

P C I - 2 0 0 0

Personal Computer Interface  
for  
IBM® Personal Computers

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# PCI-2000 TECHNICAL MANUAL

## INTRODUCTION

This manual describes the installation and operation of the HAL PCI-2000 Personal Computer Interface. This interface is specifically designed to allow use of the PC, PC-XT, PC-AT, and PC-Portable models of the IBM Personal Computer in radio systems. The PCI-2000 may also be used with some models of other manufacturers that are "PC-compatible". Since it is impossible to include data on all the possible variations of "compatible" computers, the performance of the PCI-2000 is only warranted for installation in IBM Corp. personal computers (see LIMITED WARRANTY at end of manual).

The PCI-2000 includes a large number of features, giving a great deal of flexibility to the operator. It is suggested that the operator particularly read all of Chapters 1 and 2 before installing the circuit board and Chapter 3 before attempting use of the software.

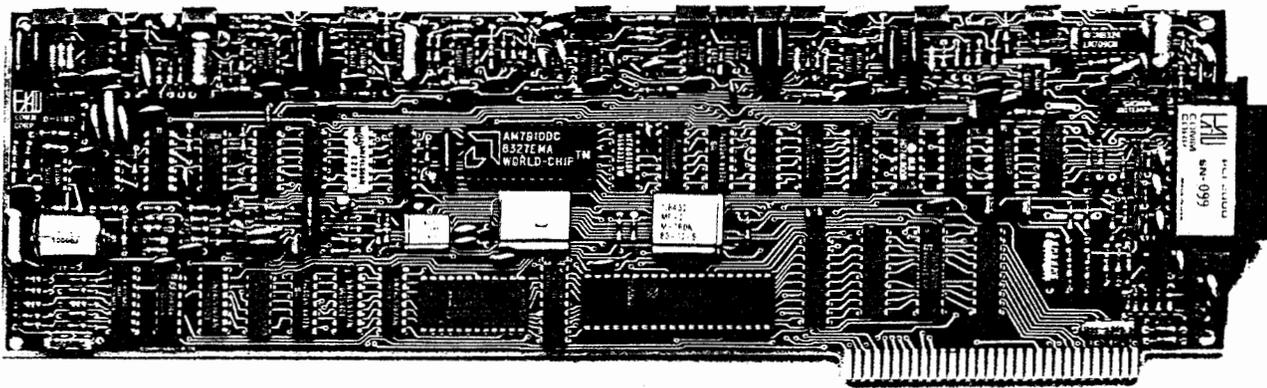


FIGURE 1. PCI-2000

## CHAPTER 1 INSTALLATION

### 1.1 Unpacking

When unpacking your PCI-2000, carefully inspect the shipping carton, the circuit board, and the software diskette for shipping damage. Any evidence of damage should be immediately reported to your supplying dealer or shipping carrier. Be sure to save all packing materials if damage is found - the shipping carrier will want to inspect them for any insurance claim. Check the accessories against the following list. If any are found missing, double-check the packing for loose parts and notify your dealer or HAL Communications Corp. so that the shortage may be rectified. Please be sure to specify the HAL part number!

#### Packing List:

1 - 930-02000	PCI-2000 Circuit Board
1 - 852-02000	PCI-2000 Software Diskette
1 - 870-02000	PCI-2000 Manual
5 - 332-02010	Jumper Plugs (on PCI board)
1 - 333-10250	DB-25 Cable Connector
1 - 440-03000	Card edge guide

#### Additional Options Available for PCI-2000:

PCI-EXT: Connector Extender to provide phono type connections to the radio system.

SPT-1: SPECTRA-TUNE Tuning Indicator for RTTY and CW reception.

### 1.2 Card Installation

The PCI-2000 is constructed on one full-length IBM plug-in card. It may be inserted into any unused full-length card slot in the IBM-PC, IBM PC-XT, IBM PC-AT, or IBM PC-Portable Computers.

1.2.1 Jumper Selections

Before installing the PCI-2000 in your computer, check to see that the jumpers on the PCI-2000 circuit board are set correctly. The available jumpers are shown in Table 1 below and their positions are shown in Figure 2.

TABLE 1  
PCI-2000 JUMPERS

JUMPER	POSITIONS	FACTORY SETTINGS
IRQ	IRQ4/IRQ3	IRQ3
ADR	PRI/SEC	SECONDARY
DTR	HI/LO	HI (jumper)
FSK POLARITY	NORM/REV	NORM
FSK LEVEL	OC, +5, +12	+5V

NOTES:

1. "COM1" = IRQ4 + PRIMARY
2. "COM2" = IRQ3 + SECONDARY
3. COM setting for PCI-2000 must not be same as any other I/O board.
4. See Section 4.4 for jumper options

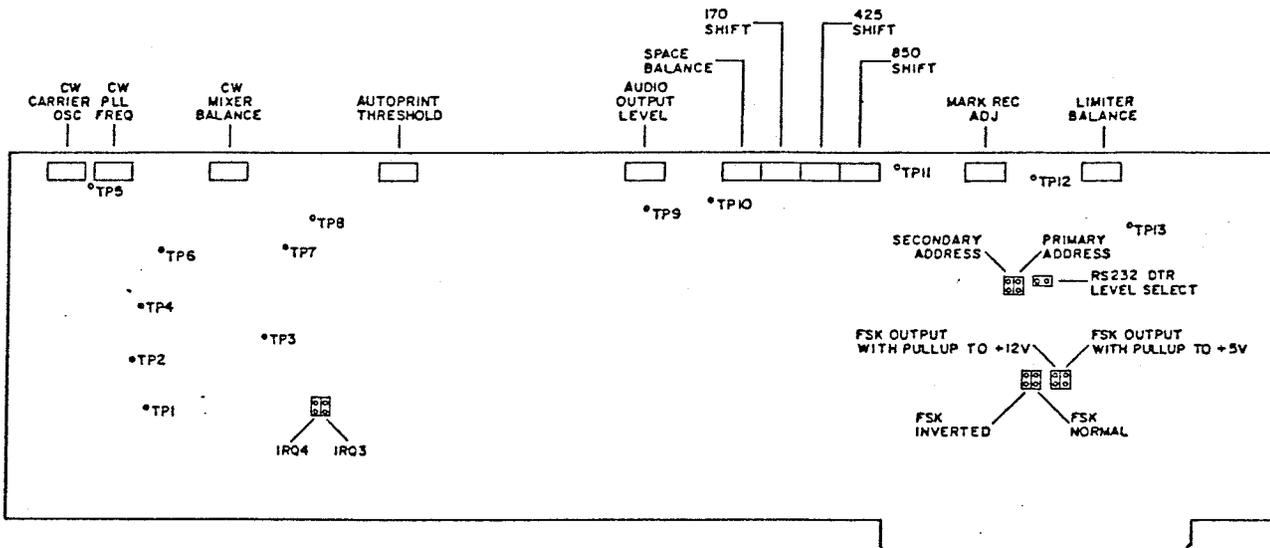


FIGURE 2. PCI-2000 JUMPER LOCATIONS

\*\*\*\*\*  
NOTE: The PCI-2000 has been tested in "standard" versions and models of the IBM-PC and works well with the IBM video card, disk controller card, and serial communications cards installed. However, HAL Communications cannot assume responsibility for operation (or non-operation) of the card when other options are installed in the computer. If problems are experienced, try removing extra option cards until correct operation is observed.  
\*\*\*\*\*

### 1.2.2 IBM PC

The PCI-2000 may be installed in any of the slots available in the IBM-PC. It is recommended, however, that it be inserted in the first slot on the left (connector J1) if at all possible. Choose the desired slot, install the supplied plastic card guide, and plug-in the PCI-2000.

### 1.2.3 IBM PC-XT

The PCI-2000 may be inserted into any of the long-card slots in the PC-XT with the left-most slot being preferred. Choose the desired slot, install the supplied plastic card guide, and plug-in the PCI-2000.

### 1.2.4 IBM PC-AT

The PCI-2000 may be used in any long-card slot of the PC-AT, but you may prefer to use a slot that has only the rear card connector to save the two-connector slots for other devices. Choose the desired slot and plug-in the PCI-2000.

### 1.2.5 IBM PC-Portable

When installed in the PC-Portable model, it is recommended that you first move the video card from the slot next to the monitor to the second slot (connector J2). Then, install the PCI-2000 in the left-hand slot (connector J1). This is necessary to avoid mechanical conflict with the CRT controls and keyboard connector on the front panel.

### 1.2.6 IBM "Compatibles"

Due to the rapid growth of the "PC-Compatible" market, it is impossible to list all possible models and variations. Compatibility questions should be addressed to HAL sales personnel. In general, the PCI-2000 will ONLY work if the hardware and firmware conditions listed in Table 2 are met by the "compatible" personal computer:

TABLE 2.  
REQUIREMENTS FOR "PC-COMPATIBLE" COMPUTERS

1. Compatible ROM BIOS routines.
2. Compatible Bus connector
3. Compatible Interrupt Routines
4. Have COM1 or COM2 serial I/O channel unused or provision to disable any on-board serial device using these addresses.

Because of the great variation in the use of the word "compatible", HAL cannot assure proper PCI-2000 operation in any but the above mentioned IBM Corporation models of the Personal Computer.

### 1.3 Software Installation

The software for the PCI-2000 is supplied on one 5.25" floppy diskette. You should make back-up copies of this diskette BEFORE attempting operation. It is recommended that you place a write-protect tab on the HAL diskette. This will help prevent accidental erasing of the original diskette when copying the files. The DOS system files must also be included on the operating PCI-2000 diskette, so first prepare new diskettes using the FORMAT/S command. Next, copy the PCI-2000 files onto the newly formatted diskettes. Refer to your DOS manual for proper procedures for your computer configuration. After copies have been made, store the original HAL diskette in a safe location and use a copied diskette for normal operation.

\*\*\*\*\*

NOTE: The PCI-2000 software will function only with the HAL PCI-2000 circuit board. The PCI-2000 software is copyrighted by HAL Communications Corp. and duplication of the software for other than your own use with the PCI-2000 is specifically prohibited. Any attempt to copy this software for resale or any use other than with the supplied PCI-2000 circuit board will be vigorously prosecuted to the full extent of the copyright laws.

\*\*\*\*\*

After the PCI-2000 circuit board is installed in your computer (but before connection to the radio system), refer to section 3.1.1 of this manual, install the PCI-2000 diskette in disk drive 1, and boot the computer ("cold" or "warm" boot). The diskette includes an "AUTOEXEC.BAT" file that will first request the time and date and then automatically load the PCI-2000 software. You will first see the title page with copyright notice, and software version number. Remember the version number! We will need to know this version number if you call HAL with a problem.

Some brands of clock cards may be used with the PCI-2000 and the necessary calling routine should then be inserted in the AUTOEXEC.BAT file. The clock card software routine must also be copied onto the PCI-2000 software diskette. Further details about clock cards are found in section 3.5.4 of this manual.

Approximately 6 seconds after the title page appears, you will see the operating screen format of the PCI-2000 with a status line on top and a vertical row of line numbers down the left margin. The top half of the line numbers are for the receive buffer (12-1 using bright video). The transmit buffer line numbers show in the lower half of the screen (1-12 using dim video). Typed characters should show in dim video on the lower half of the screen. Control of the PCI-2000 board and screen features will be discussed in detail in Chapter 3.

## CHAPTER 2 CONNECTIONS

All I/O connections to the PCI-2000 are made via the 25-pin connector on the rear panel. All signals required for direct connection to a radio system, an RTTY tuning indicator, the internal 103/202 modem, or an external modem or computer are supplied on this connector. Therefore, the cable connections will vary with the intended application and few installations will require use of all 25 pins. Note that this DB25 connector is NOT compatible with "standard" DB25 modem connectors! All PCI-2000 I/O connections are explained in Table 3 and voltage and current limitations in Table 4.

TABLE 3.  
I/O CONNECTIONS

PIN	NAME	FUNCTION
1	AF IN	(audio from RX speaker)
2	TXD	(RS232 transmit data)
3	RTS	(RS232 request to send)
4	KY2	(switched output No. 2)
5	CD	(RS232 carrier detect)
6	SPACE	(SPACE tuning indicator)
7	MARK	(MARK tuning indicator)
8	KY1	(switched output No. 1)
9	MODEM	(103/202 Modem AF I/O)
10	GROUND	(signal ground)
11	FSK	(FSK output to TX)
12	GROUND	(signal ground)
13	+CW KEY	(positive CW key output)
14	PTT	(TX push-to-talk circuit)
15	DTR	(RS232 Data Terminal Ready)
16	RXD	(RS232 receive data)
17	CTS	(RS232 Clear To Send)
18	AF OUT	(TX microphone input)
19	GROUND	(signal ground)
20	RING	(103/202 modem ring signal)
21	+12V	(+12VDC to accessory)
22	-12V	(-12VDC to accessory)
23	+5V	(+5VDC to accessory)
24	-CW KEY	(negative CW key output)
25	GROUND	(signal ground)

**WARNING:**

**Do NOT connect a standard Modem cable without using the optional PCI-EXT. AVOID SHORTING PINS 21, 22, AND 23 TO ANY OTHER PINS OR GROUND. DAMAGE TO PC POWER SUPPLIES MAY RESULT IF THIS OCCURS.**

TABLE 4.  
I/O RATINGS

PIN	SIGNAL	MAXIMUM	TYPICAL
1	AF IN	10V P-P	0 dBm (0.7V RMS)
2	TXD	+/-12V	RS232 Signal (out)
3	RTS	+/-12V	RS232 Signal (out)
4	KY2	+25V, .1A	+Voltage Only
5	CD	+/-12V	RS232 Signal (in)
6	SPACE	10V P-P	Hi-Z Scope Output
7	MARK	10V P-P	Hi-Z Scope Output
8	KY1	+25V, .1A	+Voltage Only
9	MODEM	0 dBm	DAA Phone Line
11	FSK	+12V, .1A	O.C. or +V output
13	+CW KEY	+50V, .1A	+Voltage Only
14	PTT	50V, .2A	+/- Relay Output
15	DTR	+/-12V	RS232 Signal (out)
16	RXD	+/-12V	RS232 Signal (in)
17	CTS	+/-12V	RS232 Signal (in)
18	AF OUT	0 dBm	-30 dBm (200 mV rms)
20	RING	+12V	DAA Signal (in)
21	+12V	.05A	PS Output
22	-12V	.05A	PS Output
23	+5V	.1A	PS Output
24	-CW Key	50V, .1A	-Voltage Only

**WARNING:** Avoid shorting ANY signal pins to ground or to a power supply voltage. IMPROPER USE OF PINS 21, 22, OR 23 MAY RESULT IN DAMAGE TO THE PC POWER SUPPLIES.

