controller may send BELLs even when no data is displayed. This is due to redundant I-frames.

MB MBX call1[,call2][-"n"] *Default: none*

Mode: Packet

Parameters:

call The call signs of one or two stations to be monitored.

"n" 0 to 15, indicating an optional SSID.

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 W1AW-4

or

cmd:MBX W2JUP-4,W2HPM-4

NOTE: In this example, 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:

1. Read or record transmissions from any packet station without any extraneous material.

2. Read or record transmissions from a PBBS (Packet Bulletin Board System) while another station is downloading files or messages.

3. Read or record dialog between two connected packet stations or two PBBSs during mail forwarding operations.

The resulting information is free of all headers, frame identifier codes, repeats, and improperly-sequenced lines. You do not have to edit or manually purge the recorded information.

NOTE: When you use the MBX feature, your station is not part of the protocol handshake between the originating and receiving stations. If your local conditions (such as noise bursts or interfering packets) cause your packets to collide with the data being transferred between two other 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.

Clear MBX with "%", "&", "N", "NO", "NONE", or "OFF" as the argument.

MC MCON "n" *Default: 0 (none)*

Mode: Packet

Parameter:

"n" 0 to 6 signifies various levels of monitor indications.

Use MCON for selective monitoring of other traffic while you are connected to another station.

MCON works in similar fashion to MONITOR, but affects your display while the Controller is in a connected state.

As the value of MCON settings increases, additional functions are included in the monitoring sequences.

If MCON is set to a value between "1" and "5," frames meant for you are displayed as though monitoring was OFF. You will see only the data. If MCON is set to "6", frames meant for you are displayed as any other monitored frame. The headers appear together with the data. NOTE: Refer to the MONITOR command for more information about parameter value 6.

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", roundtable type QSO. Other mutually connected stations using the frequency are also 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 acknowledgment (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.

MD MDIGI ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON I and UI frames that have your call sign (MYCALL or MYALIAS) as the next digipeater in the digipeater field are displayed, whether your Controller is 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 better understand the digipeating paths that may involve your station, even when you have been unaware of what is happening on the channel.

Use MDIGI to see why your transmitter is being keyed when you are not actively involved in a communication session, or when your system is more active than you expect. When MDIGI is OFF you will see those frames that include your station as one of the digipeaters, 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.

ME MEMORY

Mode: Special.

Refer to the Technical Manual for more information about the MEMORY command.

MFI MFILTER n1[,n2[,n3[,n4]]] *Default: $80*

Mode: Morse, Baudot, ASCII RTTY, AMTOR, and Packet.

Parameter:

"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.

NOTES:

1. To prevent a <CTRL-L> character from clearing your screen, set MFILTER 12.
2. To eliminate <CTRL-Z> characters, which some computers interpret as end-of-file markers, set MFILTER 26.
3. To eliminate <CTRL-G> characters, which beep your computer or terminal, set MFILTER 7.
4. To eliminate all control characters except CR and LF, set MFILT ER 128.

MF MFROM all, none, yes/no call1[,call2..] *Default: all*

Mode: Packet

Parameter:

Call All, none YES list, NO list. The list can contain up to eight call signs, separated by commas.

MFROM uses arguments to determine how your Controller 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 your Controller 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 WX1AAA,WX2BBB,WX3CCC,WX4DDD
```

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 specified as "-n" after the call sign. If MFROM is set to "no N6IA" or "yes N6IA", any combination N6IA, N6IA-1,...N6IA-15 will be matched and processed. If MFROM is set to "yes N6IA-1" or "no N6IA-1", then only N6IA-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 the argument.

MH MHEARD *Immediate Command*

Mode: Packet

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.

NOTES:

1. Stations that are heard directly are marked with a * in the heard log.

2. Stations that have been repeated by a digipeater are not marked.

3. 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.

4. 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. An actual sample of the MHEARD function with the clock set is shown below:

DAYSTAMP ON

```
cmd:mh
05-Jul-86 21:42:27 WA1FJW
05-Jul-86 21:42:24 WA1IXU*
05-Jul-86 21:32:18 K2AAA-5
05-Jul-86 21:27:57 W2HPM-4*
05-Jul-86 21:26:41 K2AAA-4
05-Jul-86 21:26:38 W2JUP-9
05-Jul-86 21:21:24 KA1EOU*
05-Jul-86 21:21:23 W2JUP-4*
05-Jul-86 21:05:07 KB1H
05-Jul-86 20:56:40 WA1LGQ
05-Jul-86 14:45:57 WA2SNA-1
05-Jul-86 14:45:53 KV1P
05-Jul-86 14:45:47 W6AXM
05-Jul-86 14:28:16 KB2ANH
05-Jul-86 14:23:32 WB2NYC
05-Jul-86 14:23:19 WB2EUL
05-Jul-86 13:55:26 N2FWE
05-Jul-86 13:50:28 W1GB-1*
cmd:
```

DAYSTAMP OFF

```
cmd:mh
21:42:27 WA1FJW
21:42:24 WA1IXU*
21:32:18 K2AAA-5
21:27:57 W2HPM-4*
21:26:41 K2AAA-4
21:26:38 W2JUP-9
21:21:24 KA1EOU*
21:21:23 W2JUP-4*
21:05:07 KB1H
20:56:40 WA1LGQ
14:45:57 WA2SNA-1
14:45:53 KV1P
14:45:47 W6AXM
14:28:16 KB2ANH
14:23:32 WB2NYC
14:23:19 WB2EUL
13:55:26 N2FWE
13:50:28 W1GB-1*
cmd:
```

M MONITOR "n" *Default: 4 (UA DM C D I UI)*

Mode: Packet

Parameter:

"n" 0 to 6 signifies various levels on monitor indications.

As the value of MONITOR settings increases, 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," roundtable-type QSO. Other mutually connected stations using the frequency are not displayed. This setting also displays beacons.

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

4 Unnumbered acknowledgment (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. This parameter value presents you with the most information. The following paragraphs describe this value in detail.

MO MORSE *Immediate Command*

Mode: Command

MORSE is an immediate command that switches your Controller to the Morse code mode.

Unless you change MSPEED, your Controller uses the default Morse transmit speed value of 20 WPM.

When your receive clear text only, use the LOCK command to lock the Controller's Morse receiving speed to the the incoming signals.

MP MPROTO ON/OFF *Default: OFF*

Mode: Packet.

Parameters:

ON Normally monitors all I-frames.

OFF Monitors only those frames with a PID byte of $F0.

MPROTO allows you to filter (remove) the NETROM and TCPIP commands from monitored packets. NETROM sends frames that contain control characters with a PID of $CF.

Normal UI and I packets have the PID byte set to F0. When MPROTO is set to OFF, only the packets are displayed. MPROTO ON, however, displays all packets.

MR MRPT ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON Show digipeaters in the header; stations heard directly are marked with an 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:

W2JUP-4*>W1AW-4 <I;0,3>:

In addition, while MRPT is OFF, the Controller will remove all indications of digipeater paths in connect requests, and all connect and disconnect stamps.

When MRPT is ON, the call signs of all stations in the entire digipeat path are displayed. The call sign of the stations received directly are flagged with an asterisk (*):

W2JUP-4*>WA1IXU>W1AW-5>W1AW-4 <I;0,3>:

NOTE: These actual samples were taken with MONITOR set to 6.

MSP MSPEED "n" *Default: 20 WPM*

Mode: Morse

Parameter:

"n" 5 to 99 signifies your Controller's Morse transmit speed in words-per-minute.

The MSPEED command sets the Morse code keying speed for your Controller.

The slowest available Morse code speed is 5 words per minute. If you set MSPEED to a number less than 5, your Controller will still transmit Morse at 5 WPM.

When you use Morse speeds between 5 and 14 WPM, the transmitted code is sent with Farnsworth spacing. The characters are actually sent at 15 words per minute, but the spacing between characters is lengthened to produce an overall code transmission rate of 5 to 14 WPM.

MS MSTAMP ON/OFF *Default: OFF*

Mode: Packet

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 your Controller'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:

W2JUP-4*>KA2EYW-1>AI2Q <I;2,2>:

When MSTAMP is ON and DAYSTAMP is OFF, the display looks like this:

22:51:33 W2JUP-4*>KA2EYW-1>AI2Q <I;1,7>:

When both MSTAMP and DAYSTAMP are ON, the display looks like this:

10-Jul-86 22:54:25 W2JUP-4*>KA2EYW-1>AI2Q <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.

MT **MTO all, none, yes/no call1[,call2..]** *Default: none*

Mode: Packet

Parameter:

call All, none, YES list, NO list. The list can contain up to eight call signs, separated by commas.

MTO uses arguments to determine how your Controller 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 your Controller 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 the mnemonic:

cmd: mto
MTO all
cmd: mt
MTO yes WX1AAA,WX2BBB,WX3CCC,WX4DDD

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 specified as "-n" after the call sign. If MTO is set to "no WB9FLW" or "yes WB9FLW", any combination WB9FLW, WB9FLW-1,...WB9FLW-15 will be matched and processed. If MTO is set to "yes WB9FLW-1" or "no WB9FLW-1", then only WB9FLW-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 the argument.

MYA MYALIAS call[-n] *Default: none*

Mode: Packet

Parameters:

call Alternate identity of your Controller.

"n" 0 to 15, an optional substation ID (SSID).

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.

MYALT MYALTCAL aaaa *Default: empty*

Mode: AMTOR

Parameter:

aaaa Your alternate SELective CALling code (SELCAL)

Use the MYALTCAL command to specify an your alternate SELCAL which, under certain conditions, may be convenient or necessary.

You can enter an additional SELCAL code not related to your call sign. The alternate SELCAL can be any four alphabetical characters, or can be numeric strings of either four or five characters. Your Controller automatically translates your numeric MYALTCAL input according to CCIR Recommendation 491, Direct- Printing Telegraph in the Maritime Mobile Service.

MYALTCAL is generally used for special applications such as receiving network or group broadcasts in AMTOR Mode B Selective (Bs or SELFEC). The sending station must address all stations by one common SELCAL. Any other type of "all ships and stations" operation using special or group SELCALs can be handled with MYALTCAL.

MY **MYCALL call[-"n"]** *Default: HK232*

Mode: Packet

Parameters:

call **Your** call sign.

"n" 0 to 15, indicating an optional substation ID (SSID).

Use the MYCALL command to load your call sign into your Controller's RAM. Your call sign is inserted automatically in the FROM address field for all packets originated by your Controller. MYCALL is also used for identification packets (see HID and ID).

Your Controller accepts connect request frames with your MYCALL in the TO field and repeats frames with this call sign in the digipeat field.

The "HK232" default call sign is present in your Controller's RAM when the system is manufactured. This "artificial call" **must be changed** for proper operation of the packet and AMTOR protocols.

Two or more stations cannot use the same call sign (including SSID) on the air at the same time.

Use the SSID to distinguish between two stations with the same amateur call.

The SSID will be zero (0) unless explicitly set to another value.

Although there is no standardization of SSIDs at present, most packet 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 packet group or club may use the same call sign for several stations in their network, each node or unit being identified with a different SSID.

As packet networks grow and become more complex, with multiport and gateway systems and frequency translation between bands, SSIDs become especially significant. For example look at the hypothetical case:

```
W2HPM-4>K2AAA-5>W2JUP-1>W2JUP-2>W2JUP-4
145.07     145.07     221.11     221.11     145.07
```

In this example, PBBS (Packet Bulletin Board System) W2HPM-4 is linked to PBBS W2JUP-4 via three digipeaters, each having a distinctive SSID.

NOTE: Your Controller **will not** operate in the Packet Mode until you have inserted your own call sign in place of "HK232."

MYS **MYSELCAL aaaa** *Default: empty*

Mode: AMTOR

Parameters:

aaaa specifies your SELective CALling code (SELCAL)

Use the MYSELCAL command to enter the SELCAL (selective calling) code required in AMTOR ARQ (Mode A) and SELFEC operating modes. MYSELCAL is a unique character string which must contain exactly four alphabetic characters and is normally derived from your call sign. You cannot operate AMTOR unless your SELCAL is installed. The following error message reminds you to enter your SELCAL:

?need MYSELCAL

Some of the call sign groupings now in use:

GROUP	CALL	SELCAL
1 by 2	W1XX	WWXX
1 by 3	W1XXX	WXXX
2 by 1	AB1X	AABX
2 by 2	AB1XX	ABXX
2 by 3	KA1XXX	KXXX

For "1 by 2" call signs, the first letter is doubled; e.g., W1AW becomes WWAW. For most cases this is acceptable. If you become aware, however, that a station in another call district or zone is also active on AMTOR and may be using the same SELCAL, you can derive your own unique SELCAL by substituting a letter for your call district number. Use the letter corresponding to the call district number as it appears on the keys of a standard typewriter or Baudot RTTY keyboard.

Assume that your call sign is N7ML. You discover that there is another station with the call sign N?ML. Change your SELCAL to NUML, according to the following table:

1 = Q	4 = R	7 = U	0 = P
2 = W	5 = T	8 = I	
3 = E	6 = Y	9 = O	

Although the convention is to form the SELCAL from the call sign, your Controller is capable of including any AMTOR character in the SELCAL, including digits 0 through 9. In accordance with CCIR Recommendation 491, four- or five-digit numbers may be entered; the Controller will automatically translate the numeric entry to your four-letter alphabetic SELCAL.

NE **NEWMODE ON/OFF** *Default: ON*

Modes: All

Parameters:

ON The Controller automatically returns to the Command Mode at disconnect.

OFF The Controller does not return to the Command Mode at disconnect.

NEWMODE determines how your Controller behaves when the link is broken.

Your Controller **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, your Controller remains in the Converse or Transparent Mode unless you have forced it to return to the Command Mode.

When NEWMODE is ON and the link is disconnected, or if the connect attempt fails, your Controller returns to the Command Mode.

Bulletin Board or other host computer programs designed to operate with earlier TNC systems may require you to set NEWMODE to OFF.

NO NOMODE ON/OFF *Default: OFF*

Modes: All

Parameters:

ON The Controller switches modes (Command, Converse, Transparent) only upon an explicit command. The NEWMODE function is ignored.

OFF The Controller changes modes according to NEWMODE.

When NOMODE is ON, your Controller never switches from the Converse or Transparent Mode to the Command Mode (or vice versa) by itself. Only specific commands (CONVERSE, TRANS, or <CTRL-C>) typed by you can change the operating mode.

When NOMODE is OFF, your Controller switches modes automatically according to the way NEWMODE is set.

Some applications programs may require NOMODE to be ON. WA7MBL's PBBS Version 3-12 program is one such example.

NU NUCR ON/OFF *Default: OFF*

Modes: All

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 (Teletype 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 your Controller 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.

NOTE: 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.

NUL NULF ON/OFF *Default: OFF*

Modes: All

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 (Teletype 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 your Controller 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>.

NULL NULLS "n" *Default: 0 (zero)*

Modes: All

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.

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. Devices that require nulls after <LF> are typically CRTs that scroll slowly.

The null characters are sent from your Controller to your computer only in the Converse and Command Modes.

OK OK *Immediate Command*

Mode: Signal

The OK command normally follows the SIGNAL command. OK accepts the estimate of the SIGNAL analysis and proceeds to the mode that SIGNAL suggests. It will automatically change the RXREV and RBAUD or ABAUD as necessary. RBAUD and ABAUD are adjusted to the commonly-used value that is closest to the SIGNAL estimate.

OK will display a message similar to:

```
OPMODE was SIGNAL
OPMODE now BAUDOT
```

if the command is successful, or it will display

```
?bad
```

if the SIGNAL estimate does not yield any useful information.

O OPMODE *Immediate Command*

Mode: Command

OPMODE is an immediate command that shows the Controller's current mode of operation and system status.

Use the OPMODE command ("O") at any time while your Controller is in the Command Mode to display the present operating mode. Here are some typical indications:

```
cmd:o
OPMODE      ASCII       RCVE

cmd:op
OPMODE      PACKET

cmd:OP
OPMODE      BAUDOT      SEND
   :           :
OPMODE      MORSE       RCVE  20
```

OPMODE	**ALIST**	**PHAS**	**RCVE**
OPMODE	**FEC**	**IDLE**	**SEND**
OPMODE	**AMTOR**	**STBY**	**RCVE**
OPMODE	**ARQ**	**TFC**	**SEND**
OPMODE	**FAX**	**STBY**	**RCVE**
OPMODE	**FAX**	**SYNC**	**RCVE**
OPMODE	**FAX**	**STBY**	**SEND**
OPMODE	**FAX**	**SYNC**	**SEND**

In FAX receive, STBY indicates that the Controller is searching for sync pulses to start printing the next image. The LOCK command allows you to manually start the image. SYNC indicates that the Controller has detected the sync pulses, or that you used the LOCK command to force synchronization, and the Controller should start printing the next image.

In FAX transmit, STBY indicates that the Controller is idling or sending the 300 Hz motor start tone before it sends the sync pulses, or that it is sending the 450 Hz stop tone. SYNC indicates that the Controller is either sending sync pulses or image dots. If the computer has not yet sent data to the Controller, it will continuously transmit the white tone, and the status will indicate SYNC SEND.

PA PACKET *Immediate Command*

Mode: Command

Use the PACKET command to switch your Controller into the Packet radio mode from any other operating mode. Your Controller automatically enters the Packet Mode at first power-up, or after a RESTART or RESET command.

PACL PACLEN "n" *Default: 128*

Mode: Packet

Parameter:

"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).

Your Controller 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 the 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 if you are transferring files to a nearby station over a high quality path.

Reduce PACLEN to 64, or even 32, when you are 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 does not exceed the receive buffer space of the TNC receiving the data.

NOTE: It is not necessary that two TNCs be set to the same PACLEN value to exchange data; some TNCs, however, may not be compatible when frames contain more than 128 data characters.

PACT PACTIME EVERY/AFTER "n" *Default: AFTER 10 (1000 msec.)*

Mode: Packet

Parameters:

"n" 0 to 250 specifies 100-millisecond intervals.

EVERY Packet timeout occurs every "n" times 100 milliseconds.

AFTER Packet timeout occurs when "n" times 100 milliseconds elapse without input from the computer or terminal.

A PACTIME parameter is always used in the Transparent Mode. PACTIME is also used in the Converse Mode if CPACTIME is ON.

When EVERY is specified, the characters you type or send from disk are packetized and queued for transmission every "n" times 100 milliseconds.

When AFTER is specified, the characters you type or send from disk are packetized 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.

PAR **PARITY "n"** *Default: 0 (none)*

Modes: All

Parameter:

"n" 0 to 3 selects a parity option from the table below.

PARITY sets the Controller'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 the Command and Converse Modes.

In the 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).

PAS **PASS "n"** *Default: $16 <CTRL-V>*

Mode: Packet

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 will use to signal that the character immediately following it is to be included in a packet or text string.

NOTE: You can enter the code in either hex or decimal.

Use the PASS character (default is <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:

BT Notice:<CTRL-V><CTRL-M>
Meeting at the Firehouse tonight <CTRL-V><CTRL-M>
at 8:00 PM. All welcome! <CR>

The other station's monitor shows:

Notice:
Meeting at the Firehouse tonight
at 8:00 PM. All welcome!

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 the Converse Mode to send multi-line packets. (The default send-packet character is <CR>.)

PASSA PASSALL ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON Your Controller will accept packets with **invalid** CRCs.

OFF Your Controller will only accept packets with **valid** CRCs.

PASSALL permits the Controller 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 Controller 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.

NOTE: When PASSALL is ON, logging of stations heard (for display by MHEARD) is disabled; the call signs detected may be incorrect.

PE PERSIST "n" *Default: 127*

Mode: Packet.

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.

"256" Causes the Controller to transmit right away without delay.

The PERSIST command works with the SLOTTIME command to achieve true p-persistent CSMA (Carrier-Sense Multiple Access) in the KISS TNC mode and in AX.25 operation. No real advantage, however, is 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 Controller monitors the DCD (Data Carrier Detect) signal from its internal modem. The Controller waits indefinately for DCD to go inactive.

When the Channel is clear, the Controller generates a random number between 0 and 255. If this number is less than or equal to "P", the Controller keys the radio's PTT line, waits .01 x TXDELAY seconds, and then transmits all frames in its queue. The Controller then unkeys the PTT line and returns to the idle state.

If the random number is greater than "P", the Controller waits .01 x SLOTTIME seconds and repeats the procedure. If the DCD signal has gone active during this wait time, the Controller again waits for DCD to clear before it continues.

The Controller waits an exponentially-distributed random interval, after it senses that the channel is clear, before it tries to transmit. When PERSIST and SLOTTIME are carefully set, several stations sending traffic are much less likely to collide with each other when they simultaneously detect that the channel is clear.

NOTE: P = 255 directs the Controller to transmit as soon as possible, regardless of the random number.

Refer to the Technical Manual for more information about p-persistent operation.

PP PP PERSIST ON/OFF *Default: OFF*

Mode: Packet.

Parameters:

ON The Controller uses PERSIST and SLOTTIME parameters when it executes p-persistent CSMA (Carrier-Sense Multiple Access).

OFF The Controller uses DWAIT for TAPR-type 1-persistent CSMA.

When PPERSIST is set to ON, the Controller uses the PERSIST and SLOTTIME parameters for p-persistent CSMA instead of the normal TAPR-type DWAIT procedure to achieve CSMA operation. PPERSIST may be used in both KISS TNC and normal AX.25 operation.

Also refer to the PERSIST and SLOTTIME commands.

PRC PRCON ON/OFF *Default: OFF*

Mode: FAX

Parameters:

ON A parallel printer is connected to the Controller via a special cable. The mode LEDs are disabled and may stay lit or flash randomly.

OFF A parallel printer is not connected to the Controller, or it is currently not in use. The mode LEDs are enabled and correctly show the operating mode.

When PRCON is ON, the Mode LEDs are disabled. You will have to use the OPMODE command to see the mode.

When PRCON is OFF, the LEDs are functional and indicate the operating mode.

PRF PRFAX ON/OFF *Default: ON*

Mode: FAX

Parameters:

ON FAX bit-graphics are sent to the parallel printer for immediate print-ing, if PRCON is also ON.

OFF FAX bit-graphics are sent to the terminal using Epson-type escape codes, for storage and later retrieval.

PRFAX OFF is useful in cases where the combination of FSPEED, ASPECT, and GRAPHICS settings result in data that is assembled too fast to print directly on a slow printer.

A way to use PRFAX OFF is to set ip for 8-bit operation in the Transparent Mode, to record the binary bit-graphics data to a disk file via the terminal. Set AWLEN 8, PARITY 0, RESTART, and then TRANS. Use TRFLOW ON if you need to. NOTE: Your terminal emulation program may respond to escape codes and filter out characters less than $20 (space).

Another way is to set TRACE ON. This translates each binary character into two hex characters. In this case, you could stay in the command mode and record the hex data into a disk file. Interspersed command prompts, and even the L and R commands, have no effect on the final data. This happens because you would retranslate the hex data back to a binary file, using a program like this one for the IBM:

```
10  INPUT "FILENAME OF HEX INPUT? ";FH$
20  INPUT "FILENAME OF BINARY OUTPUT? ";FB$
30  OPEN FH$ FOR INPUT AS #1
40  OPEN FB$ FOR OUTPUT AS #2
50  IF EOF(1) THEN 999
60  LINE INPUT #1, C$:CL=LEN(C$)
70  GOSUB 300:I=A*16
80  GOSUB 300:PRINT #2,CHR$(I+A);:GOTO 70
300 IF CL=1 THEN A$=C$:CL=0:GOTO 330
310 IF CL=0 THEN LINE INPUT #1,C$:CL=LEN(C$)
320 A$=LEFT$(C$,1):CL=CL-1:C$=RIGHT$(C$,CL)
330 A=ASC(A$)-48:IF A<0 GOTO 300
340 IF A<10 THEN RETURN
350 A=A-7:IF A<10 GOTO 300
360 IF A>15 GOTO 300
370 RETURN
999 CLODE #1:CLOSE #2:END
```

PRO PROUT ON/OFF *Default: OFF*

Mode: Command

Parameters:

ON All text characters, including terminal echoes, are sent to the parallel printer if PRCON is also ON. You can still use keyboard input.

OFF All text data is sent to the terminal through the serial port.

The PROUT command is useful for any text mode when you want to use the terminal or computer for another task. The received data is printed continuously with no need for a terminal to be connected to the Controller.

NOTE: Do not set PRCON ON in the host mode. The data will be in the host format, but it may be illegible on the printer.

PRT PRT PRTYPE "n" *Default: 2*

Mode: FAX

Parameter:

"n" 0 to 255 specifies a code for the type of dot graphics sequences that are used by your printer.

The following codes are presently supported:

PRTYPE	PRINTER	"ENTER GRAPHICS" SEQUENCE
0	Epson	CHR$(27) K n1 n2
4	IBM	CHR$(27) K n1 n2
8	Radio Shack (Tandy)	CHR$(18
12	Apple (G)	CHR$(27) G n n n n
16	Apple (S)	CHR$(27) S n n n n
20	Old Okidata	CHR$(3)
24	Okidata	CHR$(3)
28	Gemini 10, 15	CHR$(27) K n1 n2
32	Star Micronics	CHR$(27) K N1 n2
36	GX-100, Gorilla	CHR$(8)
40	Texas Instruments	CHR$(27) K n1 n2
44	Genicom	CHR$(27) K n1 n2
48	Miscellaneous	CHR$(27) K n1 n2

Note that the above printers are assigned PRTYPE settings inincrements of four. Within each block of four PRTYPE settings, you can add one of the following numbers to the basic PRTYPE number to customize for a particular type of printer:

+0: 7-bit data, standard printer carriage.
+1: 7-bit data, wide printer carriage.
+2: 8-bit data, standard printer carriage.
+3: 8-bit data, wide printer carriage.

As an example, the default value is 2, which is for an Epson, 8-bit data, standard printer carriage printer (n = 0 + 2). Unsupported PRTYPE settings are treated as if they are PRTYPE 0.

Also note that even-numbered PRTYPE codes are for a standard printer carriage widths (8-inch image). To obtain a 13-inch wide image for wider carriages, use an odd-numbered PRTYPE code (for example: an Epson FX-100 would use PRTYPE 3).

Following are some specific "enter graphics" sequences for each type of printer:

PRTYPE 0 — 3, Epson:

Typical graphics code:	<ESC>	'K'	n1	n2
New-line code (7 bits):	<ESC>	'A'	7	LF
New-line code (8 bits):	<ESC>	'A'	8	LF
Printer reset code:	<ESC>	'@'	CR	LF

NOTE: Epson MX-80 with Graftrax-80 uses PRTYPE 40 or 42.

	Dot density		
GRAPHICS	PRTYPE 0,2	PRTYPE 1,3	CODE
0	60 dpi	60 dpi	ESC 'K'
1	120 dpi	120 dpi	ESC 'L'
2	fast 120 dpi	fast 120 dpi	ESC 'Y'
3	240 dpi		ESC 'Z'
4	80 dpi	80 dpi	ESC '*' 4
5	72 dpi	72 dpi	ESC '*' 5
6	90 dpi	90 dpi	ESC '*' 6

NOTE: Not all GRAPHICS settings are implemented on some models of Epson printers.

GRAPHICS:	0	1	2	3	4	5	6
dots/inch:	60	120	120	240	80	72	90
FX-80:	yes	yes	yes	yes	yes	yes	yes
RX-80:	yes	yes	yes	yes	yes		yes

PRTYPE 4 — 7, IBM:

Typical graphics code:	<ESC>	'K'	n1	n2		
New-line code (7 bits):	<ESC>	'A'	7	<ESC>	'2'	LF
New-line code (8 bits):	<ESC>	'A'	8	<ESC>	'2'	LF
Printer reset code:	CR LF					

	Dot density		
GRAPHICS	PRTYPE 4,6	PRTYPE 5,7	CODE
0	60 dpi	60 dpi	ESC 'K'
1	120 dpi	120 dpi	ESC 'L'
2	fast 120 dpi	fast 120 dpi	ESC 'Y'
3	240 dpi		ESC 'Z'
4	80 dpi	80 dpi	ESC '*' 4
5	72 dpi	72 dpi	ESC '*' 5
6	90 dpi	90 dpi	ESC '*' 6

PRTYPE 8 — 9, Radio Shack (Tandy):

Typical graphics code:	<ESC>	19	18	
New-line code:	CR 30			
Printer reset code:	<ESC>	19	CR	LF

The Radio Shack model DMP-130 printer may be used with PRTYPE 4 (IBM) if the following switches are set to ON: 1-1, 1-3, and 1-6. To use PRTYPE 8, set all DIP switches to OFF.

For Radio Shack models DMP-400, -420, and -500, set the DIP switches for DMP-series emulation (note LP-series).

GRAPHICS	Dot density PRTYPE 8	PRTYPE 9	CODE
0	60 dpi	60 dpi	ESC 19
1	120 dpi	120 dpi	ESC 23
2	144 dpi	144 dpi	ESC 19
3	200 dpi		ESC 20
4	80 dpi	80 dpi	ESC 19
5	72 dpi	72 dpi	ESC 23
6	100 dpi	100 dpi	ESC 20

NOTE: The following chart shows that not all densities apply to each printer:

GRAPHICS:	0	1	2	3	4	5	6
dots/inch:	60	120	144	200	80	72	100
LP VII:	yes	.	.	.	.	.	.
LP VIII:	yes	.	.	.	.	.	.
DMP-100:	yes	.	.	.	.	.	.
DMP-105:	yes	.	.	.	.	yes	.
DMP-110:	.	yes	.	.	.	.	.
DMP-120:	.	yes	.	yes	.	.	.
DMP-130:	yes	.	.	.	.	.	.
DMP-200:	.	yes	yes	yes	.	.	.
DMP-400:	yes	.	.	.	.	yes	yes
DMP-420:	yes	.	.	.	.	yes	yes
DMP-2100:	yes	.	.	.	.	.	.
CGP-220:	.	.	.	.	yes	.	.

PRTYPE 12 — 15, Apple (G):

Typical graphics code:	<ESC>	'N'	<ESC>	'G0640'
New-line code (7 bits):	<ESC>	'T14'	LF	CR
New-line code (8-bits):	<ESC>	'T16'	LF	CR
Printer reset code:	<ESC>	'N'	CR	LF

The "G" refers to the graphics escape code being used. Most Apple printers respond to both the Escape-G and Escape-S codes in exactly the same way. For those printers that use only the Escape-S command, use PRTYPE 16 — 19.

NOTE: We know of no Apple printers that have a parallel interface. Either connect the Controller's serial port directly to the Apple printer and turn PRFAX OFF, or use a parallel-to-serial converter.

GRAPHICS	Dot density PRTYPE 12,14	PRTYPE 13,15	CODE
0	136 dpi	136 dpi	ESC 'Q'
1	120 dpi	120 dpi	ESC 'q'
2	144 dpi	144 dpi	ESC 'p'
3	160 dpi		ESC 'P'
4	80 dpi	80 dpi	ESC 'N'
5	72 dpi	72 dpi	ESC 'n'
6	96 dpi	96 dpi	ESC 'E'

PRTYPE 16 — 19, Apple (S):

Typical graphics code:	<ESC>	'N'	<ESC>	'S0640'
New-line code (7-bits):	<ESC>	'T14'	LF	CR
New-line code (8 bits):	<ESC>	'T16'	LF	CR
Printer reset code:	<ESC>	'N'	CR	LF

The "S" refer to the graphics escape code being used. Some printers are mostly compatible with Apple graphics escape codes, except they use the Escape-S sequence, but not the Escape-G sequence. The C. Itoh 1550 and 8510 printers are in this category. Except for the graphics escape sequence, PRTYPE 16 — 19 works exactly the same as PRTYPE 12--15 (Apple G).

PRTYPE 20 — 21, Old Okidata:

Typical graphics code:	30	3		
New-line code:	3	14	3	2
Printer reset code:	24	CR	LF	

NOTE: Okidata 82A and 83A printers must have Okigraph I EPROMS installed.

GRAPHICS:	0	5	6
Code:	30	28	29
Density, dpi:	60	72	100
Okidata ML 82A:	yes	.	yes
Okidata ML 83A:	yes	.	yes
Okidata ML 92:	yes	yes	.
Okidata ML 93:	yes	yes	.

PRTYPE 24 — 27, Okidata:

Typical graphics code:	30	<ESC>	'P'	3
New-line code:	3	14	3	2
Printer reset code:	<ESC>	24	CR	LF

PRTYPE 26 and 27 are for the Okidata models 192 and 193 that have APA graphics selected. In the 7-bit mode, these printers also accept 20, 21, 24, and 25.

PRTYPE 24 and 25 are similar to PRTYPE 20 and 21, except these codes use the ESC-P and ESC-R codes.

In the Okidata models 192 and 193 printer's Menu Select Mode, select "CH SET NORM". For 7-bit data (PRTYPE 24 and 25), select "7/8 BIT" 7 and "APA-7/8" 7. For 8-bit data (PRTYPE 26 and 27), select "7/8 BIT" 8 and "APA-7/8" 8. In addition, "APA-UNI" Y gives better print quality.

	Dot density		
GRAPHICS	PRTYPE 26,28	PRTYPE 25,27	CODE
0	60 dpi	60 dpi	30 ESC 'P'
1	120 dpi	120 dpi	30 ESC 'R'
2	144 dpi	144 dpi	28 ESC 'R'
3	240 dpi		ESC '*' $71 $58
5	72 dpi	72 dpi	28 ESC 'P'

NOTE: When you switch from GRAPHICS 3 to some other GRAPHICS setting, type "R" to stop the image and reset the printer, change GRAPHICS, and then type "L" to start the image again. If you do not want to lose sync, just change the GRAPHICS setting, turn the printer off, and then turn it back on.

PRTYPE 28 — 29, Star Gemini:

Typical graphics code:	<ESC>	'K'	n1	n2
New-line code:	<ESC>	'1'		
Printer reset code:	<ESC>	'@'	CR	LF

PRTYPE 28 and 29 are for the older Star Gemini 10 and 15. The Gemini 10X and 15X use PRTYPE 32 and 33. The Star Micronics SG-10 and SG-15 use PRTYPE 4—7 (IBM) or 32—33 (Star).

PRTYPE 32 — 35, Star Micronics:

Typical graphics code:	<ESC>	'K'	n1	n2
New-line code (7 bits):	<ESC>	'J'	14	CR
New-line code (8 bits):	<ESC>	'J'	16	CR
Printer reset code:	<ESC>	'@'	CR	LF

This set of PRTYPE codes is used for various printers that are manufactured by Star Micronics, including the following:

Delta 10, 15
Radix 10, 15
Gemini 10X, 15X
SD-10, SD-15 in Star Mode
SG-10, SG-15 in Star Mode
SR-10, SR-15 in Star Mode

The following Star printers use other PRTYPE settings:

Gemini 10, 15	PRTYPE 28—29
SB-10	PRTYPE 0—3?
SD-10, SD-15 in IBM Mode	PRTYPE 4—7
SG-10, SG-15 in IBM Mode	PRTYPE 4—7
SR-10, SR-15 in IBM Mode	PRTYPE 4—7
NB-15 in 9-wire emulation mode	PRTYPE 4—7
Gemini 10XPC, 15XPC	PRTYPE 4—7
Delta 10PC, 15PC	PRTYPE 4—7

Radix 10PC, 15PC	PRTYPE 4—7
Gemini 10X Plus, 15X Plus	PRTYPE 0—3
Delta 10 Plus, 15 Plus	PRTYPE 0—3
Radix 10 Plus, 15 Plus	PRTYPE 0—3
NL-10, NL-15 w/ std. cartridge	PRTYPE 0—3
NL-10, NL-15 w/ IBM cartridge	PRTYPE 4—7

GRAPHICS	Dot density: PRTYPE 26,28	PRTYPE 25,27	CODE
0	60 dpi	60 dpi	ESC 'K'
1	120 dpi	120 dpi	ESC 'L'
2	fast 120 dpi	fast 120 dpi	ESC 'y'
3	240 dpi	240 dpi	ESC 'z'
4	80 dpi	80 dpi	ESC 'g' 4
5	72 dpi	72 dpi	ESC 'g' 5
6	90 dpi	90 dpi	ESC 'g' 6

PRTYPE 36, GX-100/Gorilla:

Typical graphics code:	8	<ESC>	16	0	0
New-line code:	LF	15			
Printer reset code:	16	'00'	LF		

PRTYPE 36 includes the Commodore 1525, Leading Edge Gorilla Banana, Seikosha GX-100, and C. Itoh GX-100

GRAPHICS	DOT DENSITY	CODE
0	60 dpi	8 ESC 16 0 0

These printers have a vertical dot density of 63 dpi, which changes the aspect ratio as follows:

ASPECT	CCITT IOC
1	963
2	481
3	321
4	241
5	193
6	160

PRTYPE 40 — 43, Texas Instruments:

Typical graphics code:	<ESC>	'K'	n1	n2
New-line code (7 bits):	<ESC>	'A'	7	LF
NEW-line code (8 bits):	<ESC>	'A'	8	LF
Printer reset code:	<ESC>	'@'	CR	LF

Texas Instruments 850 and 855 in the DP Mode.
Epson MX-80 with Graftrax-80 (GRAPHICS 0—2 only).

GRAPHICS	DOT DENSITY	CODE
0	60 dpi	ESC 'K'
1	120 dpi	ESC 'L'
2	fast 120 dpi	ESC 'J'
5	72 dpi	ESC 'N'
6	144 dpi	ESC 'O'

PRTYPE 44 — 47, Genicom:

Typical graphics code:	<ESC>	'K'	n1	n2		
New-line code (7 bits):	<ESC>	'A'	7	<ESC>	'2'	LF
New-line code (8 bits):	<ESC>	'A'	8	<ESC>	'2'	LF
Printer reset code:	CR LF					

Genicom 3310 and 3320 in the IBM-GP Mode.

GRAPHICS	DOT DENSITY	CODE
0	72 dpi	ESC 'K'
1	144 dpi	ESC 'L'
2	fast 144 dpi	ESC 'Y'

PRTYPE 48 — 51, Miscellaneous:

Typical graphics code:	<ESC>	'K'	n1	n2
New-line code (7 bits):	<ESC>	'A'	7	LF
New-line code (8 bits):	<ESC>	'A'	8	LF
Printer reset code:	<ESC>	'@'	CR	LF

BMC BX-80, Blue Chip 120/10, Mannesmann Tally Spirit 80.

	Dot density		
GRAPHICS	PRTYPE 48,50	PRTYPE 49,51	CODE
0	80 dpi	80 dpi	ESC 'K'
1	160 dpi	160 dpi	ESC 'L'

Refer to "Appendix J" for information about many different kinds of printers.

RB RBAUD "n" *Default: 45 bauds (60 WPM)*

Mode: Baudot RTTY

Parameter:

"n" Specifies the rate or signaling speed in bauds from the Controller to the radio.

RBAUD sets the radio baud ("on-air") rate only in the Baudot/CCITT International Telegraph Alphabet #2 operating mode. This value has **no relation-ship** to your computer or terminal program's baud rate.

Baudot RTTY operation requires you to use the same data rate used by the other station.

Available Baudot/CCITT ITA#2 data rates include 45, 50, 57, 75, 100, 110, 150, 200, and 300 bauds (60, 66, 75, 100, 132, 145, 198, 264, and 396 WPM).

Example: RBAUD 75

Use RBAUD UP (RB U) to go to the next highest Baudot speed or RBAUD DOWN (RB D) to go to the next lowest Baudot speed. This is especially useful when you are trying various combinations of RBAUD and RXREV to decode an unknown Baudot signal.

NOTE: Modern commercial and amateur radio operations no longer always refer to the operating speeds or data rates in "WPM." The term "bauds" is now accepted for FSK and AFSK operations using monobit data. The terms "bauds" and "bits per second" mean the same thing and may be used interchangeably.

R RCVE *Immediate Command*

Mode: Command

RCVE is an immediate command, used in the Command Mode, to switch your Controller from transmit to receive when you operate Baudot and ASCII RTTY.

<CTRL-D> returns the Controller to the receive mode, without the necessity of first entering the Command Mode. During FAX operation, <CTRL-D> sends the stop signal before the Controller returns to the receive mode. This stops the receiving stations' printer.

<CTRL-F> is the same as <CTRL-D>, except it sends your SW ID before the Controller returns to the receive mode.

In the FAX mode, this command turns off FAX reception manually, or goes to receive from transmit.

Normally, the transmitting station ends the FAX image by alternating the black and white tones at 450 Hz for a few seconds. The Controller detects these tones and adds two line feeds to separate the consecutive images before it stops the printer. Under noisy conditions, the Controller may not detect the stop dignal. If this happens, it will also miss the following sync pulses, and the next image will be mis-framed. Use the R command to manually stop the FAX reception if it looks like the Controller missed the stop.

Once the FAX image has stopped (FAX STBY), the Controller waits for the next sync pulse to start the image.

You can also push the Controller's Power switch to OFF and then ON again to manually turn off FAX reception. This process restarts the Controller. The Controller is still in the FAX mode, but always in FAX Standby. This method is useful if you are using your computer or terminal for some other task and cannot issue commands.

During transmit, the R command ends the image transmission without sending the 450 Hz stop tone.

REC **RECEIVE "n"** *Default: $04 <CTRL-D>*

Modes: Baudot, ASCI, Morse, and AMTOR.

Parameter:

"n" 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

The RECEIVE command allows you to insert a control character (default <CTRL-D>) in your typed text or disk file; when this is read by your Controller, your system is switched from transmit to receive and returns to the Command Mode.

Type the RECEIVE Command character at the end of your text or message while recording a disk file or on-the-air typing into the Controller's transmit buffer.

RED **REDISPLA "n"** *Default: $12 <CTRL-R>*

Modes: All

Parameter:

"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 you will use when you want to redisplay the current input line.

NOTE: You can enter the code in either hex or decimal.

Type the REDISPLA character to redisplay a line you have just typed. The following things will happen:

1. Type-in flow control is temporarily turned off (if it had been active). Any incoming packets that are pending are displayed.

2. A <BACKSLASH> is appended to the line you just typed and the line is shown below it. Only the final form of the line is shown if you have deleted or changed any characters.

3. You can now continue typing where you left off.

Use the redisplay-line character to see a "clean" copy of your input if you are using a printing terminal and you have deleted characters.

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.

Use the REDISPLA character if a packet is received while you are typing a message in Converse Mode. You can see the incoming message before you send your packet without canceling your input.

REL **RELINK ON/OFF** *Default: OFF*

Mode: Packet.

Parameters:

ON Causes the Controller to try to automatically reconnect to another station after the link has timed out on retries.

OFF The Controller will not try to re-establish a failed link.

Set RELINK to OFF when you use your Controller with host computer applications, computer-based message systems, and programs like WA7MBL's Version 3.12 Packet Bulletin Board (PBBS) software.

RESET **RESET** *Immediate Command*

Mode: Command

RESET is an immediate command that resets all parameters to the Controller's PROM default settings and reinitializes the Controller.

WARNING: All parameter customizing and monitor lists are lost.

To reinitialize the Controller using the parameter values in bbRAM, turn the Controller OFF then ON, or use the RESTART command.

RES **RESPTIME "n"** *Default: 10 (1000 msec.)*

Mode: Packet

Parameter:

"n" 0 to 250 specifies 100-millisecond intervals.

RESPTIME **adds** a minimum delay before your Controller sends acknowledg-ment 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.

These collisions can be avoided if the receiving TNC sets RESPTIME to 10.

RESTART RESTART *Immediate Command*

Mode: Command

RESTART is an immediate command that reinitializes the Controller using the defaults stored in the it's bbRAM.

The effect of the RESTART command is the same as turning the Controller OFF, then ON again.

RESTART **does not** reset the parameter values in bbRAM.

Also refer to the RESET command.

RE RETRY "n" *Default: 10*

Mode: Packet

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.

The time between retries is specified by the command FRACK. A value of 0 for "n" specifies an infinite number of retries. Also refer to the FRACK command.

The Controller enters the disconnected state if the number of retries is exceeded.

If your Controller is not in the Transparent Mode, the following message is displayed:

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

RF RFEC ON/OFF *Default: On*

Mode: AMTOR.

Parameters:

ON Mode B (FEC) signals are displayed during AMTOR standby.

OFF Mode B (FEC) signals are not displayed during AMTOR standby.

Use the RFEC command to prevent reception and display of all FEC signals that are received during AMTOR standby.

RXR **RXREV ON/OFF** *Default: OFF*

Modes: Baudot and ASCII RTTY, and AMTOR.

Parameters:

ON Received data polarity is reversed (mark-space reversal).

OFF Received data polarity is normal.

Use the RXREV Command to invert the polarity of the data demodulated from the received mark and space tones.

In some cases, you may be trying to copy a station that is transmitting "upside down" but receiving your signals correctly.

Set RXREV ON to reverse the data sense of received signals.

Type RXREV TOG (RXR T) to "toggle" the polarity of received signals. This is useful when you are trying various combinations of RBAUD and RXREV to decode an unknown Baudot signal.

SEL **SELFEC aaaa** *Default: empty*

Mode: AMTOR FEC

Parameter:

aaaa Specifies your SELective CALling code (SELCAL).

The SELFEC command starts a SELective FEC (Mode B) transmission to a specific station when you enter that station's SELCAL (selective calling) code.

The SELFEC command must be a unique character sequence that contains four alphabetic characters. It is normally derived from the call sign of the other station.

Refer to MYSELCAL for further information on the derivation and use of SELCALs.

To end your SELFEC transmission, return to the Command Mode by typing <CTRL-C> (default value) and then typing "R" to switch back to receive mode.

You do not have to type the SELCAL a second time if you intend to call the same station again right away.

SE **SENDPAC "n"** *Default: $0D <CTRL-M>*

Mode: Packet

Parameter:

"n" 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

Use the SENDPAC command to select the character used to force a packet to be sent in the Converse Mode. The parameter "n" is the numeric ASCII code for the character you want to use to force your input to be packetized and queued for transmission. You can enter the code in either hexadecimal or decimal numbers.

Use default SENDPAC value $0D for ordinary conversation with CR ON to send packets at natural intervals with <CRs> included in the packet.

When you are setting CPACTIME ON, set SENDPAC to some value not ordinarily used (say, <CTRL-A>), with CR OFF). This setting forces packets to be sent without extra <CR> characters being sent in the text.

SI SIGNAL *Immediate Command*

Modes: Baudot and ASCII RTTY, AMTOR, and Packet.

This command begins a signal analysis routine for an unknown radio teleprinter signal.

To use this feature, be sure the Controller is in the Command Mode. Then type SIGNAL followed by a <RETURN>. The screen will show the previous operating mode:

OPMODE was BAUDOT
OPMODE now SIGNAL

About 10 seconds after you enter the SIGNAL command, the screen will display something similar to:

0.47: 50 baud

which consists of a confidence factor of between 0.10 and 0.99 and an estimate of the signal's baud rate. After another short wait (less than 25 seconds), the class of the signal will be displayed:

0.47: 50 Baud, Baudot, RXREV OFF

This shows the operating mode and the state of the signal inversion parameter that is needed to decode the signal. This routine runs repeatedly until you change the operating mode.

Some other possibilities for the signal analysis display are:

noise
6-bit
ASCII
AMTOR
ALIST
RXREV ON
synchronous

If you tune to a different signal during an analysis, you can reinitialize the analysis for the new signal by simply typing SIGNAL again.

Also refer to the OK command.

SL **SLOTTIME "n"** *Default: 10(100 msec.)*

Mode: Packet.

Parameter:

"n" 0 to 250 specifies the time interval during which the Controller waits between generating random numbers to see if it can trnasmit.

The SLOTTIME command works with the PERSIST command to achieve true p-persistent CSMA (Carrier-Sense Multiple Access) in KISS TNC and normal AX.25 operation. No real advantage, however, is obtained during AX.25 operation unless other stations on the channel also use PERSIST and SLOTTIME.

SQ **SQUELCH ON/OFF** *Default: OFF*

Mode: Packet

Parameters:

ON Your Controller responds to positive-going squelch voltage.

OFF Your Controller responds to negative-going squelch voltage.

Normally, to determine if the channel is clear so that it can transmit, your Controller uses its CSMA (Carrier Sense Multiple Access) circuit by sensing audio mark and space tones from your packet receiver.

If there are nonpacket signals on the channel you are using (such as voice operation), it is possible that your Controller might not be quite as polite as it is normally and double with the other signals.

The Controller 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. Since your carrier-sensing signal can be active-low or active-high (depending on the individual radio manufacturer's design), you can set your Controller to sense either positive or negative squelch voltages.

SRX **SRXALL** *Immediate Command*

Mode: AMTOR

Parameters:

ON Receives ALL selective (SELFEC) transmissions.

OFF Receives only SELCAL-addressed SELFEC transmissions.

SRXALL permits the reception of selectively-coded inverse FEC signals normally not available for decoding.

Set SRXALL ON to activate this feature.

STA START "n" *Default: $11 <CTRL-Q>*

Modes: All

Parameter:

"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 Controller to the terminal after you have halted it by typing the User Stop character.

NOTES:

1. The User Stop character is set by the STOP command.
2. You can enter the value in either hex or decimal.

If the User Start and User Stop characters are set to $00, software flow control to the Controller is disabled; the Controller will only respond to hardware flow control (CTS).

If the same character is used for both the User Start and User Stop characters, the Controller alternately starts and stops transmission on receipt of the character ("toggles").

STO STOP "n" *Default: $13 <CTRL-S>*

Modes: All

Parameter:

"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 Controller to the terminal. Type this character to halt the Controller's output to your monitor so that you can read the received text before it scrolls off your screen display.

NOTES:

1. Output is restarted with the User Start character.
2. The User Start character is set by the START command.
3. You can enter the value in either hex or decimal.

If the User Start and User Stop characters are set to $00, software flow control to the Controller is disabled; it will only respond to hardware flow control (CTS).

If the same character is used for both the User Start and User Stop characters, the Controller alternately starts and stops transmission upon receipt of the character ("toggles").

TB **TBAUD "n"** *Default: 1200 bauds*

Modes: All

Parameter:

"n" Specifies the rate or signaling speed, in bauds, on the serial I/O terminal port.

TBAUD displays the baud rate set by the auto-baud routine when you first apply power to the Controller, or after you type "RESET".

Use TBAUD to select terminal rates not covered by the autobaud routine, such as 110 and 600 bauds.

Use TBAUD to specify a terminal baud rate that will become active at the next power-up 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.** Then, turn off the Controller, change the terminal, and turn the Controller on again.

TC **TCLEAR** *Immediate Command*

Mode: Command

The TCLEAR command clears your Controller's transmit buffer and cancels any further transmission of data in the Baudot, ASCII, AMTOR or Morse operating modes. In the Packet Mode, all data is cleared except for a few remaining packets.

The Controller **must** be in the Command Mode to use TCLEAR.

Use the <CTRL-C> (default) command to return to the Command Mode.

Type "TC" to clear the transmit buffer.

TI **TIME** *Default: $14 <CTRL-T>*

Modes: All

Parameter:

"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.

Type <CTRL-T> to embed the TIME command in your message text or file.

At transmit time, the Controller reads the embedded control code (default <CTRL-T>), reads the time-of-day from the it'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, BTEXT, or AAB.

TRAC TRACE ON/OFF *Default: OFF*

Mode: Packet

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 when you use the mnemonic - do not use "TRA"! TRA causes the Controller to change to the Transparent Mode!

The TRACE display is shown as it appears on an 80-column display. The following monitored frame is a sample:

```
W2JUP*>TESTER <UI>:
This is a test message packet.