## 2.1 Radio Connections

If a single-cable harness is to be used with the radio system, all wires may be connected to the supplied DB-25 connector. However, it may be more convenient to use separately shielded phono-type cables for each function (RX AUDIO, TX AUDIO, etc.). In this case, the HAL PCI-EXT accessory Cable Expander is very useful. Whether connections are made directly to the 25-pin connector or through the PCI-EXT, it is HIGHLY recommended that ALL cable to and from the PCI-2000 be shielded and that a separate low inductance RF ground also be connected between one of the rear corner screws of the IBM-PC cabinet and the radio equipment.

### 2.1.1 Direct DB25 Connections

In some radio systems, it is convenient to make up one or two multi-conductor cables that include all the necessary signals to and from the PCI-2000. This may be particularly desirable when transceivers with multi-pin I/O connectors are used. In this

case, use a shielded, multi-conductor cable with No. 24 or 26 wire size for the system cable. The simplest hook-up involves only one 5-conductor shielded cable (Ground, AF IN, AF OUT or FSK, PTT, and CW KEY). A second 2-conductor shielded cable is also desirable for connection to a tuning indicator or RTTY scope. A typical radio system direct cable connection is shown in Figure 3.

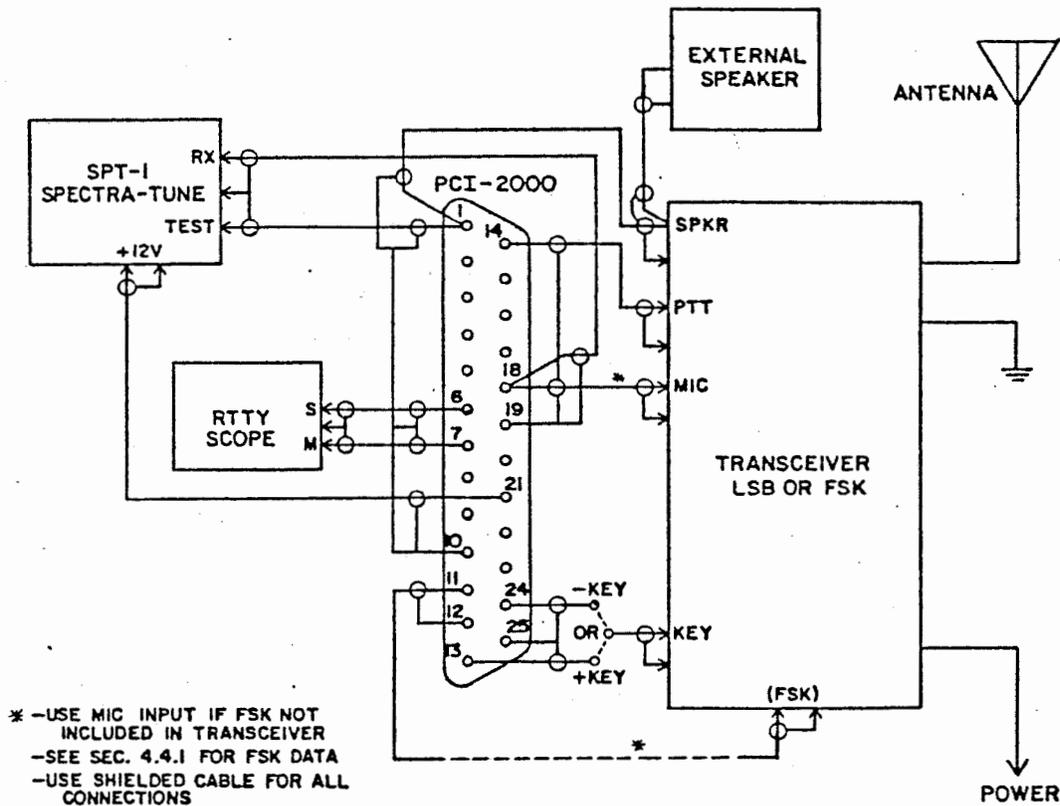


FIGURE 3. DIRECT RADIO CONNECTIONS

## 2.1.2 Use of PCI-EXT Cable Expander

Some receiver-transmitter systems have separate rear panel connections for each I/O function (receive audio, transmitter audio, push-to-talk, etc.). In this case, it may be desirable to use separately shielded cables for each signal. The PCI-EXT accessory provides a convenient expansion of the DB-25 connector to 10 phono connectors for radio connection and to a standard DB-25 for the external modem or other serial device. The PCI-EXT also allows rapid cable change between different transmitters and receivers and greatly reduces the need to fabricate custom cables. When using the PCI-EXT, be sure to include a good low inductance ground between the PCI-EXT ground terminal and the cabinets of the transmitter and receiver. Also, use ONLY shielded cables for each signal connection. The common hi-fi monaural cables and stereo cables work well for this use and may often be purchased with connectors that match those on the transmitter and receiver, eliminating most connector assembly. Typical radio system connections using the PCI-EXT are shown in Figure 4.

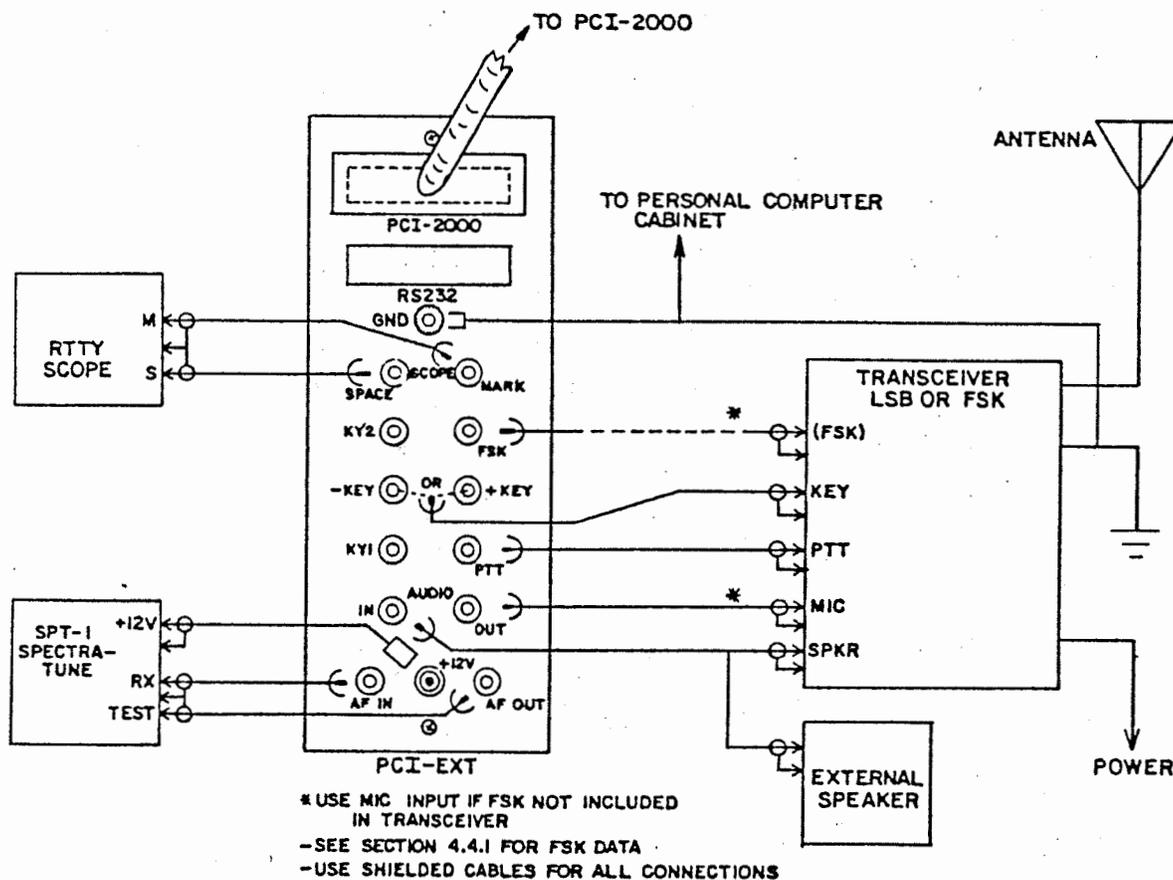


FIGURE 4. RADIO SYSTEM USING PCI-EXT

## 2.2 Tuning Indicators

An RTTY tuning indicator is a highly recommended addition to the PCI-2000 radio system. Two slightly different tuning indicators maybe connected to the PCI-2000: (1) a "standard" X-Y oscilloscope or RTTY scope, or (2) an audio spectrum indicator (such as the HAL SPT-1 SPECTRA-TUNE). Both indicators may be connected simultaneously, if desired.

### 2.2.1 RTTY Tuning Scope

The RTTY scope should be connected to the MARK and SPACE outputs to give the normal X-Y ellipse presentation. Conversely, any standard oscilloscope with separate vertical (Y=SPACE) and horizontal (X=MARK) can be used as a tuning indicator. The MARK and SPACE outputs of the PCI-2000 produce audio signals with approximately 10V P-P amplitude when the input signal frequencies match those of the discriminator filters. Some older vacuum tube type oscilloscopes may require additional amplification for the horizontal (X) axis input. Be sure to use shielded cables for all tuning scope connections. Typical scope connections are shown in Figures 3 and 4.

### 2.2.2 Spectrum Indicator

An oscilloscope gives a very good RTTY tuning indicator, preferred by many experienced RTTY operators, but does NOT give a tuning indication for reception of Morse code. The HAL SPT-1 SPECTRA-TUNE gives an equally effective tuning indication for RTTY and many also be used for reception of Morse code. Three special connections are provided for the SPT-1 SPECTRA-TUNE: Receive Audio, Audio Out, and DC Power.

Be sure to use shielded cables for all audio connections to the SPT-1. Connections to the SPT-1 are shown in Figures 3 and 4.

## 2.3 Modem Connections

The PCI-2000 is a versatile addition to the Personal Computer and provides more than the minimum connections for use with a radio system. In addition, the serial I/O UART of the PCI-2000 may be used directly with an external modem or computer, by-passing the PCI-2000 RTTY modems. An added advantage of the PCI-2000 is the internal 103/202 modem. Although this modem will normally be used for radio communication, it may also be used in phone-line applications if external line protection is provided ("DAA" device).

There are two ways in which a telephone line modem may be used with the PCI-2000: (1) use the internal 103/202 modem with external isolation device, and (2) use an external modem connected to the RS232 signals. Two more options are also available for general PC use: (3) use a modem card in another slot in the computer, or (4) use a communications card in the PC connected to an external modem. These last two options do not

involve use of the PCI-2000 but are available since the PCI-2000 may be assigned to either COM1 or COM2 serial I/O channels in the PC. Obviously, the optimum choice will depend upon what options and external devices you already have for the computer.

### 2.3.1 Use of PCI-2000 Internal Modem

If it is desired to use the internal 103/202 modems of the PCI-2000, you should consider the following requirements:

1. The PCI-2000 does NOT include the FCC-required DAA isolation device. You must use an approved DAA (such as the Bell CDT or equivalent) to make a legal connection to the telephone system.
2. The PCI-2000 does NOT include a ring-detection circuit. This feature is supplied by the DAA device. However, a "RING" or connect/disconnect input is provided to the modem circuit (connect = logic low, disconnect = open circuit, pulled to +5VDC internally).
3. The PCI-2000 software does NOT support telephone line type protocol, dialing, and other desirable phone modem features. However, the PCI-2000 may be used with other software if the operating parameters are first set-up with SETUP.EXE, the modem set-up program on your HAL diskette.
4. The PCI-2000 does include FDX for either ANSWER or ORIGINATE modes when the 103 modem option is selected. This should also be set-up beforehand as discussed in item 3.
5. The PCI-2000 202 modem does NOT support the 75 baud reverse channel feature of some 202 type modems.
6. Audio connections to and from the radio equipment should be disconnected when the PCI-2000 modem is connected to telephone lines.
7. Connections to MODEM LINE and RING must be made directly to the PCI-2000 DB-25 I/O connector (pins 9 and 20). These connectors are NOT available on the PCI-EXT accessory.

Typical connections for use of the PCI-2000 103/202 modem on telephone lines are shown in Figure 5.

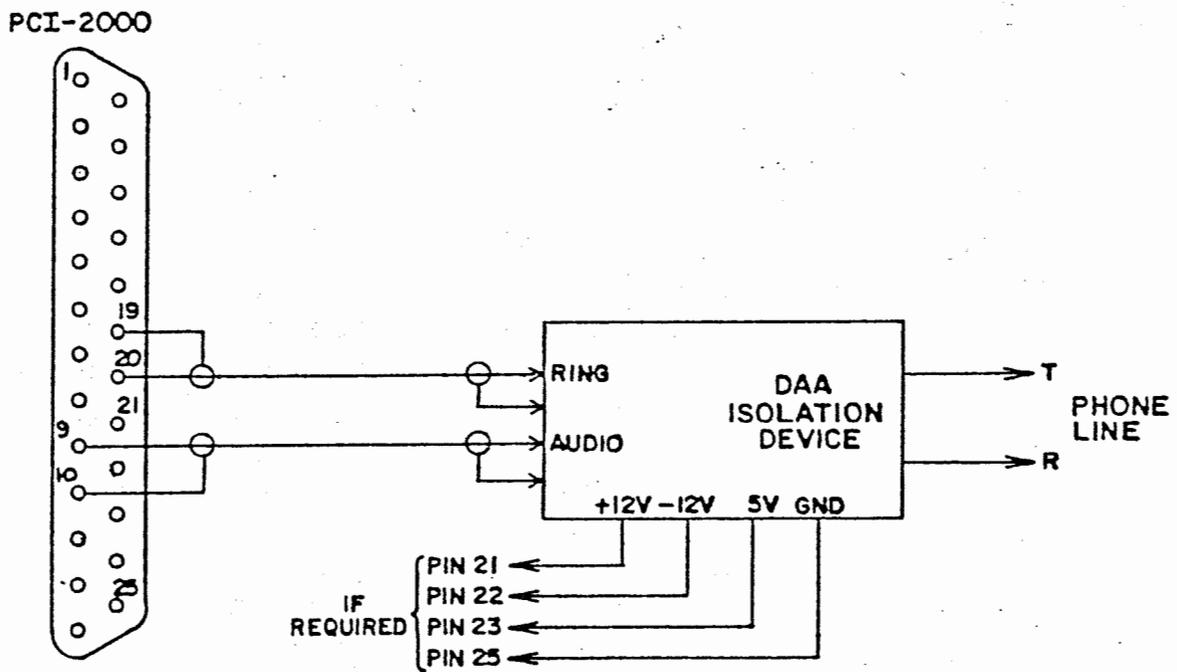


FIGURE 5. PCI-2000 TELEPHONE LINE CONNECTIONS

### 2.3.2 External Modem with PCI-2000

The UART circuit of the PCI-2000 may also be directly connected to an external modem. In this case, the PCI-2000 operates much like any other serial asynchronous communications card. You should, however, furnish your own telephone communications software that utilizes the selected PCI-2000 serial I/O channel (COM1 or COM2). The external modem in this arrangement should be connected directly to either the DB-25 connector on the PCI-2000 or to the special DB-25 on the PCI-EXT accessory.

\*\*\*\*\*  
NOTE: The DB-25 connector on the PCI-2000 does NOT follow standard modem pin arrangement due to the large number of signals required to support all PCI-2000 modes. If a direct connection is required, a special cable will be required between the PCI-2000 DB-25 and the modem. CHECK YOUR WIRING CAREFULLY!  
\*\*\*\*\*

Conversely, the MODEM DB-25 connector on the PCI-EXT accessory DOES follow standard DTE pin arrangement and most modems may be connected directly to this connector with standard cables. Addition of the PCI-EXT is highly recommend when an external modem is to be connected to the PCI-2000.  
\*\*\*\*\*

## CHAPTER 3 OPERATION

This section of the manual discusses how to use the software supplied with the PCI-2000. A complete reading of this chapter is of course recommended. However, section 3.1 contains an outline-view of operation that will get the experienced computer user going.

### 3.1 Getting Started

A few easy steps are required to start the PCI-2000. These steps are much the same as you would perform for any other program and will become very familiar after some practice.

#### 3.1.1 How to Make Back-up Copies of the Diskette

Some PC owners seem to have confusion about how to copy the PCI-2000 software to their own diskette. For IBM PC owners, the following technique works well:

- a. Format a new diskette that includes the DOS system files using the `FORMAT/S` command. In a two-drive system, put the DOS diskette in drive A and the new diskette in drive B. After booting DOS, type:  
`FORMAT B:/S` (and the enter key)
- b. Copy all files from the HAL PCI-2000 diskette to the newly formatted diskette. In a two drive system, put the HAL diskette in drive A and the newly formatted diskette in drive B. Then type: `COPY *.* B:` (enter) All of the files on the HAL diskette will now be copied to the new diskette. When complete, put the HAL copy in a safe place and use the newly prepared diskette for operation.

#### 3.1.2 Loading the Software

Be sure that you have the DOS system files on the copied PCI-2000 diskette. The software for the PCI-2000 is controlled by an "AUTOEXEC.BAT" file that automatically loads the main program called "PCRTTY". The software may be loaded using either a "cold boot" or a "warm boot". The full procedure for a "cold boot" is listed in Table 5. For a "warm boot", simply press `ALT-CTRL-DEL` and start at step No. 4. You may also run the program by typing "PCRTTY" in response to the system prompt.

For experienced computer users, later versions of PCRTTY have been designed to operate in multi-tasking environments like TOPVIEW from IBM. This means that you can do word processing or homework on the PC while PCRTTY monitors radio link activity.

TABLE 5  
BOOTING THE SOFTWARE

1. With the PC power turned OFF, install the PCI-2000 circuit board in the computer as discussed in Chapter 2.
2. Insert the PCI-2000 software diskette in disk drive "A" (top or left-hand drive in most machines). Have you made back-up copies? If not, do it NOW and use the copy! See Section 3.1.1 if you are still confused about how to copy the program to another diskette. DON'T close the door lever until after power is turned on.
3. Turn-on the PC power switch.
4. After the computer power is on, close the drive door lever.
5. After the PC memory check is completed, the disk light will come on and the screen will request the time. Enter the time in the normal format (hrs:mins:sec). Then enter date as requested (mo-day-yr). (Use of clock cards is discussed in section 3.6.4.)
6. The executive file will now call "PCRTTY" and the title page will be displayed. Note that a version number is displayed on this page. Write down this number in your manual for future reference.
7. After a short delay, the operating screen will be displayed.

### 3.1.3 The HELP Page and Use of the FN Keys

The ten function (FN) keys of the PC are used to set and control many hardware and software features. A "HELP" menu page explaining the function key uses is available at any time by typing "ALT-H". The following tables present a complete list of the controls available. The features will be discussed in detail in following sections of this chapter. In the following tables, the symbol "CR" means carriage return, or the ENTER key on most PC-compatible keyboards.

TABLE 6  
FN KEYS  
HERE IS MESSAGES

KEYS	OPERATION
F1 CR to F10 CR	Load contents of HERE IS message No. 1-10 into TX buffer to be transmitted.
F1 F1 to F10 F10	Program selected HERE IS message. Message displayed on top status line of screen; maximum of 72 characters. Old message is first displayed; CR to keep with no change. Type any other keys to erase old and write new message; end program with CR ("Enter" key).

NOTE: HERE IS 5 is for transmission header. See Section 3.6.3.

TABLE 7  
ALT-FN KEYS  
PCI-2000 CONTROL

KEYS	OPERATION
ALT-F1	Select code: ASCII, BAUDOT, MORSE
ALT-F2	Set speed: 45-9600 baud RTTY; 5-125 WPM CW transmit. Increase or decrease speed with each press, depending upon SCROLL-LOCK status.
ALT-F3	Turn Unshift-on-space (USOS) ON/OFF
ALT-F4	Set half or full duplex (HDX/FDX)
ALT-F5	RTTY polarity (NORM/REV)
ALT-F6	Set RTTY shift (170/425/850) or modem mode (103-O, 103-A, 202) or use as serial I/O (RS232).
ALT-F7	Set WORD/LINE/CHAR transmit mode
ALT-F8	Set RTTY Sync-idle ON/OFF
ALT-F9	Autosend/Continuous TX Control
ALT-F10	Transmit Enable/Inhibit Control

NOTE: Default HERE-IS messages and operating modes are set in PCRTTY.CNF file (CTRL-F2 to save).

TABLE 8  
SHIFT-FN KEYS  
SCREEN AND BUFFER CONTROL

KEYS	OPERATION
SH-F1	Save receive or transmit buffers to diskette. Status line prompts for directory, buffer selection, file name, or abort command. Also allows continuous save of receive text.
SH-F2	Load receive or transmit buffers from disk. Prompts for directory, buffer selection, file name, or abort command.
SH-F3	Copy lines from receive to transmit buffer. Prompts for range of line numbers.
SH-F4	Enter 18 pairs of "RY" into transmit buffer (36 characters total).
SH-F5	Select alternate transmit buffer, "B1" or "B2" (indicated on status line).
SH-F6	Perform Block operations.
SH-F7	Clear receiver buffer.
SH-F8	Clear selected transmit buffer.
SH-F9	Change equally split RX/TX screen to 20 line RX / 4 lines TX.
SH-F10	Send file directly from disk. (Prompts for filename.)

TABLE 9  
CTRL-FN KEYS  
SYSTEM CONTROL

KEYS	OPERATION
CTRL-F1	Select DOS options.
CTRL-F2	Set up system configuration; Disk Drive, ASCII Data Format, End-of-line, TX line length, and US or CCITT #2 Baudot. Save or Load System Configuration.
CTRL-F3	Exit to DOS.
CTRL-F4	Turn line printer ON/OFF (LP1)
CTRL-F5	AUTOPRINT ON/OFF
CTRL-F6	Reserved for future use.
CTRL-F7	Turn CW-TX sidetone ON/OFF
CTRL-F8	Turn CW-RX sidetone ON/OFF
CTRL-F9	Set KY1 ON/OFF
CTRL-F10	Set KY2 ON/OFF

NOTE: CTRL-F2, line printer, and KY settings are stored in PCRTTY.CNF file.

TABLE 10  
SPECIAL KEYS

ALT-D	Insert Date into TX Buffer or Here-Is msg.
ALT-I	Insert "DE (Callsign)"
ALT-S	Insert MARS Test Msg.
ALT-T	Insert Time
ALT-W	Insert 12 LTRS characters
ALT-Z	Insert MARS Date/Time Group
ALT-J	Add LF character
ALT-M	Add CR character
<	Add LTRS character (Baudot only)
>	Add FIGS character (Baudot only)
F#	Add HERE-IS message
F# F#	View and program HERE-IS message
ALT-R	Load Ruler Line test message into TX Buffer
ALT-Q	Load QBF test message into TX buffer
ALT-F	Force RX to FIGS shift immediately
ALT-L	Force RX to LTRS shift immediately
ALT-X	Toggle RTS output to KEY Transmitter
ALT-H	Show the HELP page

TABLE 11  
EDITING KEYS

KEY	OPERATION
→	Move edit cursor one position right
←	Move edit cursor one position left
↑	Move cursor one line up
↓	Move cursor one line down
CTRL →	Move cursor one word right
CTRL ←	Move cursor one word left
HOME	Move cursor to top left display
CTRL-HOME	Move cursor to top of buffer
END	Move cursor to bottom display line
CTRL-END	Move cursor to end of buffer
DEL	Remove cursor character
RUB OUT	Remove character to left of cursor (large arrow key right of "=")
INSERT	Toggle INSERT or TYPE-OVER mode
DISPLAY	
SCROLLING:	Select RX/TX buffer with SCROLL-LOCK
PAGE UP	Scroll displayed buffer up one line
CTRL-PG UP	Scroll displayed buffer up one page
PAGE DOWN	Scroll displayed buffer down one line
CTRL-PG DN	Scroll displayed buffer down one page
NOTES:	<ol style="list-style-type: none"> <li>1. Editing available only for TX buffer displayed (B1 or B2).</li> <li>2. Any file may be loaded into TX buffer, edited, and saved.</li> <li>3. See section 3.5 for editing details.</li> </ol>

TABLE 12  
STATUS LINE  
(Left Section)

↑ ↓	BAUDOT	0074	HDX	US	WRD
SCROLL LOCK Status	CODE ASCII or Baudot RTTY	SPEED 45 to 9600 baud	HDX or FDX	USOS on/off (Baudot) (only)	MODE Word Char Line
(↑) Scroll Rx scrn and Incr. Speed	Morse Xmit	5 to 125 WPM	ALT-F4	ALT-F3	ALT-F7
(↓) Tx scrn Decr Speed	ALT-F1	ALT-F2		CW RCVE speed in Morse	

(Center Section)

RX	DIS	ASR	*SYN	B1	AP
TX OUTPUT CONTROL			Sync Idle (RTTY) (only)	TX Buffer Select	AUTO PNT on/off
TX PTT STATE	TX buffer control	AUTO TX/RX control	on/off	B1 B2	
RX TX	DIS EN	AUTO CONT	ALT-F8	SH-F5	
	ALT-F10	ALT-F9	* Flashes for Rcvr CW		

TABLE 12  
(Continued)  
STATUS LINE

(Right Section)

NOR	170	LP	KY	1031 UTC
 RTTY Polarity	 RTTY Shift	 Line Printer Control	 Key Switches	 Time & Zone
 NOR	 170	 CTRL-F4	 KY	
 REV	 425		 KY1	
 ALT-F5	 850		 KY 2	
	 103-O		 KY12	
	 103-A		 CTRL-F9	
	 202		 (KY1)	
	 RS232		 CTRL-F10	
	 ALT-F		 (KY2)	

### 3.2 Reception

It is recommended that you devote some time to practicing reception of RTTY and Morse code before attempting to use the transmit modes. Correct tuning of an HF receiver is considerably simpler if a tuning indicator such as a RTTY scope or the HAL SPT-1 SPECTRA-TUNE is connected as discussed in section 2.2 of this manual.