Byte  Hex                                 Shifted ASCII      ASCII

000:  A88AA6A8 8AA460AE 6494AAA0 406103F0 TESTER0W2JUP 0.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:

1. The call sign address field is displayed correctly in the ASCII column.

2. A text message is displayed correctly in the ASCII column.

3. Nonprinting 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 byte and the control bytes used by the protocol.

TR TRANS *Immediate Command*

Mode: Packet

TRANS is an immediate command that switches the Controller from the Command Mode to the Transparent Mode. The current state of the radio link is not affected.

The Transparent Mode is primarily useful for computer communications. In the Transparent Mode, "human interface" features such as input editing, echoing of input characters, and type-in flow control are disabled.

Use the Transparent Mode when you need to transfer binary or other nontext files.

TRF TRFLOW ON/OFF *Default: OFF*

Modes: All

Parameters:

ON Software flow control for the computer or terminal can be activated in the Transparent Mode.

OFF Software flow control for the computer or terminal is disabled in the Transparent Mode.

If TRFLOW is ON, the type of flow control used in the Transparent Mode is determined by the way 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 Controller 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 Controller 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 Controller to control output from the terminal.

TRI TRIES "n" *Default: 0*

Mode: Packet

Parameter:

"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 Controller returns the current number of tries if an outstanding unacknowledged frame exists. If no outstanding unacknowledged frame exists, the Controller 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.

TXD TXDELAY "n" *Default: 30 (300 msec.)*

Mode: Packet

Parameter:

"n" 0 to 120 specifies ten-millisecond intervals.

The TXDELAY command tells your Controller 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 to these radios:

1. Crystal-controlled radios with diode antenna-switching do not need much time.

2. Synthesized radios need time for their phase-lock-loops (PLLs) to lock up.

3. Radios with mechanical transmit/receive relays need time for the physical movement of the relays.

4. External amplifiers that use RF-driven relay switching usually require you to increase TXDELAY to allow for the additional delays.

Experiment to determine the best TXDELAY value for a specific radio.

TXDELAY can also compensate for certain characteristics of the radio used by the station which you are communicating with.

If the other station's radio has slow AGC recovery or squelch release times when it is switching from transmit to receive, increasing your TXDELAY may reduce retries and improve throughput by retarding the start of your data until the other receiver has reached full sensitivity.

TXF TXFLOW ON/OFF *Default: OFF*

Mode: Packet

Parameters:

ON Software flow control for the Controller can be activated in the Transparent Mode.

OFF Software flow control for the Controller is disabled in the Transparent Mode.

When TXFLOW is ON, the setting of XFLOW determines the type of flow control used in the Transparent Mode.

When TXFLOW is OFF, the Controller uses only hardware flow control; all data sent to the terminal remains fully transparent.

When TXFLOW and XFLOW are ON, the Controller 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 Controller.

If the Controller Start and Stop characters are set to $00, hardware flow control will always be selected regardless of the setting of TXFLOW.

TXR TXREV ON/OFF *Default: OFF*

Modes: Baudot, ASCII, and AMTOR.

Parameters:

ON Transmit data polarity is reversed (mark-space reversal).

OFF Transmit data polarity is normal.

Use the TXREV Command to invert the polarity of the data sent to the Controller's AFSK tone generator, thus reversing mark and space in the transmitted AFSK and FSK signals.

In some cases, the station you are working may be receiving inverted data but transmitting in correct polarity.

Set TXREV ON to reverse the sense of your transmitted signals.

TXREV does not apply to packet operation. Since the packet mode sends ASCII in NRZI format, data polarity has no real meaning. In HF packet operation, however, the choice of sideband does have an effect upon the frequency that is displayed on your transceiver.

U **UNPROTO call1 [VIA call2[,call3...,call9]]** *Default: CQ*

Mode: Packet

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".

You can monitor unconnected packets sent from other packet stations by setting MONITOR to a value greater than "1" and setting MFROM to ALL.

You can also use the digipeater list for beacon packets.

To send your beacon message through one or more digipeaters, type:

UNPROTO BEACON VIA WX1AAA,WX2BBB,WX3CCC

Your beacon is routed to and repeated by each of the digipeaters in the order listed.

Some PBBSs and other types of host computer systems may use this form of UNPROTO addressing to disseminate their traffic or mail lists over the channel to a wider audience.

To address a PBBS mail list through one or more digipeaters, type:

UNPROTO MAIL VIA WX1AAA,WX2BBB,WX3CCC

The resulting "unproto" beacon may look like this:

W2JUP-4> WX1AAA>WX2BBB>WX3CCC>MAIL:
QTC (list of call signs with mail waiting in the PBBS)

US USERS "n" *Default: 1*

Mode: Packet

Parameter:

"n"	0 to 10 specifies the number of active simultaneous connections that can be established with your Controller.

USERS only affects the way that **incoming** connect requests are handled. It does not affect the number of connections you **initiate** with your Controller. 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.

USO USOS ON/OFF *Default: OFF*

Mode: Baudot RTTY

Parameters:

ON	Letters (LTRS) case IS forced after a space character.
OFF	Letters (LTRS) is NOT forced after a space character.

Use the USOS Command when you want your Controller to automatically change from figures to letters after receiving a space character.

When you are using Baudot RTTY in poor HF receiving conditions, a received character can be incorrectly interpreted as a FIGURES-SHIFT character, forcing the received data into the wrong case. Many otherwise good characters received after this will be interpreted as figures (numbers and punctuation), not as the letters sent by the other station.

USOS ON helps reduce these receiving errors. But some weather, commercial, point-to-point, and utility stations use Baudot RTTY to send consecutive groups of numbers separated by spaces. In these cases, USOS produces unacceptable results by forcing the system into letters case when the originator may have intended the information to be in figures case.

V VHF ON/OFF *Default: ON*

Mode: Packet

Parameters:

ON	Packet tones are shifted 1000 Hz.
OFF	Packet tone are shifted 200 Hz.

Use the VHF Command for immediate software control of the Controller's modem tones. Changing components or switch settings is not required.

Set VHF OFF for HF packet operation.

Set VHF ON for VHF operation.

NOTE: Be sure to change HB to 300 bauds when you operate below 28 MHz.

WI WIDESHFT ON/OFF *Default: OFF*

Modes: Baudot and ASCII RTTY, and AMTOR.

Parameters:

ON	RTTY tones are shifted 1000 Hz.
OFF	RTTY tones are shifted 200 Hz (emulates 170-Hz shift).

The WIDESHFT command permits you to use the Controller on VHF or HF with either wide (1000 Hz) or narrow (200 Hz) shifts.

Nearly all amateur radio VHF and HF Baudot and ASCII RTTY operators use 170-shift. The Controller's 200-Hz shift is well within the passband and filter tolerances of any RTTY demodulator in general service.

MARS stations will find WIDESHFT generally compatible with standard MARS 850-Hz shift Baudot RTTY operations.

The WIDESHFT command has no effect in AMTOR operation.

WO WORDOUT ON/OFF *Default: OFF*

Modes: Baudot and ASCII RTTY, AMTOR, and Morse.

Parameters:

ON	Typed characters are held in the transmit buffer until a space character or punctuation is typed.
OFF	Typed characters are sent directly to the transmitter.

Use the WORDOUT Command (in all modes except packet) to choose whether or not you can edit while entering text for transmission.

When WORDOUT is ON, each character you type is held in a buffer until you type a "space", a carriage return, a line feed, or any punctuation mark. This includes parentheses, plus signs, asterisks, etc. You can correct spelling or change words before the transmit buffer's contents are sent to the radio.

When WORDOUT is OFF, each character you type is sent to the radio just as you type it, without delay.

Set WORDOUT ON to permit limited on-screen editing with your terminal program before each word is sent to the transmitter.

Set WORDOUT OFF to transmit each character immediately as it is typed.

WR WRU ON/OFF *Default: OFF*

Modes: Baudot, ASCII, and AMTOR ARQ.

Parameters:

ON	Your answerback is sent after a other station's WRU?
OFF	Your answerback is NOT sent after a other station's WRU?

Use the WRU command in Baudot, ASCII and AMTOR to enable or disable your Controller's automatic answerback feature.

When WRU is ON, your Controller sends the answerback on receipt of another station's WRU? request ("FIGS D" or "$" in Baudot and AMTOR, or <CTRL-E> in ASCII). Your Controller turns on your transmitter, sends the text stored in the answer-back field (AAB), turns your transmitter off, and returns to receive status.

In AMTOR ARQ operation, your answerback will automatically send the +? changeover command to the other station and maintain the link.

These related features can be used in message handling in either direction to confirm that you are sending to the proper station, and the other station is probably receiving your traffic successfully.

XF XFLOW ON/OFF *Default: ON*

Modes: All

Parameters:

ON	XON/XOFF (software) flow control is activated.
OFF	XON/XOFF flow control is disabled and hardware flow control is enabled.

When XFLOW is ON, software flow control is in effect; it is assumed that the computer or terminal will respond to the Controller's Start and Stop characters defined by the XON and XOFF commands.

When XFLOW is OFF, the Controller sends hardware flow control commands via the RTS line.

For full hardware control in both directions, set START, STOP, XON, and XOFF all to $00.

XMIT **XMIT** *Immediate Command*

Mode: Command Mode in Baudot, ASCII, and Morse.

XMIT is an immediate command that keys your radio's PTT line and prepares the radio to receive outbound data and Morse characters from the Controller.

The XMIT Command can only be used from the Command Mode.

Type <CTRL-C> (default) to enter the Command Mode before typing the "X."

XMIT switches your Controller to either the Converse Mode or the Transparent Mode, depending upon the setting of CONMODE.

Before you transmit FAX, PRFAX must be OFF, AWLEN must be set to 8, and PARITY should be 0. Refer to the facsimile transmit section before you begin to transmit so you can set the proper comands, and send data at the appropriate time.

XMITO **XMITOK ON/OFF** *Default: ON*

Mode: Morse, Baudot and ASCII RTTY, AMTOR, and Packet

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 Controller functions remain the same. Your Controller 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 your Controller does not transmit.

Set XMITOK OFF if you are absent and wish to leave your Controller on as a channel activity monitor.

Set XMITOK OFF for testing in loopback or direct wire connections when PTT operation is not required.

XO — XOFF "n" *Default: $13 <CTRL-S>*

Modes: All

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.

NOTE: You can enter the code in either hex or decimal.

The Stop character default value is <CTRL-S> for computer data transfers.

If you are operating in the Converse Mode, and there is a chance that activity might fill the Controller's buffers, you can define the Stop character as <CTRL-G> ($07), which "beeps" many terminals.

XON — XON "n" *Default: $11 <CTRL-Q>*

Modes: All

Parameter:

"n" 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

XON selects the Controller Start character that is sent to the computer or terminal to restart input from that device.

NOTE: You can enter the code in either hex or decimal.

The Start character default value is <CTRL-Q> for computer data transfers.

If you are operating in the Converse Mode, and there is a chance that activity might fill the Controller's buffers, you can define the Stop character as <CTRL-G> ($07), which "beeps" many terminals.

IN CASE OF DIFFICULTY

This section of the Manual is divided into five parts:

- "General Troubleshooting Information" describes what you should do if you experience difficulty with your Controller right after you assemble it.
- "Troubleshooting Precautions" points out the care and methods you should use when you service the Controller to help prevent damage to the components.
- "Troubleshooting Chart" identifies a number of problems and lists one or more conditions or components ("Possible Causes") that could cause each difficulty.
- "Troubleshooting the Filters" describes how you can troubleshoot the Controller with instruments.
- The "Voltage Chart" shows the DC voltages at each of the integrated circuit pins.

GENERAL TROUBLESHOOTING INFORMATION

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequency helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.

2. About 90% of the kits that are returned for repair do not function properly due to poor soldering. You can correct many problems, therefore, by carefully inspecting the connections to make sure they are soldered as described on Page 12 of the Assembly Manual. Reheat any doubtful connections.

3. Closely examine each circuit board foil to make sure no solder bridges exist between adjacent foils. If you are not sure a solder bridge exists, compare the circuit board foil to the corresponding x- ray view (beginning on Page 12-1 of this Manual). To remove a solder bridge, hold a clean soldering iron tip between the two points that are bridged until the excess solder flows down the tip of the solder ing iron. You can also use desoldering braid. Be sure to examine the component side of the circuit boards for solder that may have built up on the top side.

4. Make sure each transistor is in the proper location (correct part number and/or type number). Also make sure each transistor lead is in the correct hole and is properly soldered to the foil.

5. Check the integrated circuits (ICs) for the proper installation. Make sure the dot or marked (pin 1) end of each IC is towards the index mark on the circuit board. Check each integrated circuit to make sure each lead is in its socket hole and not bent out or under the IC.

6. Check each capacitor value. Make sure you installed the correct value capacitor at each location. Check electrolytic capacitors to make sure the positive (+) or negative (-) marked lead is in its corresponding circuit board hole.

7. Check each resistor value carefully. It would be easy, for example, to mistake a 10 kΩ (brown-black-orange) resistor where a step calls for a 100 kΩ (brown-black-yellow) resistor. This is especially true for resistors that have five color bands, since each band may be quite narrow. Use a magnifying glass to inspect these resistors. A resistor that is discolored, cracked, or shows signs any signs of bulging indicates that is it damaged and should be replaced. Since damaged resistors are often the result of some other difficulty (such as faulty wiring), you should try to locate the cause as well as the result.

8. Make sure the banded end of each diode is positioned correctly.

9. Make sure the bargraph is fully seated in its socket and none of the leads are bent out or under it.

10. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

11. Check all of the component leads connected to the circuit boards. Make sure the leads do not extend through the board and come into contact with other connections or the chassis.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

NOTE: Refer to "Circuit Board X-Ray Views" beginning on Page 12-1 for the physical locations of the parts.

TROUBLESHOOTING PRECAUTIONS

Always observe the following precautions when you troubleshoot your Controller:

1. Make sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead should slip, for example, and short together two adjacent connections, it could damage an IC, transistor, or resistor.

2. Be careful when you test any circuit that contains an IC or transistor. Although these components have almost unlimited life when they are used properly, they are much more vulnerable to damage from excessive voltage and current than many other parts.

4. When you make repairs to the Controller, be sure to eliminate the cause as well as the effect of the trouble. If, for example, you should find a damaged resistor, be sure you find out what damaged the resistor. If you do not eliminate the cause, the replacement resistor may also become damaged when you place the Controller back into operation.

5. In several areas of the circuit boards, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier. You may also wish to use the desoldering braid supplied with the kit. Refer to the instructions on the package.

Also keep in mind the following troubleshooting techniques:

1. Use a high-input-impedance (10 MΩ or higher) DC voltmeter to measure DC voltages during troubleshooting. Voltage readings may vary ± 10% from those shown on the "Voltage Chart."

2. When you make ohmmeter tests, use only the X10, X100, or X1000 ranges. Lower or higher ranges may impose excessive current or voltage on the circuitry.

3. Refer to the "Circuit Board X-Ray Views" and the Schematic to locate the various components or circuit areas listed in the "Possible Cause" column of the "Troubleshooting Chart."

4. Refer to "Semiconductor Identification" beginning on Page 11-1 to identify diode, transistor, and IC basings. A cross-reference of Heath part numbers to manufacturer's type numbers is also included.

COMPONENT REPLACEMENT

To remove faulty resistors, capacitors, or diodes, first clip them from their leads. Then heat the solder on the foil side and pull each part out of its hole. Preshape the leads of the replacement part and insert them into the holes in the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

You can remove transistors in the same manner as other components. Make sure you install the replacement transistor with its leads in the proper holes. Then solder the leads quickly to avoid heat damage. Cut off the excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, first clear the solder resist coating to expose clean foil. Then bridge solder across the break. Use a length of bare wire to bridge large gaps in the foil. Lay the wire across the gap and solder each end to the foil. After the connections cool, carefully trim off any excess bare wire.

PLATED-THROUGH HOLES

Some of the circuit board holes have foil connections on both sides. These plated-through holes carry the circuit from one side of the circuit board to the other. When you troubleshoot the Controller, make sure you check for circuit continuity through these holes.

If you are not sure about a plated-through hole where a component is not installed, install a small piece of wire in the hole. Then solder the wire to the foil on both sides of the circuit board. To correct a problem where a component lead is installed at the hole, simply solder the lead on both sides of the circuit board.

TROUBLESHOOTING CHART

The following chart lists the "Condition" and the "Possible Causes" of some problems you may encounter for each function of the Controller. If particular parts are mentioned (R15, C3, etc.) as a possible cause, check these parts to make sure you correctly wired or installed them. Also make sure the proper part is installed at each location. It is possible, on rare occasions, for a part to be faulty.

CONDITION	POSSIBLE CAUSES
No 13 VDC supply.	1. Fuse F1. 2. Switch SW1. 3. Integrated circuits U22 through U37. 4. Diode D10 or D11. 5. Capacitor C28
No 5 VDC supply.	1. Diode D10, D11, D12, or D13. 2. Capacitor C26. 3. Integrated circuit U21. 4. Resistor R31 or R32.
LED Tune bargraph does not work.	1. See "Troubleshooting the Filters." 2. Connector J11 or J12. 3. Resistor R137, R138, or R139. 4. Integrated circuit U36, U18, or U41. 5. Capacitor C52 or C28.

CONDITION	POSSIBLE CAUSE
Cannot set the tone frequencies.	1. Integrated circuit U40, U35, U37, or U41. 2. Resistors R153 through R168. 3. Capacitor C56, C57, or C58.
No VR (voltage reference) or +10R source.	1. Integrated circuit U41 or U28. 2. Capacitor C65 or C67. 3. Resistor R173, R174, R175, or R176.
No -10D or +10D source.	1. Diodes D3 through D9. 2. Resistor R28, R29, or R30. 3. Integrated circuit U13. 4. Capacitor C17, C22, C23, C24, or C25.
2.4576 MHz oscillator does not operate.	1. Crystal Y2. 2. Capacitor C6, C7, C8, C9, or C10. 3. Resistor R19 or R20. 4. Integrated circuit U15.
4.000 MHz oscillator does not operate.	1. Crystal Y1. 2. Capacitor C2, C3, C4, or C5. 3. Trimmer C53. 4. Resistor R4, R5, or R6.

TROUBLESHOOTING THE FILTERS

This section shows you how to troubleshoot the filters, which make up a large part of the Controller's circuitry. These tests require the following pieces test equipment:

1. Audio generator capable of producing a 1 kHz to 3 kHz (minimum) sine wave, with adjustable output.

2. 5 MHz oscilloscope (minimum) with a calibrated attenuator.

To begin the procedure, apply power to the Controller with nothing connected to it (no computer or radio equipment). The Controller should be using its default parameters while you make these tests.

Set the THRESHOLD control fully clockwise and make sure the RADIO 1 pushbutton is released (out position).

BANDPASS FILTER (VHF ON)

The bandpass filter actually contains two filters in one. Integrated circuit switches U22, U24, U25, and U27 control the switching of resistors that are in parallel with other resistors. This resistor switching changes the operating frequency of the filters.

Two sets of test frequencies are required to completely check both bandpass filter combinations. The first set of test frequencies is 1100 Hz and 2100 Hz (with VHF ON) and the second set is 2080 Hz and 2310 Hz (with VHF OFF). The Controller defaults to VHF ON at power up.

Use the following procedure to check the bandpass filters with VHF ON:

1. Verify that the DC voltages are correct. Check the power supply voltages and the voltages on integrated circuits U22 through U28. Refer to the "Voltage Chart" for the voltages that should be present at IC pins.

NOTE: In the next step, you will use the oscilloscope to check the signals at several IC pins. Set the oscilloscope for AC measurements except where DC measurements are specifically called for. Be careful not to let the probe slip and short two adjacent IC pins. You have localized the problem when you find a test point that is too low or too high in amplitude. The problem is most likely between the two adjacent test points. Check your soldering in the area of fault. Also make sure you have not interchanged some resistor values.

2. Apply an 1100 Hz, 400 mV P-P sine wave to J4 pin 1 or J3 pin 1. If this portion of the filters is operating correctly, the left hand bar of the Tune bargraph should be lit. If the correct bar is lit, proceed directly to the next test frequency (Step #4).

3. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)*	Waveform
U28 pin 14	0.800	A
U28 pin 7	0.100	A
U23 pin 1	0.250	A
U23 pin 14	0.600	A
U26 pin 1	1.800	A
U26 pin 14	5.000	A
U28 pin 1	1.100	B

4. When you have the correct signals at the above test points, apply a 2100 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1. The second bar from the right side of the Tune bargraph should be lit. If the correct bar is lit, proceed directly to Step #6.

5. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

* These levels will vary, depending upon the settings of controls R81 and R96. If the filters do not operate properly before you attempt this test procedure, set these controls to their centers of rotation.

Test point	Amplitude (V P-P)	Waveform
U28 pin 14	1.000	A
U28 pin 7	1.300	A
U23 pin 1	2.000	A
U23 pin 14	3.000	A
U26 pin 1	4.500	A
U26 pin 14	6.500	A
U28 pin 1	1.200	B

6. When you have the correct signals at the above test points, proceed to "Mark and Space Filters (VHF ON)."

MARK AND SPACE FILTERS (VHF ON)

You will now use the same procedure to check the signal through integrated circuits U29 through U32. These ICs form the mark and space filters, which operate in the same manner as the bandpass filters.

Use the following procedure to check the mark and space filters with VHF ON:

1. Apply an 1100 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1.
2. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U30 pin 14	5.0	C
U32 pin 14	5.0	C
U30 pin 1	1.8	D
U32 pin 1	1.8	D

3. Check the waveform at the junction of resistors R95 and R108 against Waveform E. The trace will be about 6 volts above ground with no signal input and about 7 volts above ground with an input signal. This signal will be an on-off pulse in the receive mode. With a continuous audio tone input, the level with only shift up and down as the signal frequency is swept through the filters.
4. Integrated circuits U32B, U32C, U34C, and U34D provide additional filtering. Since the signals through these ICs are pulses instead of sine waves, waveforms are not practical. You can, however, check the waveforms at these pins to make sure pulses are present and that these pulses are at the correct DC level above ground. The signal at U32 pins 7 and 8 and U34 pin 8 should resemble Waveform F, and the signal at U34 pin 14 should resemble Waveform G. NOTE: The pulse widths of these signals will vary with received signals. Waveforms E, F, G, and H are typical while you are receiving an RTTY signal.

5. Check the signal at U15 pin 6. It should resemble Waveform H. NOTE: The pulse width of this signal will vary with received signals.

6. When you have the correct signals at the above test points, apply a 2100 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1.

7. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U30 pin 14	2.8	J
U32 pin 14	2.8	J
U30 pin 1	4.8	K
U32 pin 1	4.8	K

When you have the correct signals at all of the above test points, proceed to "Bandpass Filters (VHF OFF)."