The PC screen is normally split into two halves for display of receive and transmit text. Receive text is displayed on the top 12 lines in bright video; transmit text on the lower 12 lines in dim video. The displayed lines and screen format can be changed using the SHIFT-F9, PAGE UP, CTRL-PAGE UP, PAGE DOWN, CTRL-PAGE DOWN, HOME, CTRL-HOME, END, and CTRL-END keys. The normal default configuration of the screen is to equally split the display space into 12 lines of RX and 12 lines of TX text. However, use of SHIFT-F9 will change the screen to show 20 lines of receive text and 4 lines of transmit text. Both transmit and receive buffers store up to 250 lines of text and SHIFT-F9 only affects the display format. The HOME, END, PAGE UP, and PAGE DOWN keys (and their CTRL-x combinations) may be used for either the receive or transmit display, depending upon the SCROLL LOCK key operation, shown by "↑" or "↓" on the status line (↑ for RX buffer display and ↓ for TX buffer display - see Table 11). The entire receive buffer may be cleared at any time by using the SHIFT-F7 key combination. Be careful - there is NO "undelete" key!

The SCROLL LOCK key also affects the direction of the speed change operation using ALT-F2. When the SCROLL LOCK status is ↑ (up arrow), the speed INCREASES with each press of ALT-F2. The speed decreases with each ALT-F2 when the status is ↓ (down arrow).

### 3.2.1 RTTY Reception

The U.S. version of the PCI-2000 uses the U.S. standard "high-tone" mark frequency of 2125 Hz. Space tones are higher by the amount of the shift (2295 Hz for 170 shift, 2550 for 425, and 2975 for 850). The receive filters and transmit tones are automatically matched in frequency. These tones will be compatible with all amateur radio operation on high frequencies if LSB (or FSK) mode is selected and should work directly with all VHF-FM RTTY stations in the U.S. Reception of some commercial RTTY stations may require use of reverse polarity (ALT-F5). The polarity reverse feature affects BOTH receive filters and transmit tones. Export versions of the PCI-2000 use the CCIR "low-tone" standard of 1275Hz mark and 1445, 1700, and 2125 Hz space for 170, 425, and 850 Hz shift respectively.

For initial receive testing, set your receiver to LSB (even if it has an FSK mode). Select the Baudot code (ALT-F1) and 45 baud (ALT-F2). Be sure that the status indicator says "RX" and "DIS" (ALT-F9 and ALT-F10). Set the shift to 170 (ALT-F6) and polarity to NORM (ALT-F5). Tune the receiver to a RTTY signal in the 3.6, 7.0, or 14.0 MHz band until characters are printed on the screen. If all is set correctly, you should get clear print of the signal. If not, try another signal before checking anything. You also might try reverse polarity (ALT-F5) and/or changing the baud rate to 74 baud (amateurs generally use Baudot, 170 shift, normal polarity, and 45 or 74 baud).

After you have obtained satisfactory print of amateur signals, try tuning some commercial RTTY using 425 or 850 shift and 50, 57, or 74 baud Baudot. These signals will be more difficult to tune and many short-wave signals are encrypted so no sensible print will be received. HAVE PATIENCE! An RTTY tuning indicator is invaluable in determining correct shift. After some practice, you will be able to tell the difference between shifts and speeds by listening to the RTTY signal.

After some experience is gained using LSB mode, you may switch to the FSK mode if it is available on your equipment. The FSK mode usually selects a more favorable receive pass-band for RTTY "high-tones" and may also select a narrow IF filter if one is available. Narrow IF filters can be both a boon and a hinderance to good RTTY reception. When adjacent channel interference is strong, a good IF filter may result in a considerable improvement in copy. However, most CW filters currently available also "ring" when noise or digital pulse signals are received. This "ringing" adds considerable distortion to the RTTY signal. As a general rule, don't use the narrow filter unless you need it and then don't use a filter with bandwidth less than 500 Hz. Use of

the narrow filter will also change the required setting of the autoprint threshold control on the PCI-2000 due to the tuning of receiver noise plus added noise from ringing of the narrow filter. Adjustment of this control is discussed in Chapter 4. Tuning of the RTTY signal is also much easier if the wider SSB filter is used.

### 3.2.2 CW Reception

To receive Morse code (CW), select MORSE (ALT-F1) and tune the receiver to a Morse code station. The amateur frequencies suggested for RTTY are also a good starting point for CW. You may use either LSB or USB modes, but do NOT use the CW mode if a narrow filter is installed (it complicates the tuning until you have some practice). Tune the receiver for an approximate 800 Hz beat-note tone on the CW signal. The star (\*) on the status line (see Table 12) should flash synchronously with the received CW signal. CW tuning is much simpler if the SPT-1 SPECTRA-TUNE indicator is used. The PCI-2000 will lock-onto the received CW signal and automatically track the signal after receiver tuning is correct.

The CW-RX sidetone feature gives another CW reception tuning aid. When the CW-RX sidetone is turned on with CTRL-F8, an exact 800 Hz tone is emitted from the computer's internal speaker. This tone is keyed on and off by the demodulated CW receive signal. Use this tone to audibly compare the received beat-note frequency with the 800 Hz reference. The sidetone also gives a positive indication that the computer is processing the desired signal, rather than noise or interference. Unfortunately, there is NO volume level adjustment on this internal feature of the computer, so you will probably want to turn it OFF (CTRL-F8) after correct tuning is achieved.

Even though the PCI-2000 uses a sophisticated program to decipher the Morse code, you will find that many more errors are printed on CW receive compared to RTTY reception. This is inherent in the way CW is transmitted and no computer program will receive code as well as the experienced CW operator. The reasons for this are: (1) CW is sent as ON-OFF keying and the receiver and PCI-2000 CW receive circuits hear noise between dots and dashes, (2) most hand-sent CW is pretty sloppy and the computer is not clairvoyant (run-together characters and improper letter/word spacing are very common), and (3) when listening to a CW signal, the human brain becomes a tracking filter, selecting the desired signal even when interference is very close in frequency - a better filter than can be used in the PCI-2000! The approximate WPM speed of the received Morse signal is shown on the status line (4th from left).

Problems similar to those discussed in regard to RTTY also apply to use of narrow filters for CW reception. The filters ring and usually cause more misprints than would occur if the SSB filter is used. When interference is high, the narrow filter may improve reception, but you may also see more misprints due to

noise and filter ringing. Also, it is much easier to tune to new stations when a wider filter is used.

### 3.3 Transmission

The PCI-2000 will transmit RTTY and Morse code from text typed on the keyboard or from text stored in disk files. Use of disk files will be discussed in section 3.4. The normal communications mode of the PCI-2000 is to transmit text typed on the keyboard. As mentioned above, the keyboard-entered text is shown in dim video on the lower section of the screen. To pre-type your text, set ALT-F9 for ASR on the status line and ALT-F10 for RX and DIS. Now, enter text into transmit buffer B1 as you want it sent, including the RETURN key whenever you want an end of the line. Buffer B2 is designed to be a quick break buffer and should not be used for pre-typing text because, should you change TX buffers, the text in B2 will be lost. When WRD mode is selected (ALT-F7), lines will be automatically terminated with word wrap-around so that no words are split at the end of a line. You therefore never need worry about using the RETURN until the last line of transmit text. Because of the AUTO transmit-receive control, ALWAYS end a transmission with the RETURN as the last key typed! Otherwise, the transmitter will remain on until the built-in timer turns the transmitter off. The word wrap-around feature is disabled when CHARacter mode is selected, but the terminal will automatically limit the transmit line to the selected length (20-75 characters, default at 72 characters) and split words as required. (Other transmit line lengths may be set as discussed in Section 3.6.5.)

After all transmit text has been entered, start transmission automatically by typing ALT-F10. Transmit output can also be stopped and restarted at any time using these keys. After all text in the transmit buffer has been sent, the PCI-2000 will return to receive and display RX and EN on the status line. This means that the transmit output is ENABLED (EN) and transmission will resume automatically whenever a new key is pressed. To return to the pretype state while receiving, type ALT-F10 again to get "RX DIS" status to DISABLE (DIS) the transmitter output.

If you want to have total manual control of the transmitter output, use ALT-F9 to set CONT instead of AUTO on the status line. When in CONT mode, the transmitter will turn on and stay on whenever activated with the ALT-F10 key. The transmitter is turned off with a second ALT-F10 key operation.

As will be discussed in section 3.6.2, there are two transmit buffers available for use (SHIFT-F5 to change). This allows fast-break situations where text in buffer B1 may be saved while the break response is typed and transmitted from Buffer B2. The displayed ("active") transmit buffer can be totally cleared at any time with SHIFT-F8. Be careful, there is NO "undelete" key combination! The displayed portion of the transmitter buffer may be scrolled by selecting " ↓ " on the status line with the SCROLL

LOCK key and then using the PAGE UP, PAGE DOWN, HOME, and END keys (and their CTRL- combinations). The transmit buffer always transmits from line 1 down the screen, regardless of the setting of the display format.

The time and/or date can be inserted in the transmit text at any time with one of three key combinations. ALT-T will send only the time, ALT-D sends only the date, and ALT-Z sends a standard MARS format date-time group. You may, of course, enter ALT-T ALT-D which will send time and date not in MARS format. These key operations will be shown in the transmit buffer as "γ" for time only (ALT-T), "δ" for date only (ALT-D), and "⊗" for date-time group (ALT-Z). The correct time and date will be inserted and sent when the transmit buffer contents are actually sent. These codes may be inserted in the transmit buffer, but they are NOT saved when files are saved to disk. Section 3.6.4 of this manual discusses how to use clock card options for automatic time and date information.

The end-of-line sequence is normally set to CR/LF/LTRS for Baudot and CR/LF for ASCII. However, as explained in Section 3.6.5, several other combinations may be set for special applications.

### 3.1 RTTY Transmit

RTTY transmission will be made at the same code, speed, polarity, and shift set for receive using ALT-F1, ALT-F2, ALT-F5, and ALT-F6 keys. When HDX (half-duplex) mode is selected (normal radio communications), transmitted text is "echoed" into the receive buffer using dim video. Also, receive data input is disabled while transmitting in HDX mode. When FDX mode is used (computer and modem systems), transmit text is NOT echoed in the receive buffer and both transmit and receive data circuits are simultaneously active.

The Baudot USOS (unshift-on-space) feature affects both received and transmitted text output. When USOS is turned ON, the receive case downshifts to LTRS case after EACH space-bar character. The receive does NOT automatically shift to LTRS at the end of a received line. When transmitting text with USOS turned ON, a LTRS character is inserted after each space and extra FIGS are also inserted if necessary. When USOS is turned OFF, the receive case is ONLY changed when LTRS or FIGS characters are part of the received RTTY text. Likewise, when transmitting, Baudot FIGS and LTRS codes are only inserted as needed.

The end-of-line (E-O-L) sequence transmitted operates INDEPENDENT of the USOS condition and may be set to many conditions using CTRL-

The default for factory supplied software is to send CR/LF/LTRS for Baudot RTTY. All Baudot text received is displayed as upper-case or capital letters. Transmit text may be entered using either upper or lower case. Keys with no Baudot equivalent are ignored (CTRL-H, for example). The keys necessary to produce unique Baudot codes are listed in Table 13.

TABLE 13  
UNIQUE BAUDOT KEY COMBINATIONS

CHARACTER	TYPE	DISPLAY
BELL	CTRL-G	( )
LTRS	SHIFT-,	( < )
FIGS	SHIFT-.	( > )
CR	ALT-M	( )
LF	CTRL-J	(inverse O)
FIGS-H	SHIFT-3	( # )
Blank	ESC	( -- )
BREAK	ALT-CTRL	(continuous space)
12 LTRS	+	+ (in US Baudot only)

All standard 96 characters of the ASCII code are supported by the PCI-2000. Use the SHIFT and CTRL keys as you would on any other ASCII terminal. Use of CTRL keys will produce graphics symbols in the transmit section of the screen. The symbols correspond to those listed in your PC Operations Manual. USOS is a Baudot-only feature and has NO effect on ASCII operation. The ASCII end-of-line (E-O-L) sequence is also set using CTRL-F2. The factory default for ASCII E-O-L is CR/LF.

### 3.3.2 CW Transmit

To send Morse code, select MORSE (ALT-F1) and set the desired transmit speed with ALT-F2 (shown on status line). As in the case of the RTTY speed, the direction of the ALT-F2 operation depends upon the setting of the SCROLL LOCK toggle. If the status line shows ↓ (down arrow), the speed DECREASES 1 WPM with each ALT-F2 press; ↑ (up arrow) gives a speed INCREASE with each ALT-F2. Holding ALT-F1 down will rapidly increment the speed. Morse code is always transmitted using half-duplex (HDX) mode and the receive circuitry is ignored when transmitting. Capital letters are assumed for Morse code transmissions whether the SHIFT key is used or not. Special Morse code prosign key combinations are shown in Table 14.

TABLE 14  
MORSE PROSIGNS

PROSIGN	CODE	KEY
AA	.-.-	< (Shift ,)
AR	.-.-.	@ (Shift 2)
AS	.-....	=
BT	-...-	+ (either key)
KN	-....	> (Shift .)
SK	...--	* (Shift 8)
error	.....	! (Shift 1)
Key Down		ALT-CTRL

### 3.4 Use of Disk Storage

The PCI-2000 software is contained on one 5.25" floppy diskette. This diskette is also used to store the start-up parameters of the system and text files received and to be transmitted. If another disk drive is available in your system, text files may also be stored on a separate diskette. All text files for the PCI-2000 are written in plain-text and may therefore be edited by any standard word processing program using "non-document" or other mode that does not insert special characters for formatting.

#### 3.4.1 Configuration File

The turn-on or "boot" parameters of the PCI-2000 hardware and software are stored in a file titled "PCRTTY.CNF". These parameters may be changed at any time during PCI-2000 operation using the FN keys, but will revert to the default values stored in PCRTTY.CNF when the software is re-loaded. The actual start-up parameters in PCRTTY.CNF can also be changed by use of the CTRL-F2 plus SAVE key combinations. PCI-2000 parameters stored in PCRTTY.CNF are shown in Table 15.

TABLE 15  
PCRTTY.CNF STORED PARAMETERS

PARAMETER	OPTIONS
CODE	BAUDOT, ASCII, MORSE
SPEED	Separate speed for each code
HDX/FDX	Half- or full-duplex
USOS	Unshift-on-space (Baudot)
MODE	WORD, LINE, CHARACTER
SYN	RTTY Sync Idle ON/OFF
PRINTER	Printer ON (LP) / OFF
POLARITY	RTTY NORM/REV
SHIFT	170/425/850/RS232/ 103-O/103-A/202
KY12	KY1 and KY2 ON/OFF
HERE IS	All 10 HERE IS message texts
COM1/COM2	Serial I/O Channel
ASCII FORMAT	Low and High speed format
E-O-L	RTTY End of line sequences
TX LINE	Length of TX line
BAUDOT	U.S. or CCITT No. 2 Code
AUTOPRINT	Turn RTTY autoprint ON/OFF
PTT DELAY	For ASCII/Baudot - 1 to 9999
CALLSIGN	Selected callsign for ID

In addition to the above parameters, video screen attributes and status line time display parameters are also stored.

You may create other configuration files for special applications, such as packet operations. For example, suppose you wish to create a special configuration file which will be named PACKET.CNF. You intend to use this file to boot-up for packet operation. First, exit to DOS from PCRTTY. Next, enter PCRTTY by typing: PCRTTY PACKET This will tell the program that you wish to enter PCRTTY with the setup parameters from file PACKET.CNF. The PACKET.CNF file does not yet exist, so PCRTTY will create one using the default parameters from PCRTTY.CNF. Now you may go through and change any of the parameters for packet operation and simply store the configuration (option 8 after entering CTRL-F2). Note that the configuration file name is shown at the end of the option 8 line in the initial menu. To change configuration files, you must exit PCRTTY and type:

```
PCRTTY          (to use the regular PCRTTY.CNF file)
or PCRTTY PACKET (to use the PACKET.CNF file)
```

Each configuration file may have its own time reference, such as local time or UTC. To do this you may use the time offset value on the CTRL-F2 option page, option 9. The offset is the number of hours added to or subtracted from the computer clock to obtain the time displayed by PCRTTY. For example, if your current time zone is Central Standard Time (CST), you would set the offset to +6 to move PCRTTY to UTC (Universal Coordinated Time, or GMT).

### 3.4.2 Storing Text

The PCI-2000 can store to disk text that is in either the receive or transmit buffers; or it can continuously record received text to disk. To select storage, enter SHIFT-F1. The status line will change and prompt for receive or transmit buffer (R or X), continuous receive (C), or directory (D). If storage of the receive buffer is selected, the status line again prompts for line numbers of the block of receive text to be stored and the desired file name. In the receive buffer, text starting at the highest line number and continuing through the lowest line number is stored. Entry of RETURN for the starting point is interpreted as line 250 (if it is used - highest used line number otherwise). Entry of a RETURN for the ending point is interpreted as line number 001.

For storage of text from the transmit buffer, you must first display the desired transmit buffer (B1 or B2) using SHIFT-F5. Then use SHIFT-F1, answer "X", and enter the desired file name. The entire displayed or "active" transmit buffer will be stored.

For continuous storage of received text, select C. The PCI-2000 will respond with Normal or Auto Format (N or A). When files are stored to disk, they are converted to ASCII files. This results in the Baudot Characters FIGS and LTRS not being stored in the disk file. If you select N for Normal, all other characters are stored as received, and there is no attempt by the PCI-2000 to reformat the text to match the current transmit line length. If

you select A for Auto Format, the PCI-2000 will ignore all CR characters and store the end of line sequence as a CR/LF whenever it sees a LF appear in the received text. Also, if the received text line should extend past the display line width, the PCI-2000 will insert a CR/LF with the proper word wrap, when optioned. Most of the time you should use Normal mode so that disk files contain all of the information received.

After you select the file save format, you are asked to select either Single or Auto-Increment mode for RXON. If you select Single, all text is stored to a single file until you disable RXON. If you select Auto-Increment, a new text file is created each time the sequence NNNN is received. When receiving message traffic, the Auto-Increment mode is usually used.

Next, you must specify a file name for the disk file. If you are in Single file mode, the name you type is the name under which the file is stored. If you are in Auto-Increment mode, the name you select will be the prefix for the entire group of files and the first file stored will have a .000 file extension. The second will be .001, etc. Thus, if you name the file RX, the first file stored will be RX.000, followed by RX.001, RX.002, etc. New file generation will continue with reception of each NNNN sequence until you disable the save function. When continuous receive is activated, the right half of the status line is replaced by "RXON: RX.002", for example. The file name will show the file extension currently being recorded.

To terminate continuous receive, select Shift-F1 again and select continuous receive. You will be asked if you wish to terminate continuous receive. Answer "Y" for yes to terminate. Should the destination disk for continuous receive become full, you will receive the appropriate error message, and you will not be able to receive any more text.

If you select D as the operation from Shift-F1, you may obtain a listing of the directory. This listing can be a specific file, a partial listing (for instance, RX.\*, using the wildcard to list all numbered files named RX), or the complete directory. To get the complete directory, simply type an ENTER key when asked for the file name. To list individual or partial listings, specify the filename of interest (with a wildcard for partial listings).

All text files may be edited at any time using the PCI-2000 edit features described in section 3.5 or by using a word-processing program in "non-document" mode.

### 3.4.3 Transmitting Disk Files

Files may be transmitted directly from disk using the Shift-F10 function. After typing Shift-F10, the PCI-2000 asks for the name of the file to be transmitted. Enter the file name and a CR, and the PCI will ask for another file name. If there are no others to be transmitted, simply enter a CR and transmission will begin.

NOTE: A special feature of PCRTTY is that it transmits the contents of HERE IS #5 immediately before any files being transmitted directly from disk. HI5 will only be transmitted once if you specify a string of files for a single transmission.

You may enter up to 10 filenames and these will be transmitted in the order of entry. If you wish to send a list of files with a common character sequence (like RX.000 through RX.015), enter a wildcard representation of the filenames (RX.\*, for example). Remember that any filename matching the wildcard specification will be sent. The filename \*.\* specifies all files on the disk! As files are transmitted, the status line changes to show "TXON: Filename" showing the name of the file currently being transmitted. If an invalid filename is entered, it will be quietly skipped and the PCI-2000 will go on to the next file to be transmitted. The normal status line returns when transmission is completed. The Shift-F10 sequence can be used to stop or restart transmission of disk files.

In addition, a file of 250 lines or less may be transmitted by loading it into the active transmit buffer (B1 or B2) with the SHIFT-F2 command. The status line prompts for the name of the file. The file is loaded into the active or displayed transmit buffer (B1 or B2). Because the transmit buffers have a maximum length of 250 lines, files longer than 250 lines should not be transmitted in this fashion. Otherwise, text beyond 250 lines will NOT be transmitted.

A special feature is included if transmitting in Baudot code. After transmission of the sequence NNNN, twelve LTRS characters will be sent. This will happen whether the NNNN sequence comes from a disk file or from text typed into the transmit buffer. This feature is to aid MARS operators who are required to send this sequence at the end of each message. In addition, the Alt-N key sequence can be used to generate the 12 LTRS characters at any time.

### 3.5 Editing Features

The available edit key combinations are shown in Table 11 at the beginning of this chapter. All typed text and any text file stored on diskette may be edited. The editor features ALWAYS operate on whatever text is displayed in the active transmit buffer area (B1 or B2). If you wish to edit a text file that is on diskette, you must first load that file into the transmit buffer (SHIFT-F2).

Editing operations involve movement of the keyboard cursor between characters and lines of the display. Some cursor movements such as the arrow keys are "NON-DESTRUCTIVE" (cursor movement does not change text); other movements such as DEL are DESTRUCTIVE (text is modified). Still other key operations involve changing the displayed section of the transmit (or receive) buffer (SCREEN SCROLL commands).

Editing may be done by inserting characters between existing characters or by over-writing previous text. Choice of which mode is used is controlled by the INS key (0 key in right-side number pad area). The PCI-2000 editor always defaults to INSERT-OFF or OVER-TYPE mode when first run. To operate in the INSERT-ON mode, hit the INS key once. The INSERT ON/OFF feature toggles with each INS key press.

The four arrow keys in the number key-pad area may be used for non-destructive cursor movement. The left and right arrow keys (4 and 6) move the cursor one character left or right, respectively. CTRL plus either the left or right arrow keys gives a one word left or right movement. The up and down arrows (8 and 2) move the cursor up or down one line. The HOME key will move the cursor to the top left corner of the DISPLAYED SECTION of the transmit buffer; SHIFT-HOME moves the cursor to the beginning of the file. Similarly, the END key moves the cursor to the beginning of the last DISPLAYED LINE of the buffer; SHIFT-HOME moves the cursor to the end of the file. The HOME and END keys may be used in either the RX or TX buffer displays, depending upon the setting of the SCROLL LOCK key. For editing, be sure that the SCROLL LOCK status indicator shows the down arrow ( ↓ ).

The displayed section of the file may be moved by scrolling the display window with the PAGE UP and PAGE DOWN keys. Each operation of these keys moves the display one line up or down. More rapid scrolling is obtained when CTRL-PAGE UP or CTRL-PAGE DOWN is used. In this case, the displayed portion of the buffer scrolls by two less lines than the total displayed. For example, if the screen is split equally showing 12 line RX and 12 lines TX, CTRL-PAGE DOWN scrolls the display down 10 lines. If the 20RX/4TX display format is used, the TX display would move two lines for each CTRL-PAGE UP or CTRL-PAGE DOWN operation and the RX buffer would scroll 18 lines. The PAGE UP and PAGE DOWN keys also operate on either the RX or TX displays as set by the SCROLL LOCK key. Be sure the down arrow ( ↓ ) is shown on the status line when editing.

The DEL key causes the cursor character itself to be erased. The RUB OUT key (large key next to = key) causes the character to the left of the cursor to be removed.

Either transmit or receive files may be edited by first storing the file on the diskette and by then loading this file into the transmit buffer. The editing changes are then made and the file is again saved on the diskette. Editing of such files may be made while receiving. When text is being transmitted, cursor movement to text that has already been sent is prohibited. Text in the transmit buffer, but not yet transmitted, may be edited while sending. It is simpler to edit files when you are not transmitting and then either send the file directly from the transmit buffer or from a disk file at a later time.

Block operations are available using the sequence Shift-F6. These are performed by moving the cursor to the first line of a text block and typing Shift-F6. Then, move the cursor to the last line of the block and type Shift-F6 again, causing the entire block to change color. Now press Shift-F6 again to give you a menu of the block operations, such as MOVE, DELETE, SAVE, UNMARK, and so on. For each block operation, follow the instructions provided on the screen.

### 3.6 Other Software Features

#### 3.6.1 Screen Format and Display Color

The Personal Computer screen can be set-up for equal display of receive and transmit buffer areas or for preferential display of receive text. The screen format is selected with SHIFT-F9 keys. The "standard" format is display of 12 lines of receive text on the upper section of the screen and 12 lines of transmit buffer on the lower half of the screen. The alternate format is to show 20 lines of the receive buffer and 4 lines of transmit buffer.

Receive text and line numbers are always shown in bright video. When HDX (half-duplex) mode is selected, transmitted text is "echoed" into the receive display area as it is transmitted but with characters in dim video. This gives a rapid indication of different sides of the conversation when the receiver buffer area is later scanned. There is NO echo of transmit text when FDX (full-duplex) mode is selected. Text in the transmit buffer is always shown in dim video.

Text may be copied from the receive buffer into the transmit buffer with the SHIFT-F3 key combination. The status line will prompt for entry of the starting and ending line numbers for the copy operation.

The receive buffer may be cleared at any time by using SHIFT-F7. The displayed transmit buffer may be cleared with SHIFT-F8. BE CAREFUL! Once cleared, the text is gone!

You may change colors of the display if you are using a color card and monitor. To change a display color, select option 7 of the Ctrl-F2 function screen. You will see the normal operating buffers on the screen, but the status line will prompt you for screen color changes. Pressing the left and right arrow keys will move you through the color options. When you are pleased with your selection, move on to the next selection with the ENTER key. When you have completed all color selections, you will be returned to the Ctrl-F2 setup screen. Your color selections are not saved to disk until you select option 8 and Save the selections to disk. You may wish to set up a special color configuration file in which to save the color options.

### 3.6.2 Transmit Buffers

There are two transmit buffers provided in the PCI-2000, with a maximum of 250 lines storage in each buffer. These buffers are called "B1" and "B2". The displayed and active transmit buffer is shown on the status line. The default and preferred buffer to use is "B1". The purpose of the two buffer system is to allow you to make rapid responses to a requested quick break-in without disturbing text you may have pretyped. Be careful when switching buffers! When switching from buffer "B1" to buffer "B2", the contents of B1 are saved in RAM and will still be there when you switch back. However, buffer B2 is temporary and is CLEARED when you switch from B2 to B1. If this causes a problem, store B2 on diskette before switching from B2 to B1. Conversely, if you have a very long message to send, load half in B1 and half in B2, switching buffers after the first portion has been sent.