BANDPASS FILTERS (VHF OFF)

Use the following procedure to check the bandpass filters with VHF OFF:

1. Turn the THRESHOLD control fully counterclockwise.

2. Connect a computer to the Controller and "sign on." Then, when you have the **cmd:** prompt, type "VHF OFF" (do not type the quotation marks). Your screen will show:

VHF was OFF
VHF now ON

3. Apply an 2080 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1. If this portion of the filters is operating correctly, the left hand bar of the Tune bargraph should be lit. If the correct bar is lit, proceed directly to the next test frequency (Step #4).

3. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U28 pin 14	1.000	K
U28 pin 7	0.340	K
U23 pin 1	0.700	K
U23 pin 14	1.400	K
U26 pin 1	3.000	K
U26 pin 14	6.800	K
U28 pin 1	1.200	B

4. When you have the correct signals at the above test points, apply a 2310 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1. The second bar from the right side of the Tune bargraph should be lit. If the correct bar is lit, proceed directly to Step #6.

5. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U28 pin 14	1.600	K
U28 pin 7	1.100	K
U23 pin 1	1.600	K
U23 pin 14	2.800	K
U26 pin 1	4.500	K
U26 pin 14	6.500	K
U28 pin 1	1.200	B

6. When you have the correct signals at the above test points, proceed to "Mark and Space Filters (VHF OFF)."

MARK AND SPACE FILTERS (VHF OFF)

Use the following procedure to check the mark and space filters with VHF OFF:

1. Apply an 2080 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1.

2. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U30 pin 14	5.0	K
U32 pin 14	4.8	K
U30 pin 1	1.8	K
U32 pin 1	1.8	K

3. When you have the correct signals at the above test points, apply a 2310 Hz, 400 mV sine wave to J4 pin 1 or J3 pin 1.

4. Use the oscilloscope probe to look at the waveforms that are present at each IC pin in the following chart. The chart shows you what the waveform's amplitude should be as well as how it should look. Refer to "Waveforms" starting on Page W1 for drawings of the various waveforms.

Test point	Amplitude (V P-P)	Waveform
U30 pin 14	2.4	K
U32 pin 14	2.4	K
U30 pin 1	5.1	K
U32 pin 1	5.1	K

CRYSTAL OSCILLATORS

Check the waveform at integrated circuit U7 pin 20. This 2.4576 MHz signal should resemble Waveform L and measure about 3.50 volts peak-to-peak.

Check the waveform at integrated circuit U1 pin 6. This 4.000 MHz signal should resemble Waveform M and measure about 4.1 volts peak- to-peak.

RESET LINE

Measure the voltage at U14 pin 1. This pin should measure +4.8 volts DC.

IC VOLTAGE CHART

IC #	PIN # 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1						2.5										4.8	4.8	3.5
2	4.8													0				
3	4.8													0				
4	0													0				
5	0													0				
6						4.0	0		3.5	3.5						2.5		
7					4.8		3.0	4.8	4.8		4.8	2.0						
8	2.0	0	2.0	2.0	2.0	2.0	0	2.0	2.0	2.0	2.0	0	2.0	4.8				
9	1.5	1.1	0.1	0.1	0.1	0.1	0	2.5	1.1	0.1	0.1	0.1	0.1	4.8				
10	0	0.45	0.6	0.5	4.8	4.8	3.9	0	4.8	4.8	4.8	4.5	0	1.2	3.8	4.8		
11	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0	0.7	0.7	0.2	0	0	3.9	3.4	4.8		
12	3.4	3.4	3.4	3.4	3.4	3.4	3.4	0	.05	0.1	.15	0	3.4	3.4	3.4	4.8		
13	6.3	6.3	8.4	1.2	5.8	6.3	0	5.8	5.6	1.1	8.5	5.8	0	12.7				
14	4.8	3.4	4.8	2.1	4.8	2.6	0	0.1	4.8	4.8	0.1	3.9	4.8	4.8				
15	1.5	0.1	1.2	2.1	3.7	0.1	0	1.2	1.4	1.2	1.4	2.5	1.2	4.8				
16	0.1	4.8	0.1	4.8	0.1	4.8	0	1.1	2.5	4.8	0.1	4.8	0.1	4.8				
17	2.4	3.4	4.2	3.4	3.3	4.2	0	2.5	1.5	2.1	4.1	1.5	3.4	4.8				
18	0	3.3	0	3.3	0	3.3	0	0.1	3.4	0	1.6	3.3	0	4.8				
19	0	0	4.8	0.7	0.7	0.1	0	0.1	0.7	3.3	0.1	0.7	3.2	4.8				
20	-10.0	0	9.5	3.9	3.9	-9.3	0	9.5	0.1	0.1	9.5	0.1	0.1	10.0				
21																		
22	6.8	6.8	6.8	6.6	0.1	13.0	0	6.8	6,8	6.8	6.8	13.0	0.1	13.0				
23	6.8	6.8	6.8	13.0	6.8	6.8	6.8	6.8	6.8	6.8	0	6.8	6.8	6.8				
24	6.8	6.8	6.8	6.6	0.1	13.0	0	6.8	6.8	6.8	6.8	13.0	0.1	13.0				
25	6.8	6.8	6.8	6.6	0.1	13.0	0	6.8	6.8	6.8	6.8	13.0	0.1	13.0				
26	6.8	6.8	6.8	13.0	6.8	6.8	6.8	6.8	6.8	6.8	0	6.8	6.8	6.8				
27	6.8	6.8	6.8	6.6	0.1	13.0	0	6.8	6.8	6.8	6.8	13.0	0.1	13.0				
28	6.8	6.8	6.8	13.0	6.8	6.8	6.8	6.8	6.8	6.8	0	6.8	6.8	6.8				
29	6.8	6.8	6.7	6.7	0.1	13.0	0	6.8	6.8	6.8	6.5	0.1	13.0	13.0				
30	6.8	6.8	6.8	13.0	6.8	6.8	6.7	6.5	6.8	6.8	0	6.8	6.8	6.8				
31	6.8	6.8	6.8	6.8	0.1	0.1	0	6.8	6.8	6.8	6.8	13.0	13.0	13.0				
32	6.8	6.8	6.8	13.0	6.8	6.8	6.8	6.8	6.8	6.8	0	6.8	6.8	6.8				
33	6.8	6.8	6.8	6.8	13.0	13.0	0	6.8	6.8	6.8	6.8	13.0	13.0	13.0				
34	1.5	6.7	1.8	13.0	6.8	6.8	6.9	6.8	6.8	6.8	0	6.7	6.8	11.5				
35	0.7	0.7	0.7	0	0.1	0.1	0	0	1.5	6.8	6.8	13.0	13.0	13.0				
36	11.5	0	13.0	5.8	6.7	7.4	1.2	0	11.2	11.8	11.8	11.8	11.8	11.4	11.8	11.8	11.8	11.8
37	3.4	0.1	3.4	0	3.4	0.1	0	13.0	0.1	5.0	0	13.0	0.2	4.8				
38	4.2	0	0.7	4.2	0.2	4.2	0	0.1	0.7	0.2	3.9	0	1.6	4.8				
39	3.4	0.2	2.5	2.2	3.5	0.1	0	0.2	3.5	0.7	3.5	0.7	4.2	4.8				
40	5.0	4.7	4.6	10.1	5.0	5.0	3.0	3.5	4.2	2.9	2.5	0	3.2	3.2	1.0	1.0		

IC #	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1					3.4		4.8		2.5	2.6	0											
2										4.8												
3										4.8												
4								4.8	4.1	5.1												
5								4.8	4.1	5.1												
6			0	3.5	4.8	4.8	4.8															
7		2.1							4.8	4.8	4.8		0									

SPECIFICATIONS

MODEM CHARACTERISTICS

Operating Modes	Morse, Baudot, ASCII, AMTOR/SITOR, Packet Radio per AX.25, half or full duplex, and WEFAX (weather facsimile) with suitable printer.
Demodulator	Limiter-discriminator type, preceded by an eight-pole Chebyshev 0.5 dB-ripple bandpass filter.
Receive Bandpass	Automatically switched by operating mode. VHF packet: Center frequency 1700 Hz, bandwidth 2600 Hz. HF (except CW): Center frequency 2210 Hz, bandwidth 450 Hz. CW: Center frequency 800 Hz, bandwidth 200 Hz.
Modulator	Low-distortion AFSK sine wave function generator, phase-continuous AFSK.
Output Level	5 to 100 millivolts rms, adjustable by a rear panel control.

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.

INPUT/OUTPUT CONNECTIONS

Radio Interface	Two five-pin TTL connectors, selectable on the front panel.
Input/Output Lines	Receive audio. Transmit audio. Push-To-Talk (PTT). External squelch input. Ground.
External modem connector	Five-pin TTL; TXD, RXD, DCD, PTT, and Ground.
Direct FSK Outputs	Normal and reverse.
Oscilloscope Outputs	Mark (stop) and Space (start).
CW Keying Outputs	Positive: +100 VDC max, at up to 100 mA. Negative: -30 VDC max, at up to 20 mA.
Terminal Interface	Standard RS-232C 25-pin DB25 connector.
Input/Output	RS-232C with full handshake (hardware and software). Must use only wires 1-8 and 20.
Data Rates	Auto-baud selection of 300, 1200, 2400, 4800, and 9600 BPS. In addition, the TBAUD command allows 110, 150, 200 and 600 BPS.

CONTROLS AND INDICATORS

Front Panel Controls	Power Switch. Radio Selector Switch. Threshold Adjust.
Indicators	Ten-segment discriminator-type bargraph indicator for HF tuning. DCD LED (Data Carrier Detect).

Status and Mode Indicators

Mode Group	Status Group
BAUDOT	STBY
ASCII	PHASE
PKT	IDLE
MORSE	ERROR/CONV
CHECK	OVER
FEC	TFC/TRANS
ARQ	RQ/CMD
MODE L	CONSTBY
STA	MULT
	SEND

GENERAL

Power Requirements . . . . +13 VDC (12 to 16 VDC) at 700 mA.

Dimensions (overall) . . . . 2-1/2" H x 8-1/4" W x 11" D
(6.4 x 21 x 27.9 cm).

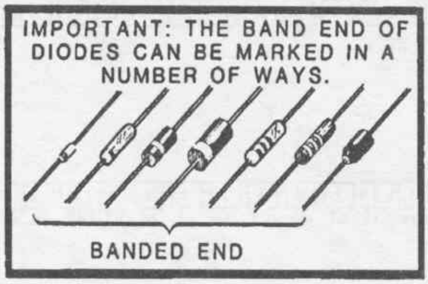
Weight . . . . 3 pounds (1.4 kg).

SEMICONDUCTOR IDENTIFICATION

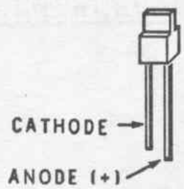
DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D1 — D9	56-652	1N4448	A1
D10	57-27	1N5397	A1
D11	57-27	1N5397	A1
D12	57-27	1N5397	A1
D13—D26	56-652	1N4448	A1
D27	56-619	1N751	A1
D28	56-652	1N4448	A1
D29	57-27	1N5397	A1
D30	57-27	1N5397	A1
D31	57-27	1N5397	A1
D32	57-27	1N5397	A1
D33	56-652	1N4448	A1
DS1 — DS20	412-646	MV5025	A2
DS21	230-8096	10-segment bargraph	A3

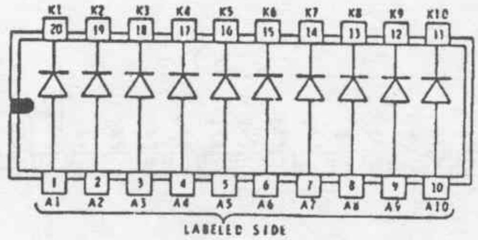
A1



A2



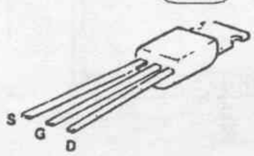
A3



TRANSISTORS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
Q1	230-8101	VN10LM	B1
Q2	230-8101	VN10LM	B1
Q3	417-172	MPS6521	B2
Q4	417-874	2N3906	B2
Q5	230-8100	MPS6561	B2
Q6	417-875	2N3904	B2
Q7	417-875	2N3904	B2
Q8	417-294	MPSA42	B2
Q9	417-874	2N3906	B2
Q10	417-875	2N3904	B2
Q11	417-875	2N3904	B2

B1



B2

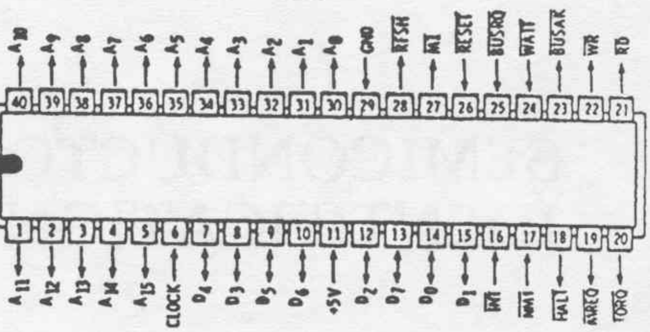
INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U1	443-881	Z80A	C1
U2	444-580	27256*	C2
U3	444-581	27128*	C3
U4**	443-1138	6264 or 5165	C4
U5**	443-1138	6264 or 5165	C4
U5**	443-1500	62256 or 43256	C5
U6	230-8122	Z8536	C6
U7	230-8121	Z8530	C7
U8	443-973	74LS393	C8

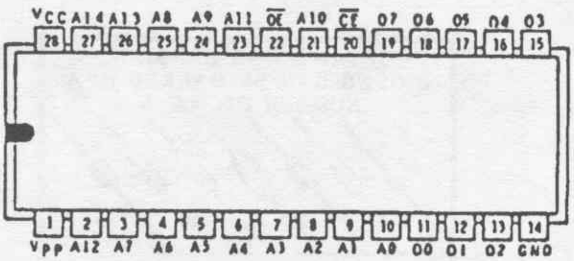
* This is a specially-programmed IC available only from the HeathCompany.

** Two #443-1138 ICs may be installed at U4 and U5, **or** one #443-1500 may be installed at U5 (U4 empty).

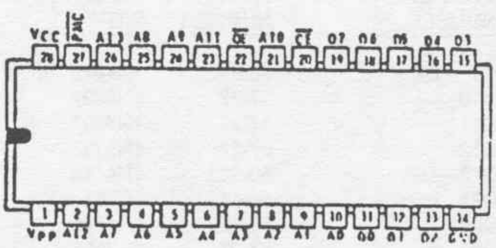
C1



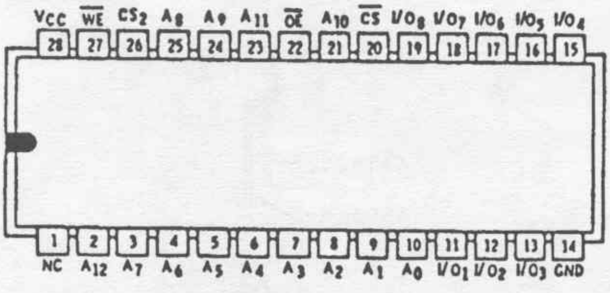
C2



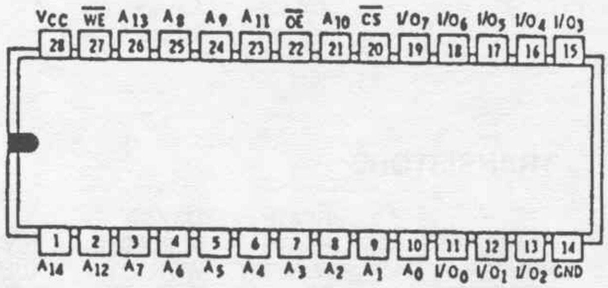
C3



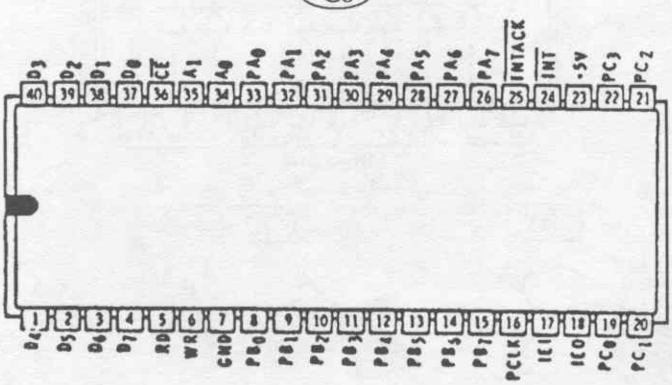
C4



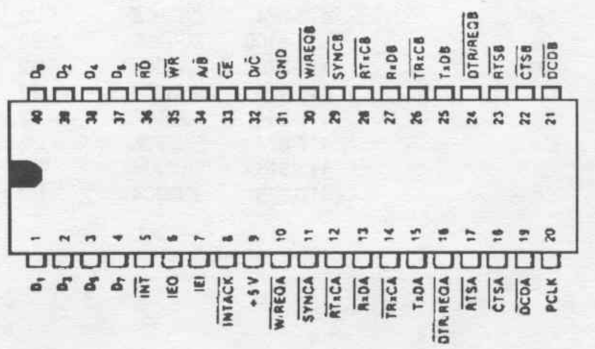
C5



C6



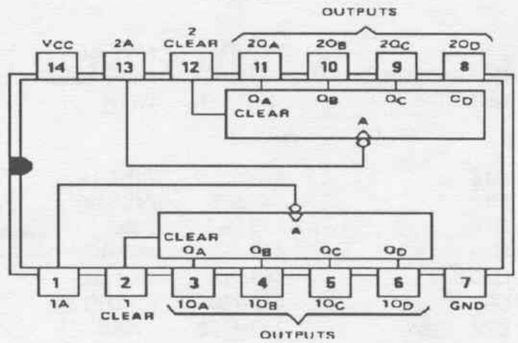
C7



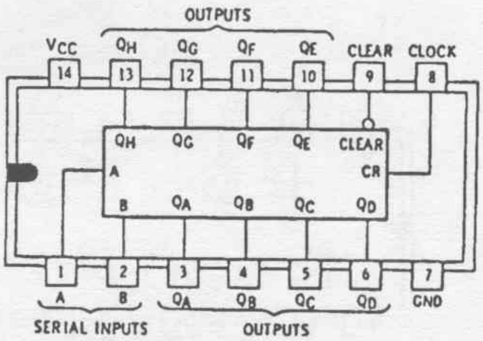
INTEGRATED CIRCUITS (Cont'd)

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U9	443-769	74LS164	C9
U10	230-8115	74HCT139	C10
U11	230-8114	7445	C11
U12	230-8114	7445	C11
U13	442-740	NE566N	C12
U14	443-864	74LS11	C13
U15	443-755	74LS04	C14

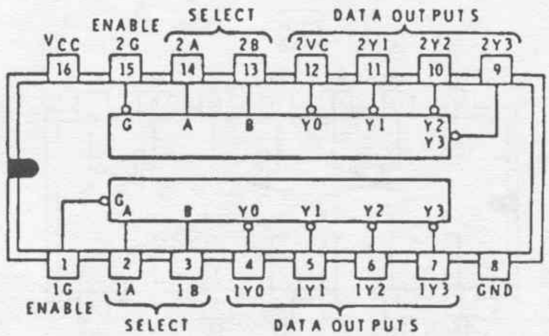
C8



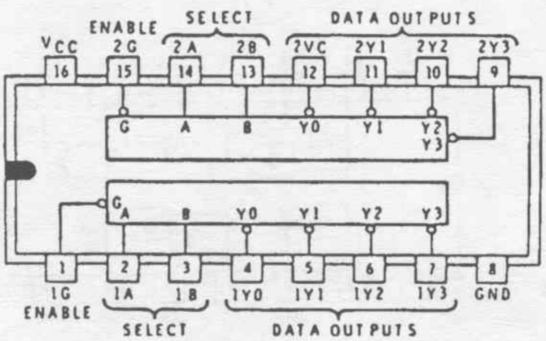
C9



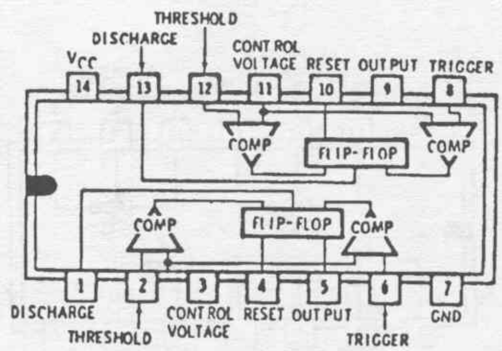
C10



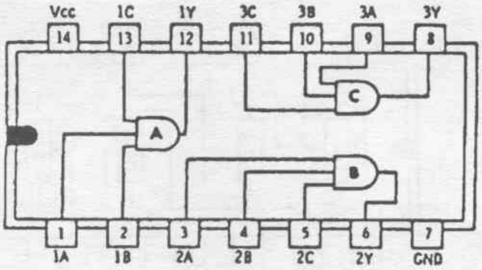
C11



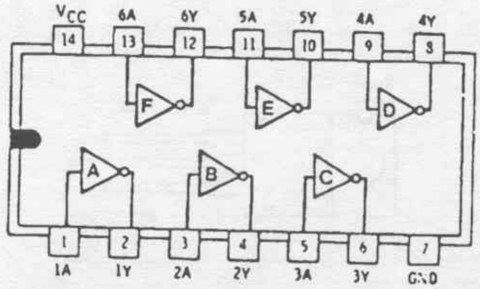
C12



C13



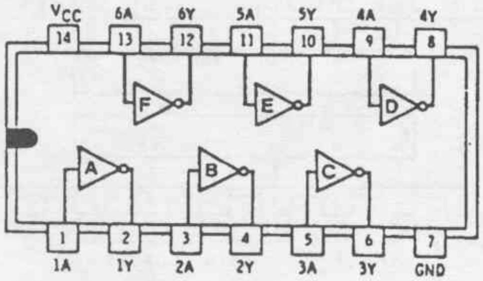
C14



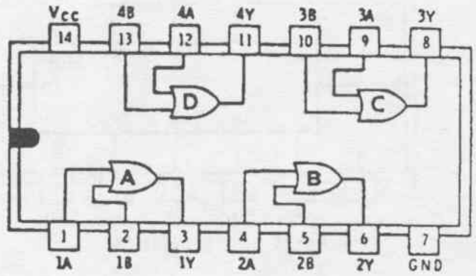
INTEGRATED CIRCUITS (Cont'd)

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U16	443-1299	74HC14	C15
U17	443-875	74LS32	C16
U18	443-967	7406	C15
U19	443-795	MC1489	C17
U20	443-794	MC1488	C18
U21	442-708	LM317T	C19
U22	230-8123	4066B	C20

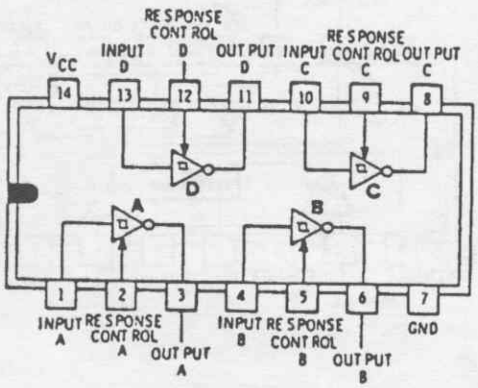
C15



C16



C17



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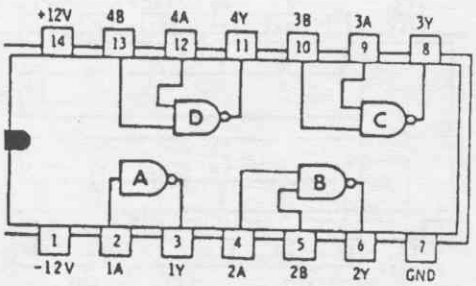

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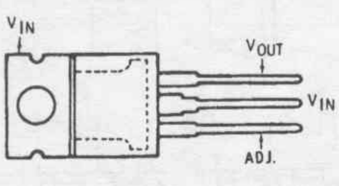
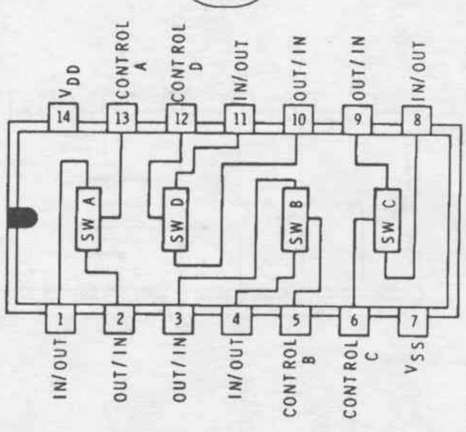