### 3.6.3 HERE IS Messages

To transmit the contents of any HERE IS message simply type the associated FN key followed by the RETURN key. (F1 for HERE IS 1). To load a HERE IS message, type the associated FN key twice (F1 F1 to load HERE IS 1). The status line will change to show the programming field and you may now enter the desired message. End the programming mode and return to normal operation by typing RETURN as the last key. There are 10 HERE IS messages available (F1 to F10) and each may contain up to 72 characters. The previously stored HERE IS message is shown when first entering program mode. To retain this message, simply type RETURN with no additional characters. All ten HERE IS messages are stored in the PCRTTY.CNF file.

HERE IS 5 is used to store a special sequence which is sent immediately before a file or group of files being transmitted from disk with the Shift-F10 sequence. This allows special services, like MARS, to send a specific sequence at the beginning of each string of traffic. The sequence required by USNMC MARS is:

```
LTRS LTRS SPACE SPACE SPACE SPACE SPACE CR CR LF
```

This sequence can be loaded into HI5 using "<" for LTRS, the space bar for SPACE, ALT-M for CR, and ALT-J for LF.

It is possible to store one HERE IS message within another. In other words, if you put the station callsign in HERE IS 1 and the station location in HERE IS 2, you may use both of these in HERE IS 3. Each call to another HERE IS will appear as a graphic character within the message. When transmitted, however, this graphic character will cause the other HERE IS message to be called and sent. Likewise, it is possible to store any of the Alt- sequences like Alt-T for time to be stored within a HERE IS message.

### 3.6.4 Using Clock Cards

The PCI-2000 uses the IBM-PC clock system for the on-screen time and to time and date files as they are created. In a PC without a clock card feature, the internal PC clock is started when you fill-in the time and date at start-up. The time will be as accurate (or inaccurate) as the oscillators in the PC. If you just enter RETURN in response to the time and date queries at the start, the PC defaults will be used and all files will have similar times and dates!

Clock-card options are available for the Personal Computer series that eliminate this need for re-entry of time and date each time you turn-on the system. The PCI-2000 software can support these clock card options if you include the proper call routine in the AUTOEXEC.BAT file AND load any other required clock card programs on the PCI-2000 diskette. The AUTOEXEC.BAT file may be modified by using an external editor or by loading the file into the transmit buffer, editing, and then saving it as discussed in section 3.5. The PCI-2000 will now automatically retrieve the correct time and date whenever the system is booted.

### 3.6.5 Communications Parameters

The communications parameters of the PCI-2000 can be set from a menu when CTRL-F2 is typed. Each parameter may be changed for just the current operating session or changed and then saved in the PCRTTY.CNF file for future use. Unless option 8 and Save is selected after the communications parameters are changed, the software will revert to previous settings when next booted.

ASCII communications parameters are divided into two speed ranges, "Low Speed ASCII" (110 baud and slower), and "High Speed ASCII" (above 110 baud). The parity, number of data bits, and number of stop bits may be set for each range. The factory settings for "Low Speed ASCII" are no parity, 7 data bits, and 2 stop bits; "High Speed ASCII" is set for no parity, 7 data bits, and 1 stop bit.

The end-of-line (E-O-L) sequence may be set separately for ASCII and Baudot codes. Up to 5 characters may be used in each E-O-L sequence. In ASCII, the allowed characters are CR or LF; for Baudot, CR, LF, LTRS, or FIGS may be used. The factory set E-O-L sequences are CR/LF for ASCII and CR/LF/LTRS for Baudot. Some FDX computer systems may require ONLY a CR for the E-O-L sequence. The U.S. Navy Baudot E-O-L sequence should be set for CR/CR/LF. An early Baudot standard was CR/CR/LF/LTRS/LTRS.

The length of the transmitted line can be set for any number between 20 characters per line and 75 characters per line (limit of the display screen). This feature can be quite convenient when you wish to communicate with another station using limited display equipment (such as a number of hobby computers). The "standard" line length of 72 characters is set in the factory

supplied PCRTTY.CNF file. The standard line length in Europe and for U.S. Navy communications is 69 characters per line.

The PCI-2000 software supports either the U.S. or CCITT #2 Baudot code. Factory software is set for U.S. Baudot. The two codes differ only in the FIGS case presentation of 4 characters as shown in Table 16.

TABLE 16  
BAUDOT CODE DIFFERENCES

CODE	CHARACTER	U.S. BAUDOT	CCITT #2
00100	FIGS-S	BELL	'
01011	FIGS-J	'	BELL
10001	FIGS-Z	"	+
11110	FIGS-V	;	=

Video screen attribute changes are covered in section 3.6.1.

Option 8 is for saving or loading the system configuration file as selected when the PCRTTY program was activated. If PCRTTY was called with no configuration file specifier, then it will use the configuration file PCRTTY.CNF. If PCRTTY is called with a file specifier, like PCRTTY PACKET, then the system looks for or sets up a new configuration. The configuration file would be named PPACKET.CNF in this case. When saving or loading the configuration file, PCRTTY will use the file name which appears under option 8. To change configuration files, you must exit PCRTTY and re-enter by specifying the configuration file.

The time on the right side of the status line may be turned off if desired. This may be particularly helpful for users who wish to run PCRTTY with window programs such as DESKVIEW.

ASCII/Baudot transmit delays are designed in to allow a short period between actuation of the PTT line of the transmitter and actual beginning of text transmission. Also, there is a delay for the amount of time to wait after transmission to release the PTT line. This is particularly helpful to keep the transmitter from dropping out between words or lines while you gather your thoughts! Both of these delays are set to 0800 at the factory and can be changed to anything from 0001 to 9999. 0800 is a good starting point for a PC-XT type computer running at 4.77 MHz. You may wish to change these time delays to match your personal operating habits. Never set the delays to 0000 or the system will not transmit.

The station callsign may be entered under option C. This will be the callsign that is sent if you type Alt-I during operation.

Finally, you have the option of storing or not storing control characters into disk files. PCRTTY automatically strips off control characters before storing the text to disk if you select that option.

Changing any of the communications parameters will immediately change the operation of the PCI-2000. However, these changes will not be reflected when the software is next booted unless, they are saved in the configuration file by using CTRL-F2, option 8, and Save.

### 3.6.6 DOS File Directory Operations

The sequence Ctrl-F1 is used to provide several standard disk directory operations without exiting PCRTTY. When you press Ctrl-F1 a menu of disk operations appears. In addition to the ability to examine the disk directory, you may change the default disk drive, rename files, delete files, copy files, and combine two files together. When you combine two files, the second file specified is appended to the end of the first file specified. Note that in later versions of PCRTTY all file names and directory requests may employ the MS-DOS/PC-DOS path structure to access files in other sub-directories. If no path is specified, the default path set on the Ctrl-F1 page is used. To return to normal PCRTTY operation, you need only press the ENTER Key at the prompt. Option 7 will return you to DOS, leaving the PCRTTY program.

### 3.6.7 RTSOFF File

Later versions of PCRTTY include a file named RTSOFF.EXE which turns off the Request to Send signals from serial ports of the computer. This function is of use when using the PCI-2000 with an external modem or device which uses the RTS line for some special function. For example, the HAL ST-8000 HF Modem uses the RTS line as one method of keying the transmitter. The RTSOFF file is designed to insure that the RTS signals from the PC are turned off.

The RTSOFF.EXE program is included in the AUTOEXEC.BAT file as supplied by the factory. If you wish to change your autoexec file for any reason (e.g., to add a call to your clock card), it is a good idea to be sure that a call to RTSOFF remains in the autoexec file.

There may be certain instances where you do not wish to turn off the RTS line on one of the COM ports. In this case, you may substitute one of the following commands in the autoexec file for the general RTSOFF command:

```
RTSOFF \1      Turns off RTS on COM1 only.  
RTSOFF \2      Turns off RTS on COM2 only.
```

### 3.7 Modem Considerations

The PCI-2000 circuit board contains a very flexible system for use of either the Bell-standard 103 or 202 type modem tones. Different uses are made of this features when radio or phone line applications are desired.

The 103 modem tones have been popularized for VHF radio operations by the CT2100 and CT2200 Communications Terminals. These terminals use only the "Originate-transmit" set of tones (1270Hz = MARK, 1070Hz = SPACE). The 103 modem-tones may be used at data rates up to 300 baud in either ASCII or Baudot codes. The PCI-2000 can be used in radio applications with these tones or other combinations. The choice of which set of tones is received and transmitted varies with selection of both the SHIFT and HDX/FDX options (ALT-F6 and ALT-F4) as shown in Table 16.

TABLE 17  
103 MODEM TONES  
RADIO APPLICATIONS

SHIFT	HDX/FDX	TRANSMIT	RECEIVE
103-O	HDX	1270/1070	1270/1070
103-O	FDX	1270/1070	2225/2025
103-A	HDX	2225/2025	2225/2025
103-A	FDX	2225/2025	1270/1070

To be compatible with the CT2100 and CT2200, use "103-O" and "HDX". The other three options will be useful when communicating with another station using a standard telephone-type 103 modem in full- or half-duplex modes.

As noted in Section 2.3.2, the PCI-2000 may also be used as a phone-line modem IF THE APPROPRIATE FCC-APPROVED ISOLATION DEVICE IS ALSO USED. In this case, a special program is included on your PCI-2000 diskette (PC-MODEM.EXE; from DOS, type "PC-MODEM" plus RETURN) to set-up the correct 103 or 202 parameters for phone-line use. After selecting the mode, exit to DOS and then load your communications software (not provided). It is important that the communications software does NOT disturb the selection parameters chosen in "PC-MODEM.EXE". Note that the connections for radio and phone-line are different and you may NOT have both systems connected to the PCI-2000 at the same time.

The 202 modem tones are always 1200Hz = MARK and 2200 Hz = SPACE. The 202 modem mode will support communications up to 1200 baud, ASCII or Baudot. The 75 baud reverse-channel feature of some 202 modems is NOT supported by the PCI-2000 hardware. The 202 modem is restricted to use with asynchronous codes by the type 8250 UART on the PCI-2000.

## CHAPTER 4 TEST AND ALIGNMENT

The PCI-2000 has been factory aligned and should not require total realignment by the user. However, there are two adjustments that will vary with the receiver and transmitter used. These adjustments are: (1) Autoprint Threshold, and (2) Audio Output Level to the transmitter. Proper adjustment of these controls will be discussed first and then a general realignment procedure will be presented. All PCI-2000 adjustable controls are available on the top edge of the circuit card so that they may be adjusted with the circuit board installed in the Personal Computer. Location of the controls is shown in Figure 2 in Chapter 1 of this manual.

### 4.1 User-adjustable Controls

Two controls will be adjusted in this section - Autoprint Threshold and Audio Output Level. To make these adjustments, you must have the receiver and transmitter connected to the PCI-2000.

#### 4.1.1 Autoprint Threshold

The PCI-2000 includes an autoprint (or "autostart") circuit that may be used to suppress screen print of random characters when only noise or very weak signals are received. This feature ONLY applies to RTTY modes (Baudot and ASCII) and has NO effect on CW receive performance. This control also only applies when 170, 425, or 850 shifts are used; it will not affect 103 or 202 modem performance. Adjustment of this control involves connecting the receiver to the PCI-2000, setting its frequency and bandwidth to the preferred conditions, and then adjustment for minimum display of random characters when noise is received. The procedure is as follows:

1. Connect the receiver audio output (speaker) to the PCI-2000 audio input terminals. The receiver should be connected to the normal operating antenna.
2. Set the receiver to the preferred RTTY operating mode (LSB or FSK) and bandwidth (Normal or Narrow), and tune to a frequency where only background noise is received (no signals).
3. Set the PCI-2000 to Baudot, 45 to 74 baud, and 170 Hz shift. Turn-on the autoprint feature (CTRL-F5; "AP" on status line).
4. You may or may not see random characters in the receive section of the screen. Adjustment of the AUTOPRINT control will set a threshold at which printing of random characters on noise stops. Experiment with the control setting and set it so that

the random characters are just stopped. Turn the control slowly as there is a shut-off time delay to prevent on-off "chopping" on rapidly fluttering signals.

5. Tune to a valid RTTY signal and check that it does indeed print.

6. The setting of the AUTOPRINT control may vary with frequency band used, receiver selectivity, or with shift selected. Chose your common settings of these receiver parameters before making the final adjustment. It is normal for several noise characters to be printed after a signal is lost.

7. Weak signal performance is best when AUTOPRINT is turned OFF using CTRL-F5. The autoprnt feature may cause misprints by "chopping" on a fading signal, much like the behavior of a closely set squelch control on an FM communications receiver.

#### 4.1.2 Audio Output Level

The audio output signal to the transmitter must be adjusted with the transmitter audio input and PTT circuits connected to the PCI-2000. NOTE: If you use FSK rather than tones to transmit HF RTTY, this adjustment is NOT necessary and will not affect RTTY transmitter performance. The following adjustment procedure is recommended:

1. Connect the transmitter audio input (microphone or phone patch input) and PTT (push-to-talk) to the PCI-2000. Connect the transmitter RF output to a dummy load. Use the internal transmitter RF Output meter or connect a Wattmeter between the transmitter and dummy load.

2. Set the transmitter to LSB (RTTY on TR7) and the microphone gain control to minimum.

3. Set the PCI-2000 to Baudot, 45 baud, 170 Hz, and turn SYNC idle ON.

4. Type a few characters into the transmit buffer but do not type RETURN. Turn on the transmitter with ALT-F10 (TON EN). The transmitter should now turn on and you will be sending idle characters.