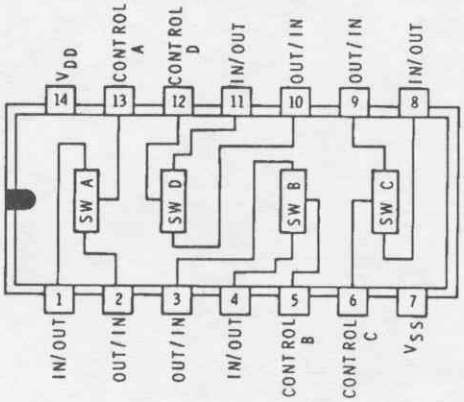
C20



INTEGRATED CIRCUITS (Cont'd)

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U23	230-8106	MC34074 or LF374	C21
U24	230-8123	4066B	C20
U25	230-8123	4066B	C20
U26	230-8106	MC34074 or LF374	C21
U27	230-8123	4066B	C20
U28	230-8106	MC34074 or LF374	C21
U29	230-8123	4066B	C20
U30	230-8106	MC34074 or LF374	C21
U31	230-8123	4066B	C20
U32	230-8106	MC34074 or LF374	C21
U33	230-8123	4066B	C20
U34	230-8106	MC34074 or LF374	C21
U35	230-8123	4066B	C20
U36	442-798	LM3914	C22
U37	443-967	7406	C23
U38	443-967	7406	C23
U39	443-755	74LS04	C24
U40	230-8107	XR2206	C25
U41	442-772	LM317L	C26

C20



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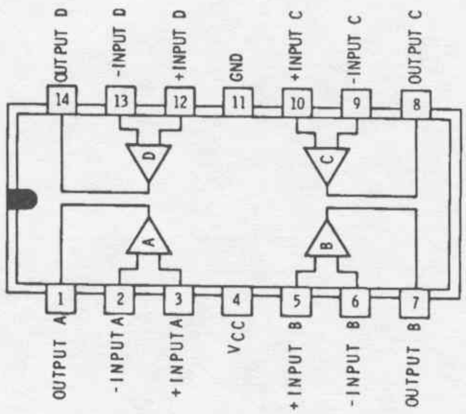

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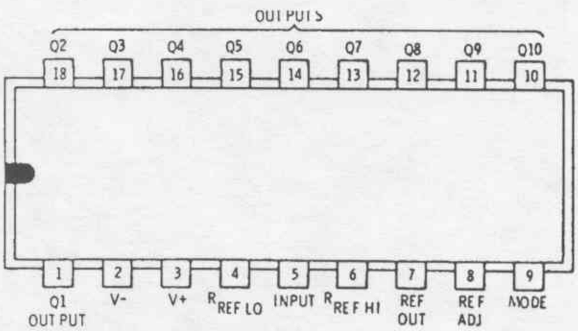
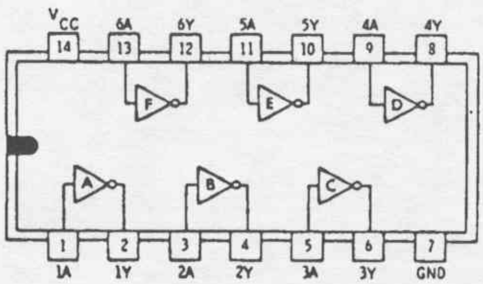


C23



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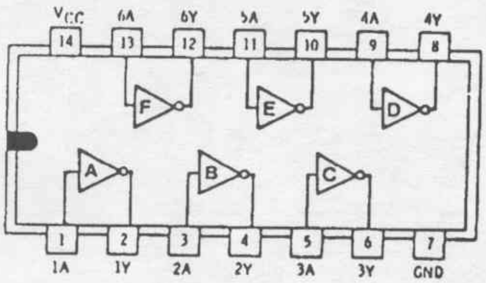

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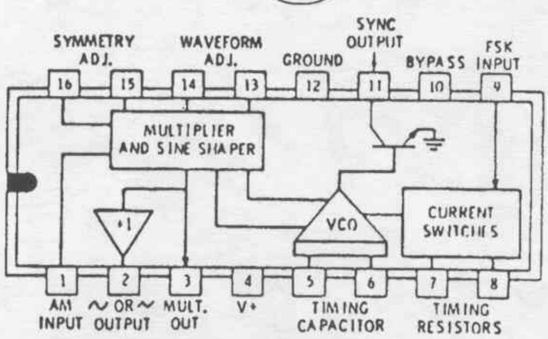
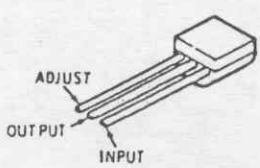


C26



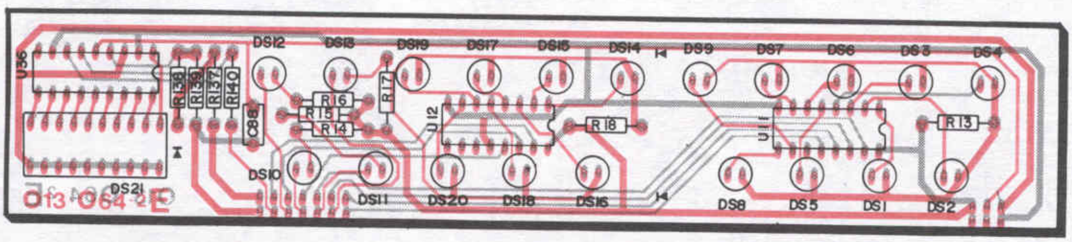
CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

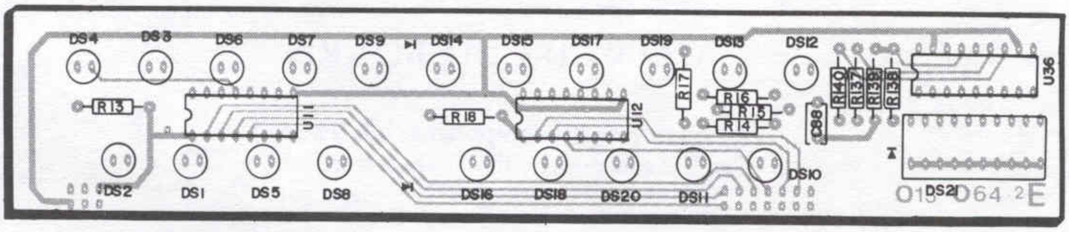
A. Find the circuit component number (R5, C3, etc.) on the corresponding x-ray view.

B. Locate this same number in the "Circuit Component Number" column of the corresponding "Parts List."

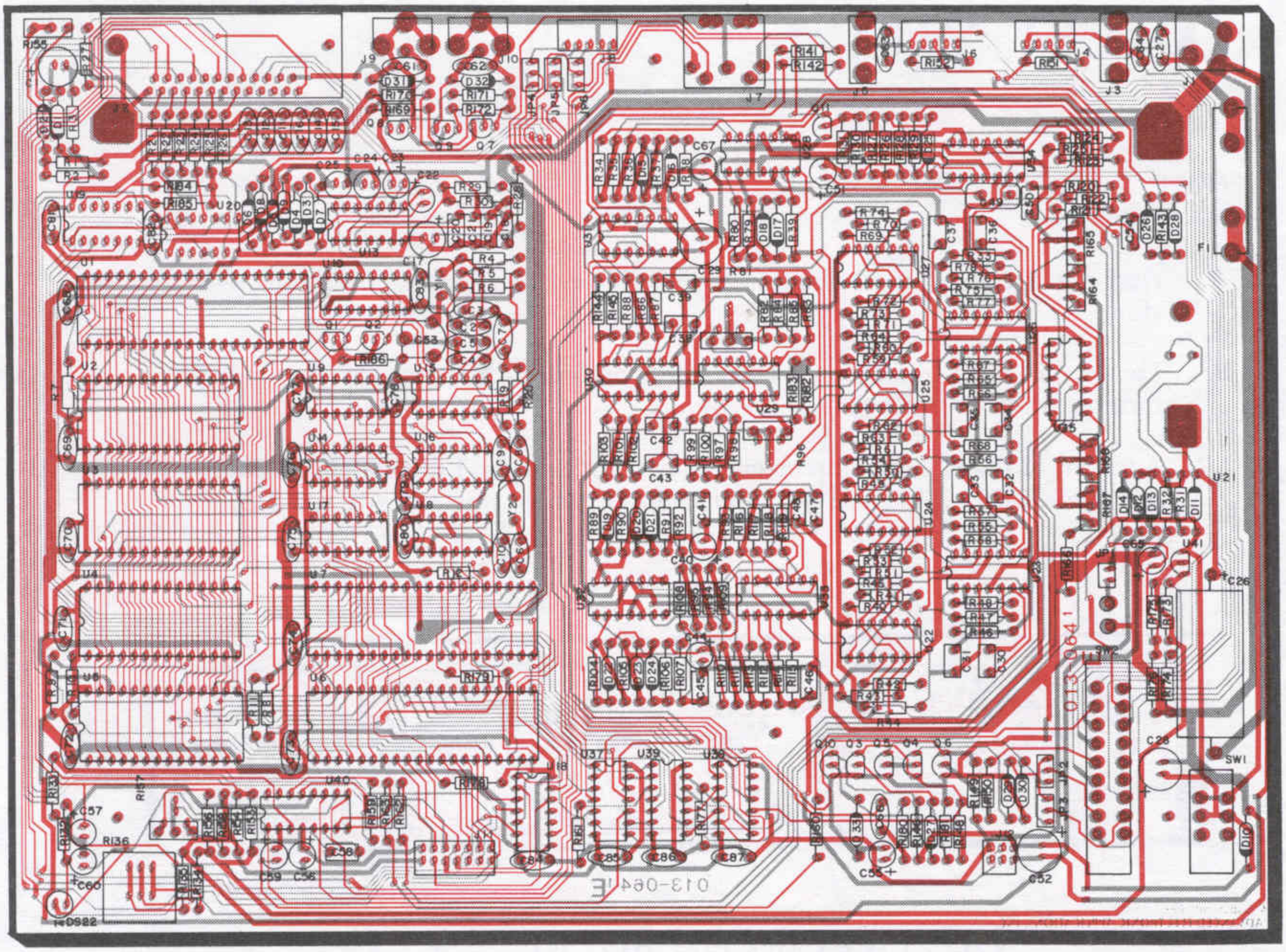
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which you must supply when you order a replacement part.



DISPLAY CIRCUIT BOARD
(Shown from the component side. The foil on the component side is shown in red.)

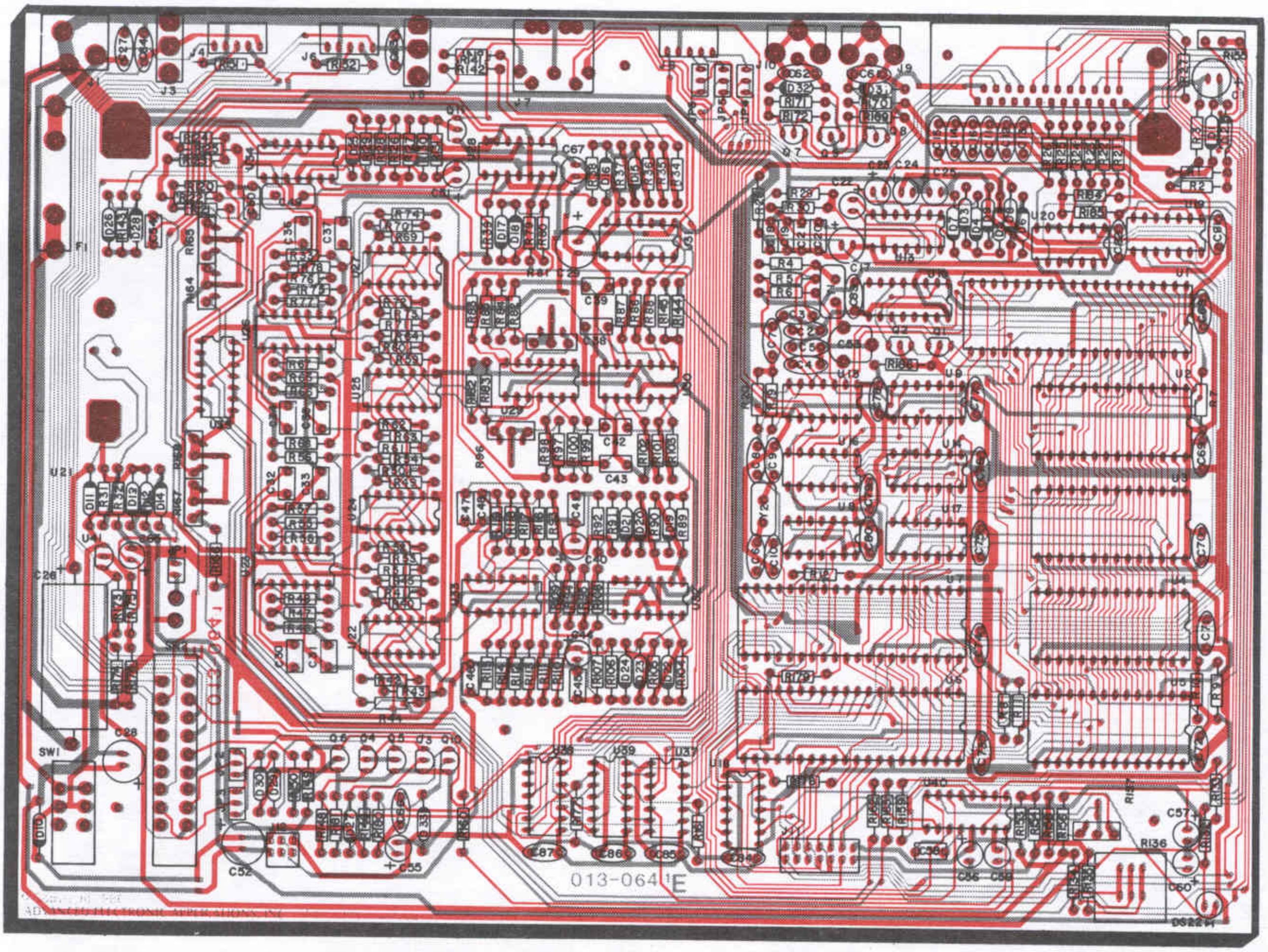


DISPLAY CIRCUIT BOARD
(Shown from the foil side. The foil on the component side is not shown.)



MAIN CIRCUIT BOARD

(Shown from the component side. The foil on the component side is shown in red.)



MAIN CIRCUIT BOARD

(Shown from the foil side. The foil on the component side is shown in red.)

APPENDIX A

COMMAND LIST

COMMAND	MNEMONIC	DEFAULT	FUNCTION
8BITCONV	8B	OFF	Strip bit 7 in CONVERSE
AAB	AA	HK-232	0-17 character answerback (WRU?)
ABAUD	AB	110 bauds	ASCII baud rate
ACHG	AC	Immediate Command	Force AMTOR ARQ Changeover
ACRDISP	ACRD	80	Screen width
ACRPACK	ACRP	ON	Add <CR> to packet
ACRRTTY	ACRR	71	Auto <CR> column in RTTY
ADELAY	AD	4 (40 msec.)	AMTOR transmit delay, (x 10 ms)
ADDRESS	ADD	Enter hex addr.	For MEMORY & IO commands
ALFDISP	ALFD	ON	Send LF after <CR> to terminal
ALFPACK	ALFP	OFF	Send LF after <CR>, packet
ALFRTTY	ALFR	ON	Send LF after <CR>, RTTY
ALIST	AL	Immediate Command	Start AMTOR ARQ "Listen" mode
AMTOR	AM	Immediate Command	Start AMTOR mode in ARQ standby
ARQ	AR	Empty; enter SELCAL	Start AMTOR ARQ call with SELCAL
ARQTMO	ARQT	90	Sets time of ARQ SELCAL
ASCII	AS	Immediate Command	Start ASCII RTTY mode
ASPECT	ASP	2 (576)	Sets aspect ratio
AWLEN	AW	7	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 (X100 ms)
BAUDOT	BA	Immediate Command	Start Baudot RTTY mode
BEACON	B	EVERY 0 (00 sec)	Set beacon timing (X10 seconds)

COMMAND	MNEMONIC	DEFAULT	FUNCTION
BITINV	BI	$00	Set bit pattern
BKONDEL	BK	ON	Send BS SP BS for DELETE char.
BTEXT	BT	(Empty)	120-byte BEACON message text
CALIBRAT	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)	Sets upper or lower case
CBELL	CB	OFF	Enable "Connect" bell
CCITT	CC	ON	Select CCITT ITA#2 or US Baudot
CFROM	CF	All	Connect request/accept list
CHCALL	CHC	OFF	Show call sign after channel ID
CHDOUBLE	CHD	OFF	Show CHSWITCH character twice
CHECK	CH	30 (300 msec.)	Idle link timeout (X10 seconds)
CHSWITCH	CHS	$00	Channel-select (Link) character
CMDTIME	CM	10 (1000 msec.)	Transparent Mode escape timer
CMSG	CMS	OFF	Send CTEXT message to caller
CODE	COD	0 (International)	Set alphabet code
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>
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
CRADD	CRA	OFF	Send <CR><CR><LF> in RTTY Modes
CSTATUS	CS	Immediate Command	Show status of channels (links)
CTEXT	CT	(Sample Text)	120-byte CONNECT message text
CWID	CW	$06 <CTRL-F>	Command to send CWID (in text)
DAYSTAMP	DAYS	OFF	Include DATE in time-stamp
DAYTIME	DA	Not set	Set/read HK-232 internal clock
DCDCONN	DC	OFF	Sets state of RS-232 cable pin 8
DELETE	DEL	OFF	Use BS ($08), not DEL ($7F)
DFROM	DF	All	Digipeat call sign list
DISCONNE	D	Immediate Command	Send DISC to distant station
DISPLAY	DISP	Immediate Command	Show HK-232 parameters/classes
DWAIT	DW	16 (160 msec.)	Delay for digi repeat (X10 ms)
EAS	EAS	OFF	Echo as sent, non-packet modes
ECHO	E	ON	Echo typed keyboard characters
ESCAPE	ES	OFF	Send ESC character $1B as $24
FAX	FA	Immediate Command	Start FAX Mode
FAXNEG	FAXN	OFF	Set white and black senses
FEC	FE	Immediate Command	Start AMTOR FEC transmission
FLOW	F	ON	Stop echo to screen while typing

COMMAND	MNEMONIC	DEFAULT	FUNCTION
FRACK	FR	3 (3 sec.)	Time (X1 sec) to wait for ACK
FSPEED	FS	2 (120)	Set FAX scan rate
FULLDUP	FU	OFF	Full-Duplex terminal operation
GRAPHICS	GR	1 (120)	Set horizontal print density
HBAUD	HB	1200 bauds	Packet link (radio) baud rate
HEADERLN	HEA	ON	Insert <CR> after headers
HELP	H	Immediate Command	Show brief HELP text on screen
HID	HI	OFF	Send ID UI packet every 9.5 mins
HOST	HOST	OFF	Host/terminal interface
HPOLL	HP	ON	Host poll, packet mode
ID	I	Immediate Command	Force ID packet via Unproto path
ILFPACK	IL	ON	Sets line feed action
IO	IO	Varies	Read/write IO register
JUSTIFY	JU	0 (zero)	Move image closer to left edge of paper
K	K	Immediate Command	Same as CONVERSE
KISS	KI	OFF	Selects TNC action
LEFTRITE	LE	ON	Set direction of scan
LOCK	L	Immediate Command	Measures speed of incoming Morse signal
MAXFRAME	MAX	4	Maximum un-ACK'd frames allowed
MBELL	MBE	OFF	Selects BELL action
MBX	MB	None, (enter calls)	Monitor channel without headers
MCON	MC	0 (none)	Monitor while connected (0-6)
MDIGI	MD	OFF	Monitor digipeated frames
MEMORY	ME	Varies	Read/write memory location
MFILTER	MFI	$80	Filter received characters
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)
MORSE	MO	Immediate Command	Start Morse mode, unlock speed
MRPT	MR	ON	Show digipeaters in headers
MSPEED	MSP	20	Set Morse speed in WPM (5-99)
MSTAMP	MS	OFF	Time-stamp monitored frames
MTO	MT	None	Monitor MTO call signs
MYALIAS	MYA	None; enter yours	Alternate MYCALL
MYALTCAL	MYALT	Empty; enter yours	Alternate AMTOR SELCAL
MYCALL	MY	HK-232; enter yours	Your call sign for packet address
MYSELCAL	MYS	Empty; enter yours	Your AMTOR SELCAL, 4 letters
NEWMODE	NE	ON	Return to Command mode at DISC
NOMODE	NO	OFF	Never switch modes

COMMAND	MNEMONIC	DEFAULT	FUNCTION
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
OK	OK	Immediate Command	Accept parameters determined by SIGNAL command
OPMODE	O	Immediate Command	Display current operating mode
PACKET	PA	Immediate Command	Start Packet Mode
PACLEN	PACL	128	# of user-typed bytes in packet
PACTIME	PACT	AFTER 10 (1000 msec.)	Packet transmit timer (X100 msec.)
PARITY	PAR	3 (even)	Terminal program parity (0-3)
PASS	PAS	$16 <CTRL-V>	Pass input editing character
PASSALL	PASSA	OFF	Ignore CRC in HDLC ("Junk Mode")
PERSIST	PE	127	Sets threshold value for random transmit attempt
PPERSIST	PP	OFF	Selects PERSIST and SLOTTIME or DWAIT
PRCON	PRC	ON	Set printer or no printer
PRFAX	PRF	OFF	Send FAX bit praphics to printer or terminal
PROUT	PRO	OFF	Send text data to printer or terminal
PRTYPE	PRT	2	Selects printer type in FAX
RBAUD	RB	45 bauds (60 WPM)	Baudot RTTY baud rate
RCVE	R	Immediate Command	Go to receive, Morse/RTTY/AMTOR
RECEIVE	REC	$04 <CTRL-D>	Receive-mode character in text
REDISPLA	RED	$12 <CTRL-R>	Redisplay current input buffer
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
RFEC	RF	ON	Determines whether Mode B (FEC) signals are displayed
RXREV	RXR	OFF	Reverse received data sense
SELFEC	SEL	?CALLSIGN	Start Selective FEC with SELCAL
SENDPAC	SE	$0D <CTRL-M>	Character that "sends" a packet
SIGNAL	SI	Immediate Command	Start signal analysis
SLOTTIME	SL	1 (10 msec.)	Sets transmit random wait time
SQUELCH	SQ	OFF	Select receiver squelch polarity
SRXALL	SRX	OFF	SELFEC Receive SELECTIVE or ALL
START	STA	$11 <CTRL-Q>	Resume sending data to terminal
STOP	STO	$13 <CTRL-S>	Stop sending data to terminal
TBAUD	TB	1200 bauds	Set terminal data rate
TCLEAR	TC	Immediate Command	Non-packet clear Transmit Buffer

COMMAND	MNEMONIC	DEFAULT	FUNCTION
TIME	TI	$14 <CTRL-T>	Insert "send time" in text
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	TXD	30 (300 msec.)	PTT key-to-data delay (X10 ms)
TXFLOW	TXF	OFF	HK232 flow control — Transparent
TXREV	TXR	OFF	Reverse transmitted data sense
UNPROTO	U	CQ	Path/address to send UI frames
USERS	US	1	# of multi-connections allowed
USOS	USO	OFF	RTTY "unshift on space"
VHF	V	ON	Packet - wide or narrow shift
WIDESHFT	WI	OFF	RTTY - wide or narrow shift
WORDOUT	WO	OFF	RTTY - word or character output
WRU	WR	OFF	Turn on auto-answerback (AAB)
XFLOW	XF	ON	Software flow control
XMIT	X	Immediate Command	Start transmission - key PTT
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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APPENDIX C

INTERNATIONAL HF AMTOR CALLING FREQUENCIES

Since the earliest days of AMTOR (around 1977), AMTOR operators around the world have agreed on the use of certain informal, internationally-recognized **calling** channels. This is similar to the conventional operating methods of the commercial stations using SITOR, the ancestor of AMTOR.

THE CONCEPT AND THE NEED

The "calling channel" concept is just that - worldwide recognition of channels reserved for stations to make their **initial** calls. Stations transmit their CQ or other general broadcast calls on a frequency established as **the** frequency to which all hands will remain tuned and monitoring.

In this way, any operator can know in advance that the station with which contact is desired can be readily accessed - you cannot raise another station by sending the SELCAL on a channel that the other station may not be actively monitoring.

THE DISCIPLINE

After initial contact is made, both stations involved in the contact **quickly move off to another channel** to continue their communication.

The calling channel should not be used as **a working** channel. Calling channels should not be used for testing or lengthy conversations. Automatic beacon transmissions should not be used on the calling channel.

Stations wishing to operate computer-based message storage or mailbox systems on these calling channels should provide automatic means of causing the system to change frequency and relocate both the calling station and the mailbox to another channel, thus leaving the calling channel free for other stations.

THE CHANNELS

80 METERS:	3588	3637.5	
40 METERS:	7045	7075	
30 METERS:	10143		
20 METERS:	14075		
15 METERS:	21075	21100	21115
10 METERS:	28075		

APPENDIX D

AMTOR OPERATING SUGGESTIONS FROM G3PLX

The following text has been adapted from a letter from Peter Martinez, G3PLX, dated 9/24/84, on the subject of good AMTOR operating practices. This information is offered as a guide to AMTOR operation from the man who is most responsible for bringing AMTOR into the amateur radio fraternity. Newcomers to AMTOR are invited to give serious consideration to the ideas presented here.

PREFACE BY PETER MARTINEZ, G3PLX

Here are some thoughts on the subject of operating rules, etc., for AMTOR. They are in no particular order and are written down exactly as they occurred to me as I sat in front of my typewriter. They represent aspects of AMTOR operating that have given rise to problems so far over here, and some (the hot QSY technique) which have been invented to complement the advantages of AMTOR.

AMTOR OPERATING NOTES
G3PLX September 1983

LEGALITIES

Before you operate AMTOR, establish whether you are authorized to do so. Most countries where there currently is AMTOR activity are permitted by general license regulations. Some countries require the licensee to apply for a special permit. Some countries do not permit AMTOR. In others, stations are active!

GETTING STARTED ON AMTOR FOR THE FIRST TIME

The most popular AMTOR mode is ARQ, since it is the most effective. Do not, however, attempt to make the first QSOs on ARQ until FEC has been tested and is known to be working. If there is a fault in part of the system, no contact will result on

ARQ at all; but if at least one direction (transmit or receive) is working, faults can be identified and cured during a contact in FEC. The following step-by-step procedure will help you find faults when you are setting up a new AMTOR station.

Check FEC receive first, with a station that you know is sending in the correct shift-polarity. This will confirm the station receiver is working, and in the correct shift-polarity.

Check FEC transmit next by asking the other receiving station to confirm that the transmit shift-polarity is correct.

Make a short transmission with an ARQ call, asking the other station to use the "listen" or "monitor" mode to check that the transmitter keying is functioning correctly. The most common fault at this stage is too slow a changeover from receive to transmit, resulting in missing transmitted data at the start of the burst.

Some AMTOR units have a delay adjustment which may allow slow transmitters to be used successfully except for very long distance contacts. Some remedial work may be required on the radio if this test fails.

If your ARQ call is successful, ask the other station to make an ARQ call to your Selcal. Your station should respond and an ARQ contact should result.

Finally, make an ARQ call to the other station and attempt an ARQ contact with your station as master rather than as a slave. If no contact results but the other station indicates that he was replying to the call, the problem is that the radio takes too long to change from transmit to receive. Remedial work may be required to correct this. No adjustment to the "delay" preset in the AMTOR unit, if it has one, will cure this problem. Consult the your radio's manufacturer if remedial work is needed.

It is important to follow these steps in order. Unnecessary confusion, frustration, and interference can result from a premature attempt to start an ARQ contact where the complete contact cannot be made until all the component parts are working correctly.

AMTOR OPERATING TECHNIQUES

AMTOR is sufficiently different from other modes that some of the operating practices traditionally used on the air are no longer appropriate, and some new techniques peculiar to AMTOR need to be explained.

FEC and ARQ. When to Use Them.

ARQ is well-known to be the better of the two, but there are several situations where FEC has its advantages, and some where its use is essential.

Use ARQ for all two-way contacts.

Use FEC for all multi-way contacts.

Do not use ARQ for CQ calls. Two reasons for this are:

1. Listeners cannot identify the calling station in an ARQ CQ call. Thus they either must risk replying to a station with whom contact was not desirable, or suffer the embarrassment of having to terminate a contact if, for example, it turns out to be the station you have just worked.

2. If a contact which resulted from a CQ call on ARQ subsequently runs into a rephasing attempt, the resultant CQ call from the master station may attract a completely new reply from a third station, thus resulting in this new station "stealing" the contact.

FEC must be used if the distance between the two stations is greater than about 22,000 miles, such as in "long path" contacts which travel more than halfway around the globe, or some high- orbit satellite contacts. Make sure you know in advance if the path you are attempting is in this category, and do not attempt ARQ under these conditions. It is very frustrating to be called on ARQ when it is known that the path is too long, and very difficult to inform the caller of the problem.

Starting an AMTOR QSO

There is no need to explain how to start an FEC QSO, since the technique is identical to that on other modes. Since in ARQ mode it is necessary in the ARQ mode to know the other station's Selcal code before you call him, however, a new technique may sometimes be required.

If the other station's Selcal code is already known, as in the case of a "sked", there is no problem. Simply enter the required Selcal code to the AMTOR unit, and if/when the desired station is on frequency, he will reply and the contact can proceed.

If you tail-end a previous contact, intending to call one station on ARQ and you do not know his Selcal code, there are two ways to proceed.

There is a convention in operation among AMTOR operators with respect to the way you choose the station Selcal code from its regular call sign. Choose the first letter of the call sign, followed by the last three letters, ignoring any figures. In the case of call signs that only have three letters, repeat the first letter twice. This method does not work for call signs in which the prefix contains figures. If the call sign of the desired station can be translated into a Selcal code in this way, however, use that Selcal code to call him after he signs off with the station he is currently working.

If you cannot encode his call sign using the above method, or you do not know his call sign, or he does not respond to the expected Selcal code, call him in FEC mode. This gives him the choice of calling you back on your Selcal code, or you can ask him what Selcal code he is using. Note that some stations who may be using commercial SITOR-type units may not always be able to make ARQ calls to all possible combinations of letters in a Selcal. Thus, they may require that you call them, often with a Selcal code that bears no relationship to their call sign. This is a translation from a telex number associated with the commercial equipment.

To make a CQ call to start an AMTOR QSO, do so on FEC mode. Mention your own Selcal code so that, at the end of your call, a prospective QSO partner can call you back directly with your Selcal. If you are expecting replies only on FEC (for contacts via a long path, for example), mention this fact in the CQ call.

Operating Techniques While You Are in Contact in FEC

Operation in FEC is very similar to that of conventional RTTY. There are two points to note, and both are related to the method by which the FEC receiver synchronizes to the other transmitter.

Since the receiver can only synchronize to the transmitter when it is not sending traffic (that is, idling), each transmission must start with a period of idling. Most AMTOR units will ensure that a short period of idle precedes the typed message. Under poor conditions or where it may help the distant receiving station to tune in, extra periods of idle will help, both at the beginning of the transmission and also at periods during the transmission in case interference may have resulted in the other receiver losing synchronization.

Note that the common practice on conventional RTTY -- of transmitting a line of test message of RYRYRY to allow the distant station to tune in -- is actually counterproductive on FEC, since the other receiver will not synchronize until the end of this test sequence, and the idle signal itself is quite suitable itself for tuning purposes.

Some commercial SITOR-type units require a received FEC transmission to start with a carriage return and/or a line feed signal. For this reason, and also to aid the formatting of any printer copy at the other station, always start an FEC transmission on a new line.

OPERATING TECHNIQUES IN THE ARQ MODE

Transmitter and Receiver Tuning.

An ARQ contact always starts with the master station making the initial call and the slave replying. The frequency, therefore, is chosen by the master station and the slave station will "net" onto that. An offset at either station often results in the signal from the slave station being received at the master a bit off tune. If the master station then readjusts his transceiver main tuning dial to correct this error, he will also offset his transmitter, probably putting his signal off tune in the distant slave station's receiver. A never ending series of readjustments can then take place. The equivalent problem on other modes rarely causes trouble since the retune operations only take place each time the transmission is passed from one station to the other. With the "quick-break" operation of ARQ, however, such offsets can cause trouble. Thus, a convention has been adopted among AMTOR operators to prevent this situation arising.

This convention is that the master station must at all times keep his transmitter frequency constant. Thus if the master finds that the slave signal is not correctly tuned, he must adjust only his receiver frequency to remove the error, leaving his transmitter frequency untouched, by the use of the RIT control on the transceiver. The slave station, on the other hand, if he finds his receiver off tune, may make a correction by adjusting both receiver and transmitter frequencies together, by means of the main tuning dial.

This convention prevents any offset from accumulating, and is the frequency-domain analogue to the time-domain synchronization in which the master station clock determines the phasing for the contact.

Changing Frequency During an ARQ QSO.

Both stations in an ARQ QSO are "listening-through." If there is some interference on the frequency, or if a change of frequency is desirable for some other reason, to clear a calling frequency (for example) then both stations may wish to move together to another frequency. At first there may seem to be no reason to discuss such a simple operation, which is very common and easy to perform on any other mode, but there are problems if a QSY is made in some ways in ARQ, and there are advantages in adopting a specific technique.

The easiest way of QSYing an ARQ QSO is to close it down and restart it again on a new frequency, with the master station choosing the new frequency. This is referred to in AMTOR circles as a "cold" QSY. This technique is the preferred one when moving off a calling frequency, and in other conditions where there is good copy between both stations, so that an orderly close-down and startup is anticipated.

However, if the QSY is desired due to interference, another technique is possible and, if carried out in the right way, can have decided advantages, but if carried out wrongly, can cause problems and offend other band users. This is referred to as the "hot" QSY technique.

In this technique, the master station moves off the old frequency to the new one while it is in the rephasing mode, and then the slave follows. It is important while the master station is doing this for him to prevent his transmitter from radiating, in order to prevent unintentional interference to other band users, and also to disable the connection between the receiver and the AMTOR Controller, in order to prevent unintentional "phantom sync" to any other ARQ signals which may be audible during the search for a new frequency. Such phantom sync will result in spillage of traffic from the QSO in progress, or from the other QSO, or both. It can only be the master station that leads in a "hot" QSY. If the slave station were to attempt to lead a QSY, then, in the event that it was not successfully completed before the contact timed-out into a rephase operation, the slave would no longer be transmitting, and there would be no way for the slave to establish a new frequency without restarting as a master and thus lose some traffic.

Fixed-channel working

Since it is possible to leave an AMTOR station in "standby" mode on a channel, and for any other station to make a specific call to that station, a common practice in AMTOR is to monitor such a specific frequency. The question arises as to what exactly is the "frequency" of an AMTOR emission. There are, unfortunately, two different conventions in use, one more commonly used in amateur circles and the other used universally by all nonamateur users.

The "amateur" convention says that an AMTOR signal (or any FSK signal) is specified with reference to the frequency of the higher-frequency tone in the pair. If a sked, for example, is prearranged to occur on 14075 kHz, this means that the two transmitted tones are on 14075.00 and 14074.83 kHz.

The "commercial" convention, also used increasingly by amateurs, says that the signal is specified with respect to the frequency of an imaginary center-channel. A signal said to be on 21100 kHz will have one tone on 21099.915 kHz and the other on 21100.085 kHz, or 85 Hz either side of the nominal, rather than with one tone on and the other tone 170 Hz below the nominal. Note that it is assumed that the frequency-shift is universally accepted to be 170 Hz.

In any specification of a "frequency" in connection with AMTOR working, therefore, due regard must be taken of the intended convention, at least until such time as one of these conventions is dropped in favor of the other.

Another factor is significant in respect to setting frequencies on the dials of SSB transceivers used on AMTOR when audio- frequency-shift tones are used. Since the tones will result in transmissions offset from the suppressed carrier frequency, the dial, which normally indicates the suppressed carrier frequency, will not read correctly. It is necessary to add or subtract a fixed amount to the dial frequency in order to establish the actual frequency in use. If the transceiver is being used on lower sideband with audio tone frequencies of 2125 and 2295 Hz, for example, to operate on an "amateur" frequency of 14075, the transceiver dial must be set to 14077.125, that is, 2.125 kHz higher than the desired frequency. The two radiated tones will then be on 14077.125-2.125 (14075) and 14077.125-2.295 (14074.83). Other offsets must be used if a "commercial" channel is to be set up (2.210 Hz), and the offset will be in the other direction if upper sideband is to be used in the transceiver. The offset must be recalculated if the tone frequencies are different from those quoted.

Transceivers owners that have an FSK connection must consult the transceiver handbook or supplier to establish if an offset has to be applied to the dial frequency. Even if the transceiver supplier indicates that no offset is needed, it will be necessary to establish if the "amateur" or "commercial" convention is implied, or some other convention.

Use of the "Over" or "Break-in" Facility

It is possible to use the "over" or "break-in" facility in the ARQ mode to interrupt the sending of the other station. This facility should be used with care, and only in situations where it is essential to do so. There are inherent reasons why recovery from such an interruption can result in garbled copy at one end of the contact, in particular in "figs" garble.

If possible, wait until the other station is idling before you break in, and if the other station breaks into your transmission, it will probably help to use the "clear buffer" facility (if such exists) to abort the later transmission of any unsent text which would be inappropriate to the new context of the break-in.

The AMTOR alphabet, like the RTTY alphabet, consists of two sets of 30 characters, with a switch made between them by two "shift" or "case" codes. One inherent result of this technique is that it is often not known which shift the receiving station is in at the commencement of the contact. For this reason, it is always good practice to send the appropriate shift code at the start of each contact, and indeed at the start of each message, and perhaps at more frequent intervals. With terminals encoded in teleprinter code, there are always two keys labeled "letters" and "figures," and so it is simply necessary to hit the appropriate one of these keys as required. However, on more modern terminals, these two keys may not exist, and the sending of the shift code may be "hidden" from the user.

However, since the other station's terminal could still nevertheless be in the wrong shift, there will always be the requirement to send the shift code at the start to prevent the distant receiver copying the first part of the text in the wrong shift. Consult the documentation with your AMTOR unit or terminal in order to establish how to do this if there is no "letters" or "figures" key.

FORMAT OF THE SELCAL CODE

Although the convention is to form the Selcal from the call sign, some AMTOR units have the possibility to include any AMTOR character in the Selcal. It is strongly recommended, however, that only the 26 letters A-Z are used in Selcal codes.

APPENDIX E

AMTOR THEORY

DEFINITION AND STANDARDS REFERENCES

AMTOR (Amateur Teleprinting Over Radio) is a microprocessor- controlled error-correcting data communications system.

AMTOR is directly derived from the commercial practice known as SITOR (Simplex Telex Over Radio), as described in Recommendations 476-2 and 476-3 of the CCIR (International Consultative Committee on Radio, an agency of the International Telecommunications Union, and in turn, of the United Nations. These international commercial standards were adapted for amateur use in 1977 by J. Peter Martinez, G3PLX.

AMTOR is now permitted in many countries, including the United States of America, as specifically defined in Part 97.69 of the Rules of the Federal Communications Commission.

APPLICATION

Like SITOR, AMTOR uses synchronous transmission of a seven-bit information code to achieve essentially error-free message and text communications. The transmit function encodes all characters with a mark-to-space polarity ratio always as four ones and three zeros, thus allowing the receiving station's processor to check for that ratio.

There are two basic AMTOR modes. In the ARQ mode (also called Mode A), Station A sends a block of three characters during an interval of 210 milliseconds. The sending system then pauses for 240 milliseconds, during which Station B transmits a single acceptance code.

MODE A - ARQ

In the interactive ARQ mode, all transmitted characters are sent in blocks or groups, each containing three characters. This mode operates between two synchronized or phased stations.

If the receiving system's processor detects an incorrect mark-to- space (ones-to-zeros) polarity ratio, the receiving station's processor or computer sends a command back to the sending station's processor or computer to retransmit the invalid group of characters.

No data are displayed on the screen at the receiving site until it has passed this test, been validated and is essentially error-free.

Data transmission is at 100 bauds, corresponding to a character length of 70 milliseconds. The overall cycle time for a three- character block and the control signal reply is 450 milliseconds.

If the information has been received incorrectly, Station B issues a "request for repetition" (RQ) code. Receiving the RQ code, Station A repeats the three-character block. This process repeats until Station B transmits a second control code, an acceptance code, after which the next three characters are sent as a block.

Station A will display the transmitted text on its display device only after receiving the acceptance code from Station B. This is called "echoing."

A third control code is used to command the direction of sending to be reversed, allowing the receiving station to reply. If there is no data waiting to be sent, Station A will fill the three- character blocks with Idle characters.

Station A can send special blocks to indicate the Selcal of the station being called, a QRT request to put Station B back into the standby mode, acknowledgement of Station B's request to transmit, or a request to repeat a badly received control code.

The receiving station controls the changeover in communication direction. Station A uses a software command, "+?," to indicate the end of his transmission. Station B recognizes the command and initiates the turnaround routine. Station B can also interrupt Station A's transmission with a break-in control code.

The "chirp-chirp" you hear on the air is the characteristic frequency-shift keying in bursts. One of the stations is transmitting a longer burst, allowing a time gap between transmissions during which the other station sends its reply. If both stations have equally loud signals at your location, the "chirp" will sound more or less contin-uous. If one station appears weaker than the other, your receiver AGC may not be fast enough to copy both sides. Try turning the AGC off.

In the ARQ mode, signal fading simply slows the text received on your screen as the stations transmit a higher proportion of retries. The overall accuracy of the data is maintained.

In the ARQ mode, your station must know the identity of the other station. Therefore, FEC (see APPENDIX D) is normally used to call CQ and start a contact. Then stations switch to ARQ. The ARQ mode also allows you to selectively access and activate any other stations monitoring on the frequency.

Your station can usually monitor a contact between two linked stations by using the ARQ Listen mode (also called Mode L). This mode may need a few moments to phase or sync with the other stations. If the linked stations that you are monitoring are experiencing ARQ retries, the your screen will display all of the retries.

The second AMTOR mode is called FEC (Forward Error Correction), or Mode B. FEC provides the means of transmitting to several stations simultaneously. This is the proper mode to use for sending QST or CQ.

FEC is a synchronous system that transmits an uninterrupted stream of characters. FEC does not operate in a "handshake" as does ARQ.

In FEC, the sending station transmits each character twice. The first transmission of a specific character is followed by the transmission of four other characters, after which the retransmission of the first character takes place. This allows for time diversity reception at 280 milliseconds time space.

The receiving station's computer searches the inbound data characters to verify and validate characters having the required 4:3 mark-to-space tone polarity ratio.

If both appearances of the same character are mutilated and fail the polarity-ratio test, no data is printed or displayed. Because the second appearance of the character occurs 280 milliseconds after the first appearance, the mathematical probabilities are that noise bursts will not destroy both appearances of the character.

At the beginning of an FEC transmission, the message is preceded by ten Idle characters. After 28 characters of the message, a sequence of five Idle characters is inserted in each message space, giving the receiving stations a reference timing interval to which they can lock again if necessary.

The code sequence for the repeated idle string is different from the first idle string so that they are identified correctly. The sequence looks like this:

Idle1 - Idle2 - Idle1 - Idle2 - Idle 1, etc.

for ten occurrences. Then each character is transmitted interleaved with four sequential characters and its own repetition.

Unlike ARQ (Mode A), in FEC (Mode B), the transmitter operates at 100% duty cycle. Consult the operating manual and duty-cycle specifications of your radio equipment for the correct operating conditions suitable for RTTY and FEC operation. As a general rule, many recent transmitters must be operated at significantly-reduced power levels to prevent excessive dissipation in the amplifier stages. A 50% reduction in operating power is frequently required.

In FEC and ARQ, accurate synchronization or phasing is necessary. Each station sends phasing bursts at the beginning of each contact, with a crystal clock maintaining the timing relationship during the contact. If the stations lose synchronization lock during the contact, the program provides automatic re-phase procedures.

APPENDIX F

ASYNCHRONOUS VERSUS SYNCHRONOUS TRANSMISSION

Since the beginning of electromechanical telegraphy and teleprinting, the problem of maintaining the proper timing relationship between the sender and the receiver has been resolved by mechanical synchronization methods. These were based on the basic ideas of "start-stop" telegraphy.

The original Baudot rotary distributor permitted the sending distributor to tell the receiving distributor when the rotary contact was at a reference point in the rotation of the motor shaft. The distributor created a start and stop pulse at the beginning and end of each character. In tele-printer operation, each character has carried its own sync information in the form of the traditional "start" element at the beginning of each character, and the "stop" bit at the end of the character.

In some systems, the "stop" element is one, one-and-one-half, or two bits. The result is reduced efficiency - each character will have a fixed amount of "overhead". These housekeeping bits carry no user in-formation. They exist only to keep the sending and receiving machines in sync. This reduced efficiency has kept a lid on higher data rates and has been a block in the constant search for faster ways of sending more information for more people.

As data processing requirements became more demanding, newer forms of synchronization evolved. A method was developed which applied a single synchronizing string to an entire string of characters, rather than include sync information in each character. The "overhead", or housekeeping bits previously inserted into each character for sync purposes were eliminated; higher data rates became practical, without sacrificing data integrity. This newer method, called "synchronous" transmission, is used in higher speed and specialized forms of transmission.

Unlike conventional Baudot and ASCII RTTY operation, both AMTOR modes, ARQ and FEC, use synchronous, rather than asynchronous transmission.

Your computer keyboard sends asynchronous data to your Controller with start and stop bits in each character.

When you enter the AMTOR operating modes, the Controller program routines strip the start and stop bits from the characters and establish the synchronous transmission required in AMTOR.

The Controller has a versatile software program for digital communications techniques that gives you computer-based Morse code, and the choice of four different data transmission codes: Baudot, ASCII, AMTOR, and Packet Radio

The question of transmission speed is discussed separately. It should be understood that the speed at which a digital code is used has no real relationship to the choice of the code itself. As a general rule, any code can be used at any speed within the capacity of the system software.

APPENDIX G

DATA TRANSMISSION CODES

MYTHS AND MISUNDERSTANDINGS

"RTTY" means "Baudot" - not true!

RTTY does not mean Baudot. RTTY is a simple abbreviation for RadioTele-Typewriter. Baudot, ASCII, AMTOR, and packet radio are not exactly different modes. They are different languages and methods within the same mode - RTTY. Think of them this way:

MODE:	Human Speech	RTTY
CODES:	English	Baudot
	French	ASCII
	Spanish	AMTOR
	Italian	Packet

"Baudot Code is Obsolete" - not true!

The largest record communications network in the world today (record communications are systems that leave a permanent record of the traffic passed) is the International Telex Network. Worldwide, there are over one-and-one-half million regular telex subscribers connected to their domestic networks, and in turn, to the International Telex Network through gateway switching systems in each country.

Telex is, by definition, a Baudot code system, operating at 50 bauds (66 WPM) in CCITT International Alphabet Number 2, the same code specified for the amateur radio service in Part 97.69 of the Commission's rules.

Although telex was invented in 1932 and the first automatic telex network established in 1933, until recently with the advent of packet network transmission and switching standards, the telex networks of the world had been growing worldwide at an annual rate of about 22% per year. This does not indicate obsolescence.

Here in the U.S.A. many of the commercial carriers are still enlarging their networks. Instead of abandoning the Baudot code in favor of anything else, they are changing from the traditional 50-baud operating speed to 200- and 300-baud telex, still using Baudot, and generally working into stored program control computer-based telex switching exchanges. In many of these cases, the Baudot code is being retained in those applications where line and circuit noise is greater than the optimal design goals, and not easily improved.

Many manufacturers are still producing Baudot telex and teleprinter systems. What has disappeared is the electromechanical teleprinter. The older teleprinters are being replaced by with all-electronic systems using microprocessor- based terminals with video displays and various types of disk and tape storage. Internally, many of these terminals work with the ASCII and EBCDIC codes.

By means of code- and speed-conversion firmware, these terminals send the Baudot code to the telex and telephone lines for integration into the telex and gentex networks and leased-line services.

At times, the Baudot code has certain advantages over other standardized codes. These advantages are discussed in detail later in these Appendices.

Some newcomers to digital radio are unsure as to which digital code is best to use on a given band under given conditions. This brief tutorial outlines some points of difference between Baudot and ASCII, and explains some of the advantages and disadvantages of both codes.

THE BAUDOT CODE

History

The Baudot/Murray code dates from about 1874, when Emile Baudot, a Lieutenant in the French Telegraph Service, developed the Baudot distributor for telegraphy. This code uses a "start" bit and a "stop" bit to mark the beginning and end of each character, and five information or data bits to identify each character.

With only five information bits, the total number of possible combinations equals 25, or 32. But, our English language has 26 letters (counting upper case only!), 10 numerical digits, and 9 common punctuation characters. That adds up to 45 alpha-numeric characters. How can we transmit at least 45 different characters if the available code only permits 32 code combinations?

The Baudot/Murray codes resolve this seeming paradox by the same stunt used on your old electromechanical typewriter - you shift to FIGS or UPPER CASE. Now, you have the numerical digits, the punctuations, and other useful things like parentheses, cent sign, dollar sign, number sign, "at" sign, asterisk, percent sign, ampersand, underscore, etc. You can handle 64 possibilities. That's fine - if you never need to handle anything but text message traffic or connect to computers!