5. Carefully increase the transmitter microphone gain control until you have the desired RF power output. The transmitter gain control and the PCI-2000 Audio Output Level control are in series, so each will affect the RF output power of the transmitter. By careful "juggling" of the settings of the PCI-2000 Audio Output Level control and the transmitter gain control, you should be able to easily control RF output with only the transmitter gain control. Typically, the RF output should go to maximum near the center of its adjustment range. Avoid operating

the transmitter for long periods at high power levels! The preferred setting of these controls is to have neither near the lower or upper setting, giving preference to a slightly higher setting of the PCI-2000 and lower setting of the transmitter gain control if necessary. RFI and hum will be minimum if a moderately high level of audio signal is set on the PCI-2000 Audio Output.

The output level is set to -32 dbm at the factory (approximately 20 mV RMS). This level is generally satisfactory for most SSB transceivers.

## 4.2 RTTY Demodulator Alignment

The RTTY demodulator section of the PCI-2000 uses active filters that should not generally require realignment. The alignment instructions in this section are presented for service situations. Unless parts in the demodulator filter circuitry have been replaced, it should not be necessary to perform these adjustments. These adjustments ONLY apply to the RTTY shifts of 170, 425, and 850 Hz. No adjustments are needed for the 103 or 202 modem sections. The transmit tones of the PCI-2000 are synthesized from a crystal oscillator and are not adjustable.

### 4.2.1 Limiter Balance

The RTTY demodulator uses a high-gain, wide-bandwidth limiter amplifier to eliminate any amplitude variations in the received signal. This limiter amplifier requires adjustment of the input DC offset to assure symmetrical limiting of the input signal and maximum sensitivity. This control will require adjustment ONLY if the type 709 integrated circuit (IC9) is replaced.

Two techniques may be used to set the limiter balance. The first technique is to connect a zero-center DC voltmeter or a direct-coupled oscilloscope to TP13 and make the adjustment with the Audio Input to the PCI-2000 shorted to ground (no receiver). Adjust LIMITER BALANCE for zero volts DC at TP13. This will be a pretty critical adjustment and the output of the limiter will quickly swing from one extreme to the other as the correct adjustment point is passed.

This adjustment may then be refined by using the direct-coupled oscilloscope to observe very weak audio signals. Connect the PCI-2000 Audio Input to an audio oscillator with the frequency set to 2125 Hz. Observe the limiter output at TP13 and reduce the oscillator signal until the audio signal is at the limiting threshold (slight clipping of peaks). The oscillator output level must be very low (of the order of 10 mV rms) and you may have to use additional attenuation between the oscillator and PCI-2000. Now, "touch-up" the LIMITER BALANCE adjustment until equal clipping of positive and negative peaks of the sine wave are observed. This procedure will give maximum sensitivity and optimum limiter performance.

### 4.2.2 Discriminator Tuning

Tuning of the discriminator sections of the 170/425/850 shift demodulator is best done by using an oscilloscope and the transmit tones of the PCI-2000 itself. Since the transmit tones are all synthesized from a crystal controlled oscillator, they will probably be more accurate than is easily obtained using an external audio oscillator and audio frequency counter.

For a preliminary setting of the MARK filter, select 850 shift and connect the oscilloscope to the MARK scope output. Connect the PCI-2000 Audio Output to Audio Input. Adjust the MARK control for maximum oscilloscope deflection.

Now, set the PCI-2000 to transmit with ALT-F10 and press the ALT-CTRL keys (BREAK) to send a continuous space condition. Hold the ALT-CTRL keys down for the following adjustment. Connect the oscilloscope to the SPACE scope output. Adjust the 850 SHIFT control for maximum oscilloscope deflection. Change the shift to 425 and adjust the 425 SHIFT control for maximum deflection. Finally, select 170 shift and adjust the 170 SHIFT control for maximum scope deflection.

With the shift set to 170 Hz, release the ALT-CTRL keys and change the oscilloscope to the MARK scope output. Note the magnitude of the scope signal displayed. Now, connect the oscilloscope to the SPACE scope output, hold the ALT-CTRL keys down, and measure this amplitude. Adjust the SPACE BALANCE control until the outputs from the mark and space filters are the same. Check these measurements several times to assure that the discriminator is truly balanced.

As a final test, connect an X-Y oscilloscope to both the MARK and SPACE scope outputs and transmit a line or two of RY's (SHIFT-F4). The scope should show the standard crossed-ellipse display. You may want to "fine-tune" the MARK and 170 SHIFT control adjustments slightly. NOTE: It is NORMAL for the two ellipses NOT to be exactly vertical. The adjustment objective is to have maximum major axis ellipse deflection on each signal, NOT to produce perfectly orthogonal "pictures"! Be careful not to make a major change in either the MARK or 170 SHIFT controls. It may be necessary to recheck the discriminator SPACE BALANCE after this test.

These are the ONLY adjustments available for the RTTY demodulator. The transmit tones are synthesized from a crystal oscillator and do not require adjustment.

### 4.3 Morse Demodulator

The test points for the Morse demodulator circuit will require that an extender card be used in the Personal Computer. Also, an audio oscillator and accurate audio frequency counter are required to make these adjustments. Realignment of the Morse demodulator is not recommended unless it has been necessary to replace components in this section.

Connect a short circuit across the PCI-2000 Audio Input and connect the oscilloscope to TP6 (sensitivity = 5mV/div). Adjust the CW MIXER BALANCE control for minimum display on the oscilloscope.

Move the oscilloscope to TP5 and connect a 0.1 uF capacitor in series with the audio oscillator to TP6. Connect the counter to read the audio oscillator frequency. Set the oscillator to approximately 9 kHz and 1V P-P output. Adjust the oscillator frequency until a peak scope display is obtained. Set the oscilloscope gain and audio oscillator output so that a 4 div peak-to-peak display is seen. Change the oscillator frequency both above and below the previous "peak frequency" and note the frequencies at which the display decreases to 2 div. peak-to-peak (two frequencies, one above and below peak frequency). Compute the center of these two frequencies and set the oscillator to the computed frequency. This frequency should be between 8500 and 10,000 Hz (typically 9400 Hz) and is the center frequency for your particular PCI-2000 Morse demodulator circuit. Write the measured frequency down in this manual.

Disconnect the oscillator, counter, and oscilloscope, but leave the short across the PCI-2000 Audio Input. Connect the counter to TP2 and measure the PLL oscillator frequency. Adjust the CW PLL FREQ control so that the frequency is the same as that computed above.

Move the counter connection to TP3 and adjust the CW CARRIER OSC control so that the frequency is 800 Hz BELOW the previously computed frequency (typically 8600 Hz). This control sets the optimum audio tone frequency for Morse reception. This frequency offset should match the tone frequency output of your receiver when a CW signal is received using the narrow filter. This frequency offset can be set between 400 and 1200 Hz to compensate for variations between receivers and filters.

You may now wish to connect the PCI-2000 Audio Input to a receiver and monitor TP4 with the oscilloscope. Tune-in a CW station and see that the digital wave form follows the on-off Morse code keying. This completes adjustment of the Morse demodulator section. No other adjustments are required on the PCI-2000

## 4.4 Jumper Settings

Jumper settings have been briefly described in Section 1.2.1, Figure 2, and Table 1 of this manual. When reading this section, refer to Figure 1 and Table 1.

### 4.4.1 FSK Jumpers

Four jumper positions are provided to allow matching of the various FSK input parameters of modern transceivers. The FSK output of the PCI-2000 (pin 11) can be used to drive an FSK input on the transmitter or transceiver. Some transmitter FSK inputs require only a switched signal to ground for MARK/SPACE switching; others require switching between a positive voltage and ground (+5 or +12VDC). Some FSK inputs define MARK as the grounded state, others as the open-circuit (OC) or positive voltage state. The requirements vary between manufacturers and even between models of the same manufacturer. Check your manual!

The polarity of the PCI-2000 FSK output may be set as follows:

	FSK POLARITY	MARK	SPACE
*	NORMAL	HI or OC	GROUND
	INVERTED	GROUND	HI or OC

\* = Factory Setting

The FSK output may be set to switch between ground and open-circuit (OC), or may be "pulled" to either +5 or +12VDC in its "HI" state. These jumper selections are as follows:

	FSK LEVEL	"HI"	"LOW"
*	NO JUMPERS	O.C.	GROUND
	+5	+5VDC	GROUND
	+12	+12VDC	GROUND

\* = Factory Setting

**WARNING: DO NOT INSTALL BOTH +5 AND +12 JUMPERS AT THE SAME TIME!**

At the time of printing, these are the recommended FSK jumper settings for popular transceivers:

TRANSCEIVER	FSK POL.	FSK LEVEL
TS940	NOR	+12
TS930	INV	+5
TS440	NOR	+12
TS180	INV	OC
IC730	NOR	+5
IC740	NOR	+5
IC745	NOR	+5
IC751	NOR	+5
FT101ZD	NOR	OC
FT107	NOR	OC
FT910/902	NOR	OC
FT980	NOR	OC
FT-ONE	NOR	OC
CORSAIR	NOR	+12
PARAGON	NOR	+12

If your transceiver has an FSK input and is not included in the above list, try using NORM polarity and OC level. Send RTTY to another station and ask him to check to see that the frequency is shifting between MARK and SPACE and is of correct polarity. If not, try other jumper combinations. The +12V level should be tried ONLY if you are sure that it is required by your equipment. The PCI-2000 cannot generate a negative voltage for the FSK output.

#### 4.4.2 COM1/COM2 Jumpers

Two jumpers are associated with selection of which serial I/O port is used on the PC for the PCI-2000. The jumpers set the Interrupt Request Output and the Primary or Secondary card address. To work properly with the PC-RTTY software, BOTH jumpers must be adjusted when changing from COM1 to COM2 or vice-versa.

SERIAL I/O	IRQ JUMPER	ADR JUMPER
COM1	IRQ4	PRIMARY
* COM2	IRQ3	SECONDARY

\* = Factory Setting

#### 4.4.3 DTR Jumper

The RS232 DTR (Data Terminal Ready) output signal may be generated with either polarity, "high" or "low" for ready condition. The DTR signal is always held in the READY state.

DTR JUMPER	DTR OUTPUT
NO JUMPER	GND
* JUMPER	+5V

\* = Factory Setting

These are the only jumpers that may be set on the PCI-2000 circuit board.

## CHAPTER 5 IN CASE OF DIFFICULTY

This section of your user's manual will discuss in general terms how to keep your PCI-2000 in top operating condition and some typical operating problems you might encounter (and some solutions).

### 5.1 Care of Your PCI-2000

Your PCI-2000 is the latest of many generations of terminals and modems manufactured by HAL Communications. In every way, it has been designed, constructed, and tested to assure years of trouble-free operation. However, there are a number of simple procedures that you, the user, can follow to further improve the reliability, performance, and lifetime of the interface card and software. The following suggestions are offered to help preserve a long operating life for your PCI-2000.

#### Environment:

Electronic equipment is very susceptible to variations in temperature and relative humidity, as well as to dust and dirt accumulations. The PCI-2000 will operate in normal room-temperature environments and should be as tolerant of temperature extremes as you are while operating it. However, inadvertent blockage of the ventilating holes in the Personal Computer cabinet will cause the INTERNAL temperature of the computer and PCI-2000 to rise considerably above the ambient room temperature and may in fact cause circuit failure. Also, accumulations of dust or dirt, particularly when accompanied by high humidity conditions, can cause overheating and may result in long-term corrosion of the internal circuitry. Therefore, try to position the Personal Computer so that its ventilating holes are not obstructed and try to avoid extremely dusty or dirty environments. On the other hand, the solid-state components in the PCI-2000 are designed to operate at considerably higher temperatures than we humans; do not be overly disturbed if the components on the circuit board operate quite warm to the touch. This internal heat often helps to "dry-out" humidity in the cabinet.

Use normal care in handling the software diskette. Avoid dust, humidity, heat, and finger prints. Do NOT use ball-point pens to mark labels on the diskette or its cover. As noted in Chapter 1 of this manual, be sure to make several copies of the PCI-2000 diskette and then USE THE COPIES. Store the original diskette in a cool and dry location away from magnetic fields (including the ringer in a telephone). A drawer in a metal desk is a good location.

### Electrical Connection:

All electrical connection points of the PCI-2000 have maximum voltage and current ratings as given in Table 4 and Chapter 6 of this manual. If these ratings are exceeded for even a short period of time, considerable damage to the PCI-2000 and the Personal Computer may result. Therefore, be very careful -- KNOW the ratings of the PCI-2000 and the characteristics of any other equipment before making connections. Some common causes of electrical failures have been found to be:

A. Inadequate grounding, causing RF interference problems as well as sensitivity to AC power line transients.

B. Connection of a high-voltage loop supply. THE PCI-2000 HAS NO PROVISIONS FOR CONNECTION TO A HIGH VOLTAGE RTTY LOOP. DAMAGE WILL CERTAINLY BE DONE IF OPERATION WITH A HIGH VOLTAGE LOOP SUPPLY IS ATTEMPTED WITHOUT PROPER LEVEL CONVERSION AND ISOLATION DEVICES.

C. Damage from lightning, or other transients on the power line or station antenna system. A good lightning protection system may help, as will disconnecting the terminal during electrical storms. However, such things are unpredictable and the PCI-2000 is no more susceptible to such problems than other electronic equipment in the station.

### 5.2 Typical Operational Problems

Because a large number of features are offered in the PCI-2000, it is by nature a complicated device. Therefore, there may be times when it first appears that the PCI-2000 or the Personal Computer has either quit completely or gone off to "do its own thing". If some of the circuitry has failed, you may well get such symptoms. However, most often when a new owner finds an RTTY terminal "unresponsive", it is actually doing what it has been instructed to do. Familiarity with the PCI-2000 software will quickly reduce the chances of "cockpit error" during operation.