Code Variations

Over the years, different versions of the same code have evolved, creating some confusion in both domestic and international traffic. Western Union, the Bell System, the Weather Bureau, the F.A.A., the Armed Forces, the Associated Press, all versions of the same code. Some users could not get together on the same keyboard configurations.

When the International Telex Network was formed before World War II, telex users had yet another version of the Baudot/Murray code, called International Telegraph Alphabet Number 2.

Although still the most widely used data transmission code in the world (the International Telex Network is still the largest of all record communications networks), the Baudot/Murray code has the following two serious drawbacks:

1. The code makes no provision for parity or any other built-in method of detecting transmission or reception errors. This means the receiving system has no way of telling if an error has occurred.

2. The code is sequential - a specific control character defines the identity of the following series of characters for a period of time until a new control character is recognized. FIGURES SHIFT is an example.

The two control characters which identify the shift, or "case" are "LETTERS" and "FIGURES". Those who operated in the days of electromechanical teleprinters and Teletype machines know what happened when the data was kicked into upper case by a noise hit, and how frustrating it was to have lines of unintelligible stuff.

Applications

Baudot/Murray code is still the most widely used RTTY code in amateur radio, and this will probably continue for some years to come. Even with its limitations, Baudot still has some advantages for the amateur operator.

THE ASCII CODE
(American Standard Code for Information Interchange)

Contrary to what many computer enthusiasts will tell you, ASCII is an extension of the eight-bit code developed decades ago and used for years in the Bell System TWX network. ASCII was published as a standard by ANSI, the American National Standards Institute around 1963, in order to achieve some degree of compatibility for the newborn data communications field. ASCII is also known as International Alphabet Number 5, and is standardized for international traffic at various data rates.

ASCII uses seven bits to define each character. That give us a maximum of 2^7, or 128 possible combinations. We now have the ability to transmit upper case and lower case letters, all punctuations, ten digits, and control codes such as "start of text", "end of text", "horizontal tab", "vertical tab", "form feed", "backspace", and many other control functions unavailable in Baudot.

ASCII is **not** an eight-bit code; the eighth bit is reserved for a parity function, a form of error detection. Many ASCII systems do not require the eighth bit for parity and operate well without it.

OTHER DATA CODES

Baudot code was fine in the days when all communiction was between humans. But as technology developed and machines had to start communicating with other machines without involving humans, better and more efficient codes had to be developed for transmitting information, so that the machines themselves could evaluate the received information and request repeats as needed in the event of errors being received.

As data processing first evolved and data communication codes were developing, the data processing systems used their own codes, one of the first of these being "BCD," Binary Coded Decimal. BCD was used for internal calculations inside a data processing device. BCD has no alpha characters, only numbers, and thus was unsuitable as a communications code for use by humans.

BCDIC — (Binary Coded Decimal Interchange Code) was developed when the data processing systems had to communicate with humans in printed characters on a printing device. This code was fine for communication with humans, but was unsuitable for machine-to- machine communications because it lacked any form of parity or error-checking capabilities.

BCDIC had the same problem as did Baudot - a machine could not tell when an error occurred in transmission.

EBCD — (Extended Binary-Coded Decimal) solved the parity problem when it was developed for the IBM Selectric typewriters. The Selectric principle allowed the typing and printing of hard copy while at the same time, generating a unique code suitable for transmission over a communications facility. Also known in the field as PTTC (Paper Tape Transmission Code), this code used six information bits and a parity bit which permitted the receiving system to determine if an error had occurred in a specific character. But, Extended BCD is a sequential code with upper case and lower case characters. So, while parity could detect errors and provoke repeats, the sequential nature of the code made its efficiency less than desirable.

EBCDIC — (Extended Binary-Coded Decimal Interchange Code) was developed in 1962 and, with its 8 bits, was capable of transmitting 256 characters. But for communications, EBCDIC might be deemed a backward step, because it had no parity capability. Some users who do not need all 256 characters have redefined the code using EBCDIC as a base and identifying particular characters with odd or even parity bits. Although there are occasional compatibility problems because of parity definitions varying between users, EBCDIC is still widely used in data processing communications systems.

Still Other Codes — Several other data codes are in use today, some of them dating back decades. Hollerith Code, developed more that 80 years ago, is still used commercially and is generally associated with punched-card systems. There are others such as Jaquard Code, Moore ARQ code, Syntoc code, AP code, and others too numerous to list here.

APPENDIX H

ASCII TO DECIMAL TO HEX CONVERSION

ASCII	DECIMAL	HEX
NUL	0	00
SOH	1	01
STX	2	02
ETX	3	03
EOT	4	04
ENQ	5	05
ACK	6	06
BEL	7	07
BS	8	08
HT	9	09
LF	10	0A
VT	11	0B
FF	12	0C
CR	13	0D
SO	14	0E
SI	15	0F
DLE	16	10
DC1	17	11
DC2	18	12
DC3	19	13
DC4	20	14
NAK	21	15
SYN	22	16
ETB	23	17
CAN	24	18
EM	25	19
SUB	26	1A
ESC	27	1B
FS	28	1C
GS	29	1D
RS	30	1E
US	31	1F
SPACE	32	20

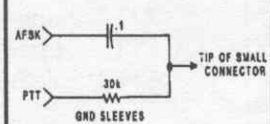
ASCII	DECIMAL	HEX
!	33	21
"	34	22
#	35	23
$	36	24
%	37	25
&	38	26
'	39	27
(	40	28
)	41	29
*	42	2A
+	43	2B
,	44	2C
-	45	2D
PERIOD	46	2E
/	47	2F
0	48	30
1	49	31
2	50	32
3	51	33
4	52	34
5	53	35
6	54	36
7	55	37
8	56	38
9	57	39
:	58	3A
;	59	3B
<	60	3C
=	61	3D
>	62	3E
?	63	3F
@	64	40

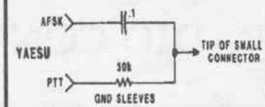
ASCII	DECIMAL	HEX
A	65	41
B	66	42
C	67	43
D	68	44
E	69	45
F	70	46
G	71	47
H	72	48
I	73	49
J	74	4A
K	75	4B
L	76	4C
M	77	4D
N	78	4E
O	79	4F
P	80	50
Q	81	51
R	82	52
S	83	53
T	84	54
U	85	55
V	86	56
W	87	57
X	88	58
Y	89	59
Z	90	5A
[	91	5
\	92	5C
]	93	5D
	94	5E
_	95	5F
`	96	60

ASCII	DECIMAL	HEX
a	97	61
b	98	62
c	99	63
d	100	64
e	101	65
f	102	66
g	103	67
h	104	68
i	105	69
j	106	6A
k	107	6B
l	108	6C
m	109	6D
n	110	6E
o	111	6F
p	112	70
q	113	71
r	114	72
s	115	73
t	116	74
u	117	75
v	118	76
w	119	77
x	120	78
y	121	79
z	122	7A
{	123	7B
|	124	7C
}	125	7D
~	126	7E
DELETE	127	7F

APPENDIX I

SPECIFIC RADIO CONNECTIONS

MFG	RADIO	PIN OUT	NOTES
HEATH	HW-101	AFSK 1 AFSK 2 GND sleeve	RX audio available on tip phono connector.
	HW-2036A	Microphone wires AFSK white PTT red GND shield	RX audio available on tip of phono connector
	HW-5400	AFSK 1 PTT 3 GND 2	RX audio available on tip of phono connector.
	SB-104A	AFSK 1 PTT 2 GND sleeve	RX audio available on tip of phono connector.
	VF-7401	AFSK 2 PTT 1 GND sleeve	RX audio available on tip of phono connector.
ICOM	4-pin	AFSK 1 PTT 2 GND 3	
	8-pin	AFSK 1 PTT 5 GND 6,7	RX audio available on pin 8 of some radios.
	HTs		RX audio available on tip of large connector.

MFG	RADIO	PINOUT	NOTES
YAESU	4 pin	AFSK 2 PTT 3 GND 1	
	8-pin	AFSK 8 PTT 6 GND 7	FT-270/2700 require DC mike blocking capacitor and a diode in series with PTT line.
	FT-x03 x09 727		RX audio available on tip of large connector.
	FT-208	AFSK 1 PTT 3 GND 4	RX audio on pin 2.
KENWOOD	4-pin	AFSK 1 PTT 2 GND 3,4	
	5-pin	AFSK 1 PTT 2 GND 4,5	
	6-pin	AFSK 1 PTT 2 GND 6	
	8-pin	AFSK 1 PTT 2 GND 7,8	
	TR-2500		RX audio available on tip of small connector.
	TR-x600 TH-x1		RX audio available on tip of small connector.
TEN-TEC	4-pin	AFSK 1 PTT 3 GND 2	
	1/4" stereo	AFSK ring PTT tip GND sleeve	

MFG	RADIO	PINOUT	NOTES
AZDEN	12-pin	AFSK 12 PTT 9 GND 2,11	
	8-pin	AFSK 1 PTT 7 GND 2	
DRAKE	4-pin	AFSK 1 PTT 2 GND 3	
	1/4" stereo	AFSK ring PTT tip GND sleeve	

NOTE: The above information was obtained from various sources, and the Heath Company assumes no responsibility for its accuracy. Please consult your particular radio's manual for verification.

APPENDIX J

PRINTER INFORMATION

Abbreviations used:

1. cps = characters per second
2. col = columns, characters per line
3. dpi = dots per inch
4. LPM = lines per minutes
5. LQ = letter quality
6. NLQ = near letter quality

Printer	Features	Type
AMT 2002	250 cps, 16-pin	
Addmaster 170	matrix, 50 cps, 18/21 col	
Addmaster 180	matrix, 48 cps, 34/40 col	
Adeus CP/2000		daisy
Alphacom 81	thermal, 80 cps, 80 dpi, 80 col	
Alphacom 1842	thermal, 80 cps, 80 dpi, 80 col	
Alphacom Sprinter 20	matrix, 20 col	
Alphacom Sprinter 40	matrix, 40 col	
Alps ALQ-218	200 cps, 18-pin	
Alps ALQ-324	240 cps, 24-pin	
Alps P2000	250 cps, 9-pin	
Alps P2100	400 cps, 18-pin	stylus
Amdek 5025	25 cps, LQ	
Amdek 5040	40 cps, LQ	daisy
Amperex GP300	matrix, 300/80 cps, 122/144 col	
Anacom 150	matrix, 150 cps, 136 col	
Anacom 150Z	matrix, 180 cps, 40/220 col	
Anacom 160	matrix, 150 cps, 80 col	
Anacom 160Z	matrix, 150 cps, 80 col	
Anadex WP-6000	230 cps, 18-pin	
Anadex DP-6500	500 cps, 18-pin	
Anadex DP-8000	matrix, 112 cps, 80 col	
Anadex DP-8000 AP	matrix, 134 cps, 96 col	

Printer	Features	Type
Anadex DP-9000	150 cps, 80 col	PRTYPE 12, 14
Anadex DP-9001	120 cps, 80 col	
Anadex DP-9500	150 cps, 15"	PRTYPE 12-15
Anadex DP-9501	120 cps, 15"	
Anadex DP-9510		
Anadex DP-9620	200 cps	
Anadex DP-9625	240 cps, 9-pin	
Antex ADS-2000		PRTYPE 0, 2
Apple Dot Matrix	predecessor to Imagewriter	PRTYPE 12, 14
Apple Imagewriter I		PRTYPE 12, 14
Apple Imagewriter II		
Apple Prowriter		PRTYPE 12, 14
Axiom AT-100		
Axiom AT-550		
Axiom EX-401	192 cps, 8-pin, 5"	
Axiom EX-801 Micro Printer	matrix, 20/80 col	
Axiom EX-1620	960 cps, 144 dpi	
Axiom GP-80M	matrix, 30 cps, 80 col	
Axiom GP-100	50 cps, 60 dpi, 80 col	
Axiom GP-550	50 cps	
Axiom GP-700	color	
Axiom IMP-1	matrix, 100 cps, 80/96/132 col	
Axiom IMP-2	matrix, 100 cps, 80/96/132 col	
Axiom IMP-3	matrix, 100 cps, 80 col	
Axiom IMP-4	matrix, 100 cps, 80 col	
BMC 401	LQ	daisy
BMC BX-80		PRTYPE 48, 50
BMC BX-100		PRTYPE 48-51?
Base 2 800MST	matrix, 100 cps, 80/132 col	
Base 2 850MST	matrix, 100 cps, 80/132 col	
Blue Chip M120/10		PRTYPE 48, 50
Blue Chip M120/15		PRTYPE 48-51
Brother HR-1	16 cps	
Brother HR-11		daisy
Brother HR-15	13 cps, LQ	daisy
Brother HR-25	23 cps	daisy
Brother HR-20		daisy
Brother HR-35		daisy
Brother M-1009		PRTYPE 4, 6
Brother M-1109 (Mode I)		PRTYPE 0, 2
Brother M-1109 (Mode II)		PRTYPE 4, 6
Brother M-1409	matrix	
Brother M-1509	matrix	PRTYPE 0, 2
Brother M-1709	200 cps, 9-pin	PRTYPE 0, 2
Brother M-2024	160 cps, 24-pin	
Brother Twinwriter 5		PRTYPE 0, 2
Cal-Abco Legend 800		PRTYPE 0, 2
Canon A-50	180 cps, 9-pin	
Canon A-60	200 cps, 18-pin	
Canon A1200		PRTYPE 12, 14
Canon LBP-8A-1P		laser
Canon LBP-8A-2P		laser

Printer	Features	Type
Canon PW-1156A		PRTYPE 0-3
Centronics GLP		PRTYPE 0, 2
Centronics H-80	140 cps, 60-240 dpi	PRTYPE 0, 2
Centronics H136A		PRTYPE 0, 2
Centronics 122G	120 cps	
Centronics 122-1		
Centronics 150	matrix, 150 cps, 80 col	
Centronics 152	matrix, 150 cps, 80 col, wide	
Centronics 351	200 cps, 132 col, 66 dpi	PRTYPE 0-3
Centronics 352	200 cps, 132 col	PRTYPE 0-3
Centronics 353	200 cps, 132 col, 66 dpi	PRTYPE 0-3
Centronics 357	400 cps, 66.7 dpi	
Centronics 358	400 cps, 66.7 dpi	no graphics
Centronics 700	matrix, 69 cps, 132 col	
Centronics 701	matrix, 60 cps, 132 col	
Centronics 702	matrix, 120 cps, 132 col	no graphics
Centronics 703	matrix, 180 cps, 132 col	no graphics
Centronics 704	matrix, 180 cps, 132 col, serial	no graphics
Centronics 730	matrix, 100 cps, 80 col	
Centronics 737	matrix, 100 cps, 80 col	no graphics
Centronics 739	matrix, 100 cps, 80/132 col, serial	
Centronics 753	matrix, 150 cps, 80 col	
Centronics 761	matrix, 30 cps, 132 col	
Centronics 779	matrix, 60 cps, 80 col	
CIE 3500	350 cps	
Citizen MSP-10 (IBM mode)	160 cps, 80 col	PRTYPE 4, 6
Citizen MSP-15 (IBM mode)	160 cps, 132 col	PRTYPE 4-7
Citizen MSP-20 (IBM mode)	200 cps, 80 col	PRTYPE 4, 6
Citizen MSP-25 (IBM mode)	200 cps, 132 col	PRTYPE 4-7
Citizen Premiere 35		daisy
Citizen 120-D	120 cps, 9-pin	PRTYPE 0,2,4,6
Citizen Tribute 224	200 cps, 24-pin	
Commodore MPS 801	same as 1525	
Commodore 1525	30 cps, 60 dpi, 7-pin	PRTYPE 36
Commodore 1526	50 cps, 8-pin	
Commodore 4022	matrix, 30 cps, 40 col	
Comrex ComRiter1		daisy
Comrex ComRiter2		daisy
Comrex ComRiter3		daisy
Comrex 420 IBM		
Coosol 101B-48E	matrix, 100 cps, 48 col	
Coosol 101B-80E	matrix, 160 cps, 80 col	
Coosol 102B-132E	matrix, 160 cps, 132 col	
Copal SC-1200		PRTYPE 0, 2
Copal SC-1500		PRTYPE 0, 2
Copal SC-5500		PRTYPE 0, 2
Cordata LP-300		laser
DTC 380 Z		daisy
Daisywriter 2000	40 cps	daisy
Dana/Abati LQ-20P	18 cps, 15", LQ	
Data ED DE-80SG	matrix, 80 col, serial	
Dataproducts M-100	matrix, 130 cps, 132 col	

Printer	Features	Type
Dataproducts B-600-3	600 LPM	
Dataproducts 8010	180 cps	
Dataproducts 8012	180 cps, 9-pin	
Dataproducts Prism 8050	200 cps, 132 col	PRTYPE 20?
Dataproducts 8051		
Dataproducts 8070	400 cps, 18-pin	PRTYPE 20?
Datasouth DS-180	180 cps, 15", serial, 75 dpi, 9-pin no graphics	
Datasouth DS-220	220 cps, 60/120 dpi no graphics	
Datasouth Personal Printer I		PRTYPE 0, 2
Datasouth Personal Printer II		PRTYPE 0, 2
DECwriter LA34	matrix, 30 cps, 132 col, serial	
DECwriter LA35	matrix, 30 cps, 132 (Graphics II)	
DECwriter LA36	matrix, 30 cps, 132 col (Graphics II)	
DECwriter LA120	matrix, 120 cps, 132 col, serial	PRTYPE 4-7
DECwriter Letterprint 100	matrix, 240 cps, 132 col, serial	
Diablo Hytype II		
Diablo D25		
Diablo P-11	100 cps	
Diablo P-31	wide	
Diablo P-32 CQ1		
Diablo 620	20 cps, serial	daisy
Diablo 630	40 cps, serial	daisy
Diablo 635		daisy
Diablo D-80 1F		
Diablo 34LQ		PRTYPE 4, 6
Diablo RO-630	25 cps, 132 col	daisy
Diablo KSR-1640	45 cps, 132 col, serial	daisy
Diablo KSR-1650	45 cps, 132 col, serial	daisy
Dip-81	matrix, 100 cps, 40/80 col	
Dip-82	matrix, 100 cps, 80 col, serial	
Dip-84	matrix, 100 cps, 40/80 col	
Dip-85	matrix, 100 cps, 80/132 col	
Dynax DM-40	dot matrix	
Dynax DX-5	thermal, 30 cps, 60 dpi	
Dynax DX-15	same as Brother HR-15	daisy
Dynax DX-25		daisy
Dynas HR-25	18 cps	daisy
Dynax HR-35	33 cps	daisy
Eaton 7000+40	matrix, 125 cps, 40 col	
Eaton 7000+64	matrix, 125 cps, 64 col	
Epson DX-10		daisy
Epson DX-35	35 cps, LQ	daisy
Epson EX-800	300/60 cps, 80 col	PRTYPE 0, 2
Epson EX-1000	250 cps, 132 col, 9-pin	PRTYPE 0-3
Epson FX-70		PRTYPE 0, 2
Epson FX-80	160 cps	PRTYPE 0, 2
Epson FX-85	160 cps	PRTYPE 0, 2
Epson FX-100	160 cps, 15"	PRTYPE 0-3
Epson FX-185	160 cps, 15"	PRTYPE 0-3
Epson FX-286	160 cps, 132 col	PRTYPE 0-3

Printer	Features	Type
Epson HS-80		
Epson HW-100	100 cps	
Epson JX-80 color		PRTYPE 0, 2
Epson LQ-400		
Epson LQ-800	180/60 cps, 80 col, 24 pins	PRTYPE 0, 2
Epson LQ-1000	180/60 cps, NLQ, 24 pins	
Epson LQ-1500	200 cps, 24 pins, 60-240 dpi	PRTYPE 0, 2
Epson LQ-2500	270 cps, 24-pin	
Epson LX-80 (Homewriter 10)	120 cps, 10"	PRTYPE 0, 2
Epson LX-86	120 cps	PRTYPE 0, 2
Epson MX-70	80 cps, 80 col	PRTYPE 0, 2
Epson MX-80 III		PRTYPE 0, 2
Epson MX-80 with Graftrax 80	80 cps, 80 col	PRTYPE 40, 42
Epson MX-85		PRTYPE 0, 2
Epson MX-100	80 cps, 15"	PRTYPE 0-3
Epson MX-185		PRTYPE 0, 2
Epson P-80		PRTYPE 0, 2
Epson RX-70		PRTYPE 0, 2
Epson RX-80	100 cps	PRTYPE 0, 2
Epson RX-85		PRTYPE 0, 2
Epson RX-100		PRTYPE 0-3
Epson RX-185		PRTYPE 0, 2
Facit 4510	matrix, 120 cps	
Facit 4511	matrix, 158 cps	
Facit 4525	matrix, 150 cps, 80 col	
Facit 4526	matrix, 150 cps, 132 col	
Florida Data OSP-120	matrix, 600 cps, 198 col, serial	
Florida Data OSP-300		
Fujitsu DPMG9	18 cps, 60/120/240 dpi	
Fujitsu DPL-24	240 cps, 90/180 dpi, 24-pin	daisy?
Fujitsu SP-320	40 cps	daisy
Fujitsu SP-830	80 cps, 163 col, serial	daisy
Fujitsu DX-2100		
Fujitsu DX-2200	220 cps, 9-pin	
Fujitsu DL-2400		
Fujitsu DL-2600	288 cps, 24-pin	
Fujitsu DM-2400		
Genicom 1020	200 cps, 18-pin	
Genicom 3014		PRTYPE 0, 2
Genicom 3024		PRTYPE 0, 2
Genicom 3210	240 cps, 8-pin	
Genicom 3310 (IBM-GP mode)		PRTYPE 44-47
Genicom 3320 (IBM-GP mode)		PRYTPE 44-47
Genicom 3410	400 cps, 18-pin	
Heath H-14	matrix, 40 cps, 80 col, serial	
Heath H-25	matrix, 150 cps, 132 col, serial	
Hewlett-Packard HP-2225	150 cps, 90/180 dpi	no graphics
Hewlett-Packard HP-2671	120 cps, 90 dpi	no graphics
Hewlett-Packard HP-2673	120 cps, 90 dpi, 80 col	no graphics
Hewlett-Packard HP-82905	80 cps, 60/120 dpi, 9-pin	no graphics
Hewlett-Packard HP-2932	200 cps, 90 dpi	no graphics

Printer	Features	Type
Hewlett-Packard HP-2933	200 cps, 90 dpi	no graphics
Hewlett-Packard HP-2934	200 cps, 90 dpi	no graphics
Hewlett-Packard HP-2601	40 cps	daisy
Hi-G 9/80	matrix, 150 cps, 80 col	
Hi-G 9/132	matrix, 150 cps, 132 col	
Howard Typrinter 221	20 cps, 132 col, serial	daisy
IBM Color		PRTYPE 4, 6
IBM Graphics		PRTYPE 4, 6
IBM Proprinter		PRTYPE 4, 6
IBM Proprinter XL	200 cps, 9-pin	
IBM Prowriter		
IBM Prowriter XL		
IBM Quietwriter		daisy
IDS Microprism 480	110 cps, 80 col	
IDS Paper Tiger 445	198 cps, 80/132 col	6-pin
IDS Paper Tiger 460	matrix, 150 cps, 80 col	
IDS Paper Tiger 560	matrix, 198 cps, 132 col	
IDS Prism 80	200 cps, 80 col	PRTYPE 8?
IDS Prism 132	200 cps, 132 col	PRTYPE 8?
Inforunner Riteman		PRTYPE 0, 2
Infoscribe 500	matrix, 150 cps, 136 col	
Infoscribe 1000	matrix, 200 cps, 136 col	
Infoscribe 1100	200 cps, 9-pin	
Infoscribe 1500	matrix, 360 cps, 136 col	
Infoscribe 1400	400 cps, 18-pin	
C. Itoh Comet I	matrix, 125 col, 80 col	
C. Itoh Comet II	matrix, 125 col, 136 col	
C. Itoh Gorilla GX-100		PRTYPE 36
C. Itoh Starwriter A10-20		daisy
C. Itoh Starwriter A10-30SP	18 cps	
C. Itoh C10		
C. Itoh D10-40		
C. Itoh Starwriter F10-40PU	40 cps, LQ	daisy
C. Itoh Printmaster F10-55PU	55 cps	
C. Itoh Riteman II		PRTYPE 0, 2
C. Itoh LQ24		
C. Itoh 620		
C. Itoh 630		
C. Itoh Prowriter 1550	120 cps, 15"	PRTYPE 16-19
C. Itoh 7500		PRTYPE 12-15
C. Itoh Prowriter 8510 A	120 cps, 136 col	PRTYPE 16-19
C. Itoh Prowriter 8510 B	120 cps	PRTYPE 16, 18
C. Itoh Prowriter 8510 S	180 cps	PRTYPE 16, 18
C. Itoh Prowriter 8510 SC		PRTYPE 16, 18
C. Itoh Prowriter 8510 SEP		PRTYPE 4, 6
C. Itoh 8600		
Juki 5500		
Juki 5510		
Juki 6000		daisy
Juki 6100	18 cps	daisy
Juki 6300		daisy

Printer	Features	Type
Leading Edge Gorilla Banana		PRTYPE 36
Legend 880	80 cps, 80/160 dpi	PRTYPE 0, 2?
Legend 1000		PRTYPE 0, 2?
Legend 1080		PRTYPE 0, 2?
Legend 1081		PRTYPE 0, 2?
Legend 1200		PRTYPE 0, 2?
Legend 1500		PRTYPE 0, 2?
Legend 1380		PRTYPE 0, 2?
Legend 1385		PRTYPE 0, 2?
MPI 88G	matrix, 100 cps, 80/132 col	
Mannesmann Tally 85 (Epson mode)		PRTYPE 0, 2
Mannesmann Tally 85 (IBM mode)		PRTYPE 4, 6
Mannesmann Tally 86 (Epson mode)		PRTYPE 0, 2
Mannesmann Tally 86 (IBM mode)		PRTYPE 4, 6
Mannesmann Tally 160L	160 cps, 80 col	PRTYPE 0, 2
Mannesmann Tally 180L	180 cps, 132 col	PRTYPE 0, 2?
Mannesmann Tally MT-290 (Epson)	200 cps, 9-pin	PRTYPE 0, 2
Mannesmann Tally MT-290 (IBM)	200 cps, 9-pin	PRTYPE 4, 6
Mannesmann Tally MT-490	400 cps, 18-pin	PRTYPE 0,1,4,5
Mannesmann Tally 420L-112		
Mannesmann Tally Spirit 80	80 cps, 80/160 dpi	PRTYPE 48, 50
Mannesmann Tally 1602		PRTYPE 0, 2?
Mannesmann Tally 1605		PRTYPE 0, 2?
Mannesmann Tally 1800	matrix, 200 cps, 132 col	PRTYPE 0, 2?
Mannesmann Tally 1802		PRTYPE 0, 2?
Mannesmann Tally 1805	200 cps, serial	PRTYPE 0, 2?
Mannesmann Tally 8024L		
Matra SCANSET		PRTYPE 4-7
Micro Peripherals Printmate 99	100 cps, 50/60/75/85 dpi	
Micro Peripherals Printmate 150	150 cps, 50-85 dpi, wide	
Micro Peripherals Sprinter	160 cps, 50-85 dpi	
Microtek Tekwriter-1	matrix, 80 cps, 80 col	
Microtek Bytewriter 1	same as Tekwriter-1	
Microtek Tekwriter-2	matrix, 80 cps, 132 col	
Microtek MT-80	matrix, 125 cps, 80 col	
NEC ELF		daisy
NEC Pinwriter P1 18 pins		
NEC Pinwriter P2-2	180 cps, 18 pins, 10"	
NEC Pinwriter P2-3	180 cps, 18 pins, 10"	
NEC Pinwriter P2-7	180 cps, 18 pins, 10"	
NEC Pinwriter P3-2	180 cps, 15"	
NEC Pinwriter P3-3	180 cps, 15"	
NEC Pinwriter P3-7	180 cps, 15"	
NEC Pinwriter P5	290 cps	
NEC Pinwriter XL	290 cps, 24-pin	
NEC Pinwriter P6	216 cps	PRTYPE 0, 2
NEC CP6		
NEC Pinwriter P7	216 cps, 132 col	PRTYPE 0-3
NEC CP7		
NEC P560		
NEC P760		

Printer	Features	Type
NEC 2000		daisy
NEC 2010	20 cps	
NEC 2015		
NEC 2030	20 cps, LQ	
NEC 2050	20 cps, LQ	daisy
NEC 2525	daisy	
NEC Spinwriter 3500		daisy
NEC Spinwriter 3510	33 cps, serial, 15"	daisy
NEC 3515		daisy
NEC 3520		daisy
NEC Spinwriter 3530	33 cps, LQ	daisy
NEC Spinwriter 3550	35 cps, LQ	daisy
NEC 5510	55 cps, 132 col, serial	thimble
NEC 5520	55 cps, 132 col, serial	thimble
NEC 5530	55 cps, 132 col, serial	thimble
NEC Spinwriter 7700		daisy
NEC Spinwriter 7710	55 cps, serial	
NEC 7715		
NEC Spinwriter 7720		
NEC 7725		
NEC Spinwriter 7730	55 cps	
NE 8023	100 cps	PRTYPE 12, 14
NEC 8025		
NEC 8027		
NEC 8810		daisy
NEC 8830		daisy
NEC 8850		55 cps, LQ daisy
Newbury OSP-3	22 cps, 18-pin	
Nissho NP-910	350 cps, 9-pin	
Nissho NP-2410	300 cps, 24-pin	
Okidata Okimate 20 (IBM mode)		PRTYPE 4-7
Okidata 80	80 cps, 80 col	
Okidata ML82A with Okigraph I	120 cps, 80 col	PRTYPE 20
Okidata ML83A with Okigraph I	120 cps, 132 col (15")	PRTYPE 20-21
Okidata ML84 (IBM mode)	200 cps, 136 col (15")	PRTYPE 4-7
Okidata ML92 (IBM mode)	160 cps, 80 col	PRTYPE 4
Okidata ML92 (Oki mode) 1	60 cps, 80 col	PRTYPE 20
Okidata ML93 (IBM mode)	160 cps, 136 col (15")	PRTYPE 4-7
Okidata ML93 (Oki mode)	160 cps, 136 col (15")	PRTYPE 20, 21
Okidata 94		
Okidata 120 NLQ		
Okidata ML182 (IBM mode)	120 cps, 80 col	PRTYPE 4, 6
Okidata ML183 (IBM mode)		PRTYPE 4-7
Okidata 192	160 cps	PRTYPE 24, 26
Okidata 192+	216 cps	
Okidata 193		PRTYPE 24-27
Okidata 193+	200 cps, 9-pin	
Okidata 292	200 cps, NLQ	
Okidata 293	200 cps, 15"	
Okidata 294	400 cps, 18-pin	
Okidata 801		

Printer	Features	Type
Okidata 2350 Pacemark	350 cps	
Okidata 2410 Pacemark	350 cps	
Olivetti DY-211	20 cps, 132 col, serial	daisy
Olivetti DY-311	32 cps, 150 col, serial	daisy
Olivetti DY-811	65 cps, 150 col, serial	daisy
Olivetti DM-80/180	matrix, 80 cps, 150 col	
Olivetti DM-280		PRTYPE 0, 2
Olivetti DM-290		PRTYPE 0-3
Olympia Compact 2		
Olympia Compact RO		
Olympia ES100		daisy
Olympia ESW 3000		daisy
Olympia Needlepoint	matrix	
Olympia NP-136	200 cps, 9-pin	
Orange Micro		
OTC OT-700	700 cps, 9-pin	
Panasonic KX-P1080i	120 cps, 9-pin	PRTYPE 0, 2
Panasonic KX-P1090		PRTYPE 0, 2
Panasonic KX-P1090i		
Panasonic KX-P1091	120 cps	PRTYPE 0, 2
Panasonic KX-P1091i	160 cps, 9-pin	
Panasonic KX-P1092	180 cps	PRTYPE 0, 2
Panasonic KX-P1092i	240 cps, 9-pin	
Panasonic KX-P1093		
Panasonic KX-P1592	240 cps, 15"	PRTYPE 0-3
Panasonic KX-P1595	240 cps, 15"	
Panasonic KX-P3131		daisy
Panasonic KX-P3151		daisy
Personal Micro DMP-85		PRTYPE 12, 14
Pertec Stylist 360	17 cps, 198 col	daisy
Printek 910	matrix, 170 cps, 80 col	
Printek 920	matrix, 340 cps, 80 col	
Printers Plus NLQ		PRTYPE 0, 2
Printronix P300	300 LPM	no graphics
Printronix P600	600 LPM	no graphics
Printronix P1013	178 cps, 24-pin	
Prism see IDS Prism		
Qantex 7020		
Qantex 7030		
Qantex 7040		
Qantex 7065		
Qume Letterpro	20 cps	daisy
Qume Sprint 5/45	45 cps, 132 col	daisy
Qume Sprint 5/55	55 cps, 132 col	daisy
Qume Sprint 9/35	35 cps, 132 col	daisy
Qume Sprint 9/45	45 cps, 132 col	daisy
Qume Sprint 9/55	55 cps, 132 col	daisy
Qume Sprint 11/40+	40 cps, 132 col	daisy
Qume Sprint 11/45	45 cps	daisy
Qume Sprint 11/55	55 cps	daisy
Qume Sprint 11/90	90 cps	daisy

Printer	Features	Type
Qume Sprint Widetrack	55 cps, 240 col	daisy
Radio Shack Daisywheel II	43 cps, 136 col	daisy
Radio Shack Lineprinter IV	50 cps, 80 col	
Radio Shack Lineprinter V	120 cps, 132 col	
Radio Shack Lineprinter VI	100 cps, 132 col	
Radio Shack Lineprinter VII	30 cps, 40 col	PRTYPE 8
Radio Shack Lineprinter VIII	80 cps, 80 col	PRTYPE 8
Radio Shack Quick Printer II	matrix, 32 cps, 16 col	
Radio Shack DMP-100	60 dpi	PRTYPE 8
Radio Shack DMP-105		PRTYPE 8
Radio Shack DMP-110	120 dpi	PRTYPE 8
Radio Shack DMP-120	120/200 dpi	PRTYPE 8
Radio Shack DMP-130	100 cps, 9-pin	PRTYPE 8, 4, 6
Radio Shack DMP-200	120/144/200 dpi	PRTYPE 8
Radio Shack DMP-400 (DMP emul.)	60/72/100 dpi	PRTYPE 8
Radio Shack DMP-420 (DMP emul.)	60/72/100 dpi	PRTYPE 8
Radio Shack DMP-430	180 cps, 18 pins	PRTYPE 4, 6
Radio Shack DMP-500 (DMP emul.)	60/72/100 dpi	PRTYPE 8
Radio Shack DMP-2100		PRTYPE 4, 6
Radio Shack DMP-2110	240 cps, 24-pin	PRTYPE 8
Radio Shack DMP-2200	380 cps	PRTYPE 4-9
Radio Shack CGP-220	80 dpi	PRTYPE 8
Ricoh RP1200		daisy
Ricoh RP1300		daisy
Ricoh RP1500		daisy
Ricoh RP1600		daisy
Ricoh RP2200		daisy
Ricoh RP3400		daisy
Sakata SP-1000		PRTYPE 0, 2
Sakata SP-1500		PRTYPE 0, 2
Seikosha GP-100		PRTYPE 36
Seikosha GX-100		PRTYPE 36
Seikosha SL-80	135 cps, 24-pin	
Seikosha SP-1000 A		PRTYPE 0, 2
Seikosha SP-1000 VC (E-64)		PRTYPE 36
Seikosha SP-1000 IBM		PRTYPE 4, 6
Seikosha SP-1000 AS		PRTYPE 0, 2
Seikosha SP-1000 AP, AP IIc		
Seikosha BP-1300		
Seikosha BP-5200		
Seikosha BP-5420	420 cps, 8-pin	
Seikosha MP-1300	300 cps, 9-pin	
Silver Reed EXP-400		daisy
Silver Reed EXP-420		
Silver Reed EXP-500	16 cps	daisy
Silver Reed EXP-550	20 cps, 132 cols	daisy
Silver Reed EXP-600		daisy
Silver Reed EXP-770	36 cps	daisy
Silver Reed EXP-800		daisy
Smith Corona TP-1	12 cps, 105/125 col	daisy
Smith Corona D-100		PRTYPE 0, 2

Printer	Features	Type
Smith Corona D-200 (standard)	120 cps	PRTYPE 0, 2
Smith Corona D-200 (IBM)	120 cps	PRTYPE 4, 6
Smith Corona D-300 (standard)	140 cps	PRTYPE 0, 2
Smith Corona D-300 (IBM)	140 cps	PRTYPE 4, 6
Smith Corona Fastext 80		PRTYPE 0, 2
Smith Corona TP-1000		PRTYPE 0,2,4,6
Star COEX 80-FT	9 pins	
Star LV12-10		
Star Gemini 10		PRTYPE 28
Star Gemini 15		PRTYPE 28-29
Star Gemini 10X		PRTYPE 32, 34
Star Gemini 15		PRTYPE 32-35
Star Gemini 10XPC		PRTYPE 4, 6
Star Gemini 15XPC		PRTYPE 4-7
Star Gemini 10X Plus		PRTYPE 0, 2
Star Gemini 15X Plus		PRTYPE 0-3
Star Micronics SG-10 (Star mode)		PRTYPE 32, 34
Star Micronics SG-15 (Star mode)		PRTYPE 32-35
Star Micronics SG-10 (IBM mode)		PRTYPE 4, 6
Star Micronics SG-15 (IBM mode)		PRTYPE 4-7
Star Delta 10		PRTYPE 32, 34
Star Delta 15		PRTYPE 32-35
Star Delta 10 PC		PRTYPE 4, 6
Star Delta 15 PC		PRTYPE 4-7
Star Delta 10 Plus		PRTYPE 0, 2
Star Delta 15 Plus		PRTYPE 0-3
Star Micronics SD-10 (Star mode)	160 cps	PRTYPE 32, 34
Star Micronics SD-15 (Star mode)	160 cps	PRTYPE 32-35
Star Micronics SD-10 (IBM mode)	160 cps	PRTYPE 4, 6
Star Micronics SD-15 (IBM mode)	160 cps	PRTYPE 4-7
Star Radix 10		PRTYPE 32, 34
Star Radix 15		PRTYPE 32-35
Star Radix 10 PC		PRTYPE 4, 6
Star Radix 15 PC		PRTYPE 4-7
Star Radix 10 Plus		PRTYPE 0, 2
Star Radix 15 Plus		PRTYPE 0-3
Star Micronics SR-10 (Star mode)	200 cps	PRTYPE 32, 34
Star Micronics SR-15 (Star mode)	200 cps	PRTYPE 32-35
Star Micronics SR-10 (IBM mode)	200 cps	PRTYPE 4, 6
Star Micronics SR-15 (IBM mode)	200 cps	PRTYPE 4-7
Star Micronics SB-10		
Star Micronics NB-15, 9-wire emulation	300 cps, 24-pin	PRTYPE 4-7
Star Micronics NX-10		
Star Micronics NX-15		
Star Micronics NL-10 (std. cartridge)	120 cps	PRTYPE 0, 2
Star Micronics NL-10 (IBM cartridge)	120 cps	PRTYPE 4, 6
Star Micronics NL-15 (std. cartridge)		PRTYPE 0-3
Star Micronics NL-15 (IBM cartridge)		PRTYPE 4-7
Star Micronics DP-8480	matrix, 80 cps, 132 col	
Star Power Type	18 cps, LQ	daisy

Printer	Features	Type
Tally see Mannesmann Tally		
Tandy see Radio Shack		
Teletex T1014		daisy
Televideo TPC 11		
Televideo 186 PS		
Televideo 1605		
Texas Instruments 743	matrix, 30 cps, 80 col, serial	
Texas Instruments 765	matrix, 30 cps, 80 col, serial	
Texas Instruments 810	matrix, 150 cps, 132 col, serial	
Texas Instruments 820	matrix, 150 cps, 132 col, serial	
Texas Instruments 825	matrix, 75 cps, 132 col, serial	
Texas Instruments 850 (DP mode)		PRTYPE 40-43
Texas Instruments 855 (DP mode)		PRTYPE 40-43
Texas Instruments Omni 880	300 cps, 9-pin	
Toshiba P321	216 cps	
Toshiba P341	180 cps, 24-pin, 132 col	
Toshiba P-1340	120 cps, 80 col, 24-pin	
Toshiba P-1350	24-pin	
Toshiba P-1351	160 cps, 24-pin	
TRS-80 see Radio Shack		
Transtar 120	14 cps	daisy
Transtar 130	18 cps	daisy
Transtar 140	serial	daisy
Transtar T315		PRTYPE 12, 14
Williams Bytewriter	12 cps, 100 col	daisy
Xerox 1730	40 cps, 132 col, serial	daisy
Xerox 1740	45 cps, 132 col, serial	daisy
Xerox 1750	45 cps, 132 col, serial	daisy
Xymec HY-Q 1000	20 cps, 198 col	daisy

WAVEFORMS

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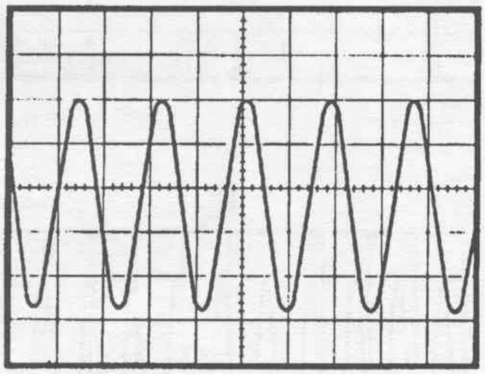

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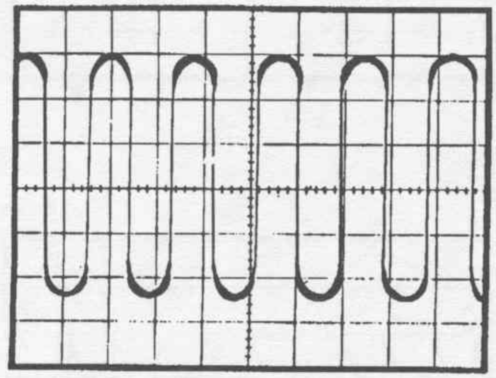

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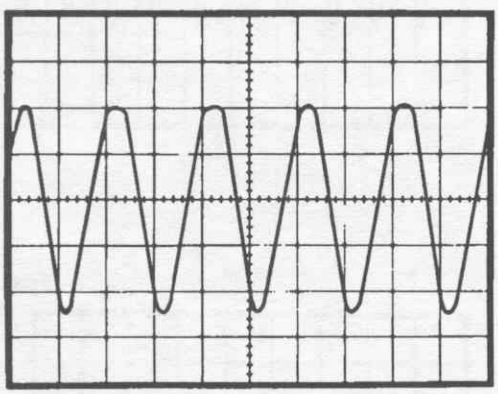

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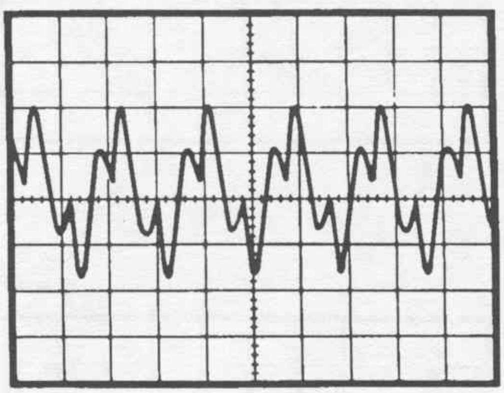

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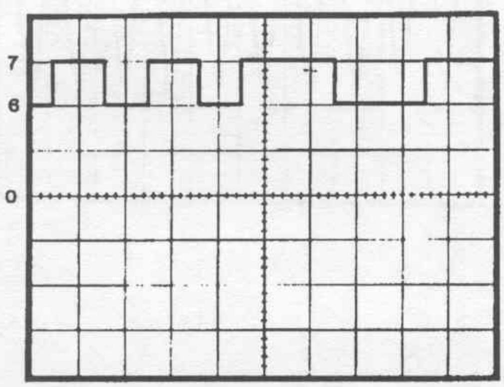

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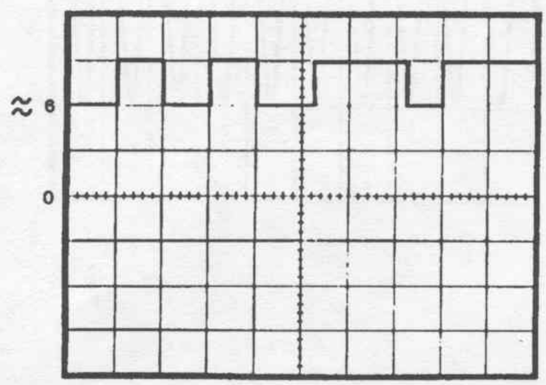

WAVEFORMS (Cont'd)

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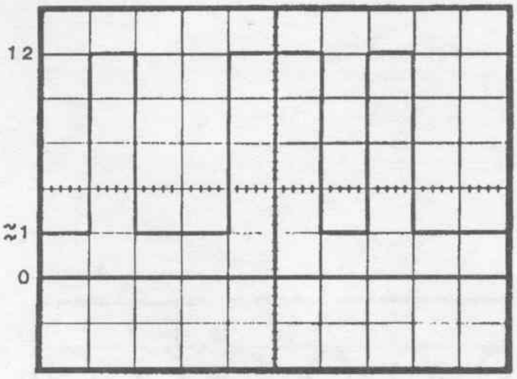

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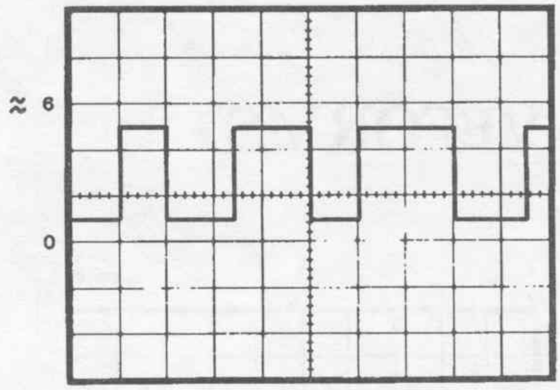

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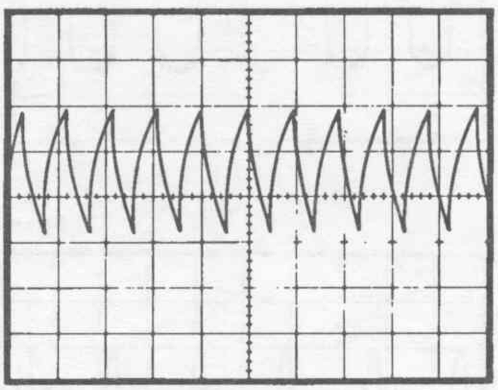

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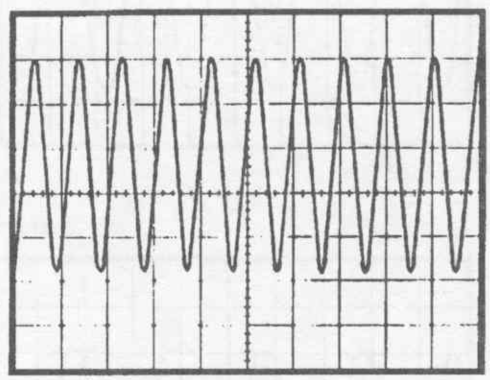

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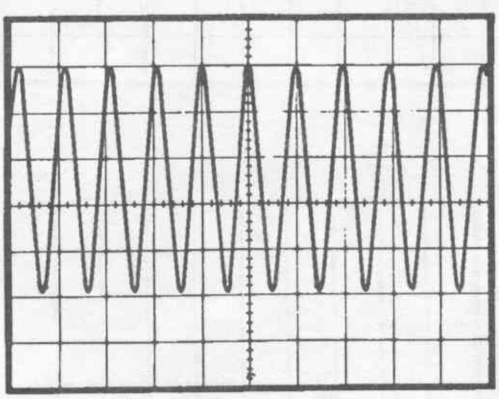

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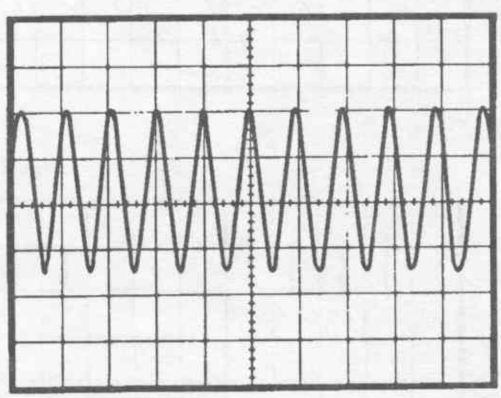

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CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath/Zenith Computers and Electronics centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH/ZENITH COMPUTER AND ELECTRONICS CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath/Zenith Computer and Electronics centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath/Zenith Computer and Electronics center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? – Operation? — Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heath/Zenith Computer and Electronics center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heath/Zenith Computers and Electronics center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

Heath Company
Benton Harbor, Michigan