The status line on the PC screen is the best key to what is happening in the PCI-2000. If confused, check the status line! Often mistyping a key may cause a result entirely different from that intended. Some of the more confusing conditions you may encounter are:

1. Forgetting to terminate the programming of a HERE-IS message. Normally, when you finish typing the desired HERE-IS message text, you terminate the programming with a RETURN key. Failure to use the RETURN key means that the text continues to be stored in the HERE-IS buffer UNTIL THE STORAGE AREA IS FILLED. At this point, the signal bell ("beep") sounds with each key pressed until you end programming with the RETURN key. You cannot pro-

ceed to typing transmit text or other features until HERE IS programming is ended with a RETURN.

2. When sending a HERE IS message, it is NOT loaded into the transmit buffer until BOTH the FN key AND the RETURN key are hit in sequence. To load HERE IS #1, type F1 and then RETURN. You will NOT see the HERE IS message in the transmit buffer until the RETURN key is typed!

3. The IBM-PC keyboard features automatic repeat for ALL keys. This is both a good and bad feature! It helps when typing tables and multiple characters, but can be very confusing with regard to the HERE IS messages. Be VERY CAREFUL about holding down ANY of the FN keys! If a FN key is held down until the automatic repeat feature starts operating, reprogramming of the message will begin AUTOMATICALLY on the second repeat and you will thereafter erase the previously stored message and add the FN key code itself in the HERE IS message on subsequent repeats. If you find your HERE IS message full of "funny" graphics characters, this is probably how it happened! DON'T REST YOUR FINGERS ON ANY KEYS! If this happens inadvertently, use CTRL-F1 and LOAD to reload the previous message from the disk.

4. When separate LTRS or FIGS characters are to be transmitted in Baudot code, the presence of these characters will be shown in the transmit section of the screen by the appropriate symbol. However, when transmitted, the effects of these characters are not shown on the screen. They are, none the less, transmitted.

5. When IDLE is used and KOS controls the transmit/receive circuit of the station, the synchronous idle feature will keep the KOS and the PCI-2000 in a continuous-transmit condition (outputting sync characters) until a RETURN key is typed or the software "times-out". Therefore, it is a good operating practice to ALWAYS END A TRANSMISSION WITH THE RETURN KEY.

6. The PCI-2000 may be operated in either half duplex (HDX) or full duplex (FDX). However, text transmitted ONLY appears in the receive buffer when in HDX mode; there is no on-screen local "echo" of transmitted text in FDX mode.

7. Be sure that you have properly selected the desired demodulator and shift combination; trying to tune an RTTY signal when the 103 or 202 modems are selected can be particularly frustrating!

8. Do NOT connect to both the RS232 I/O pins and radio equipment simultaneously. The PCI-2000 is a single channel serial I/O device and may be connected to only ONE data system at a time.

9. CTRL-F4 allows control of the PC line printer output (LP1). Do NOT use this control if a line printer is not connected! If it is used with no line printer connected (or the printer turned off), the software will appear to "hang-up" until the IBM BIOS

line printer routines "time-out" (a long wait). No received data is lost during this "hang-up", but it is a confusing situation! This situation is a function of the BIOS routines in the computer and is NOT controllable in the HAL software.

10. A "HELP" menu listing all of the function key operations is available at any time by typing ALT-H.

### 5.3 RFI Problems

The PCI-2000 has been designed to minimize radio frequency interference (RFI) problems. I/O connections to the DB-25 connector are by-passed and the circuit board is particularly designed to keep computer noise to a minimum. However, addition of the PCI-2000 will NOT reduce radio noise that emanates from the Personal Computer itself. Connecting cables directly to the PC cabinet may in fact make the computer noise more noticeable in your receiver. The computer may also be susceptible to transmitter RF. The following are recommended techniques to reduce RFI to and from the computer:

1. Use SHIELDED cables for ALL connections in the radio system. This includes all wires to the PCI-2000 AND other wires between transmitter, receiver, and accessories in the station.
2. Use COAXIAL cable to the antenna. Open-wire or twin-lead feedlines and antenna tuners are generally NOT compatible with computers.
3. Connect the cabinets of ALL equipment in the radio station together with SHORT and LOW INDUCTANCE ground leads. Shield braid that is 1/4 or 1/2" wide is recommended. Connecting the cabinets together is MUCH more important to RFI reduction than installing a wire to a "driven-rod" ground. (This is important for AC safety, however.)
4. Locate the antenna so that the radiating sections are well away from the radio equipment. Installing a dipole with one end on the outside wall of the radio room is inviting problems.
5. Make sure that the AC power line cords of the transmitter and linear amplifier include by-pass capacitors to the chassis. Some commercially manufactured amplifiers do NOT contain these capacitors and a noticeable amount of RF escapes via the power cord.
6. The Personal Computer keyboard cable can act as an antenna and be the "path" into or out of the computer for RFI. A shielded keyboard cable and/or a toroid on the keyboard cable may fix this problem.

These are just a few suggestions that have helped to reduce RFI with computers. Every RFI problem tends to be different and some experimentation is usually required before all RFI problems are solved. Additional suggestions for suppression of RFI are contained in the booklet "R.F. Induced Problems and Solid State RTTY Terminals", available from HAL free of charge.

#### 5.4 Repair Procedures

In the event that your PCI-2000 develops a malfunction, the first step is to carefully note all of the symptoms of the problem. Statements such as "BROKEN" or "DOESN'T WORK" are of little help to the service technician, and usually lead to longer repair times than might otherwise be required. Try to provide as much information concerning the failure as you can before you contact your dealer. By all means, consult your dealer before calling the factory; he may be able to fix the unit locally and avoid the shipping and delay times. The following are some of the things that will concern the dealer or factory:

1. Model number and version number (V3.x)
2. How long have you owned it?
3. Where did you purchase it (dealer's name)?
4. If purchased used, who was the previous owner? (Used to refer to any previous repair history on that particular unit.)
5. What terminal modes, rates, codes, and conditions are associated with the failure? Does it happen only in receive, transmit, or both?
6. Are there extenuating circumstances? (Lightning, spilled liquids, dropped unit?)
7. Is there anything else you can add to the description that you think might be useful?

**AFTER** you have determined answers to the above, contact your dealer and discuss the problem with him. If he indicates that he will be unable to assist you, the unit should be returned to the HAL factory for repair. Before returning the unit to the factory, either you or the dealer should call and receive factory return authorization so that we may expect the unit in shipping and be prepared to work on it when it arrives.

#### **INCLUDE IN THE BOX A SHORT DESCRIPTION OF THE PROBLEMS.**

Whenever possible, return the unit via UPS to the factory address below, insuring it for the full value. The shipping cost to the factory should be paid by you. If the repair is covered by the HAL warranty, the return shipping costs from the factory (48 contiguous states only) are paid by HAL. You will be billed for shipping costs on non-warranty repairs.

The factory "ship-to" address is:

HAL COMMUNICATIONS CORP  
1201 W. KENYON ROAD  
BOX 365  
URBANA, ILLINOIS 61801  
ATTENTION: REPAIR DEPARTMENT

Because of the complexity of the circuitry used in the PCI-2000, we do NOT recommend that you personally undertake repair of the circuit board. For the convenience of field repairs, complete realignment instructions are included in Chapter 4. However, if at all possible, we recommend that you return a defective unit to the factory for repair.

The one-year limited warranty (listed in full at the end of this manual) provides for repair of the PCI-2000 for a full year after purchase. The purchase invoice date from your dealer marks the beginning of the warranty period - save your copy of the invoice! Please read the warranty carefully to determine the full extent of the privileges and limitations.

CHAPTER 6  
TECHNICAL DATA

## 6.1 Specifications

## INPUT/OUTPUT:

AF IN: 4-600 ohms from receiver  
Morse: -20 to +10 dBm, 800 Hz, adjustable  
RTTY: -70 to +10 dBm, 1.0 - 3.0 kHz  
Modem: -20 to +10 dBm, 1.0 - 2.2 kHz

AF OUT: -32 dBm (20 mV nom.), 600 ohms  
Adjustable from 0 to -40 dBm

RS232C: All inputs: MARK = -5 to -15V  
SPACE = +5 to +15V  
All outputs: MARK = -12V  
SPACE = +12V  
DTR state jumper selected.

FSK: MARK = "HI" or Ground (jumper)  
"HI" = O.C., +5, or +12V (jumper)

PTT: Relay isolated contacts; +/- 50V,  
0.5A maximum ratings.

KY1: Open-collector NPN transistor switch;  
KY2: +40V, 0.15A maximum ratings

+CW KEY: Open-collector NPN transistor switch;  
+100V, 0.1A maximum ratings.

-CW KEY: Open-collector PNP transistor switch;  
-100V, 0.1A maximum ratings.

SCOPE: MARK and SPACE; 10V P-P maximum

MODEM: I/O audio for phone connection.  
Requires FCC-approved DAA device.

RING: TTL; Connect = 0V; off-hook pulled internally  
to +5VDC.

+12V: Personal Computer power supply for accessories;  
-12V: 0.05A maximum load.  
+ 5V: DO NOT SHORT CIRCUIT!

## DATA CODES AND RATES:

**BAUDOT:** U.S. standard 5-level or CCITT No.2  
International Telegraphic Code;  
1-unit start pulse, 1.5 unit stop pulse.

**ASCII:** ANSI X3.4-1968 8-level code; 1-unit start pulse,  
2-unit stop pulse (110 baud and slower) or  
1-unit stop pulse (higher than 110 baud).  
Parity bit state selectable.

**RTTY DATA RATES:** Baudot or ASCII may be transmitted and received at  
45, 50, 57, 74, 110, 150, 300, 600, 1200, 2400, 4800,  
and 9600 baud. Rates up to 1200 baud are supported  
by internal modems.

**MORSE CODE:** Continental Morse Code including letters, numbers,  
punctuation, and prosigns (AA, AR, AS, BT, KN, SK).  
Receive speed automatically tracks from 5 to 125 WPM;  
transmit speed adjustable from 5 to 125 WPM.

## MODEMS:

**MORSE:** Phase-lock loop; 800 Hz nominal center frequency;  
adjustable 400-1200 Hz; tracks signal +/- 250 Hz  
of center frequency.

**RTTY:** Full limiting RTTY demodulator with separate MARK  
and SPACE filters, detectors, and active LP filter.  
Transmit tones synthesized from crystal oscillator.

**RTTY TONES (U.S.):**

MARK	= 2125 Hz
SPACE	= 2295 Hz (170 Shift)
	= 2550 Hz (425 Shift)
	= 2975 Hz (850 Shift)

**RTTY TONES (EXP):**

MARK	= 1275 Hz
SPACE	= 1445 Hz (170 Shift)
	= 1700 Hz (425 Shift)
	= 2125 Hz (850 Shift)

**103 MODEM TONES:**

HDX - 103-O (ORIGINATE):	MARK = 1270 Hz; SPACE = 1070 Hz
HDX - 103-A (ANSWER):	MARK = 2200 Hz; SPACE = 2000 Hz
FDX - 103-O (ORIGINATE):	RECEIVE: 1270/1070 Hz = M/S
	TRANSMIT: 2200/2000 Hz = M/S
FDX - 103-A (ANSWER):	RECEIVE: 2200/2000 Hz = M/S
	TRANSMIT: 1270/1070 Hz = M/S

## MODEMS: (continued)

202 HDX Only, no 75 baud reverse chan.  
MODEM MARK = 1200 Hz  
TONES: SPACE = 2200 Hz

## DISPLAY:

FORMAT: Status indicators on top line; split screen to view receive and transmit buffers. Screen split may be set to 12 lines for RX (top) and 12 lines for TX buffer or for 20 lines RX and 4 lines TX. RX buffer text shown in bright video; TX text shown in dim video. Text area is 75 characters wide.

TYPE: Either Monochrome or Color-Graphics video boards are supported.

## STORAGE:

BUFFERS: Receive buffer = 250 lines  
Transmit buffer B1 = 250 lines  
Transmit buffer B2 = 250 lines  
Any section of receive or transmit buffers may be viewed by scrolling without interfering with receive or transmit operations. Each buffer may be stored on disk and recalled.

HERE IS: Ten HERE IS messages, each up to 72 characters in length. Keyboard programmed and may be stored on disk.

DISK STORAGE: System start-up parameters and 10 HERE IS messages stored into Configuration File on disk.  
RX and both TX buffers may be stored to disk and reloaded. Receive text may be directly stored to disk. All text files may be edited by word processing systems.

## CONTROL:

PRINTER: ON/OFF control of LP1 printer device.

HDX/FDX: Operate in either half- or full-duplex modes. Also affects choice of tone sets for 103 modem.

## COMPATIBILITY:

IBM PC, IBM PC Portable, IBM PC-XT, COMPAQ. Other IBM-compatibles or "clones" may also work with PCI-2000 if hardware and BIOS routines are compatible.  
Minimum Hardware Requirement: 128KB RAM and one disk drive.

## MECHANICAL:

One "large-sized" IBM-PC circuit board;  
13.25" x 4.0" with 62 contact edge connector.  
All I/O connections on one DB-25 stype connector  
using 25 female pins.

Software furnished on one 5.25" DSDD diskette.

3/4 lbs net, 3 lbs shipping weight.  
(.34 kg net, 1.3 kg shipping)

## ACCESSORIES:

PCI-EXT	Cable Expander Box
SPT-1	SPECTRA-TUNE Indicator

## 6.2 Circuit Description

The block diagram of the PCI-2000 circuit board is shown in Figure 9. The PCI-2000 serves as an interface between the radio or other communication system and the Personal Computer. It includes several different audio tone demodulators, a synthesizer for transmit tones, a UART, and interfacing circuits for the computer and I/O connections.

The audio signal from the radio receiver is connected to three different demodulators. These demodulators are: (1) a RTTY demodulator for 170, 425, and 850 Shift RTTY reception; (2) a Morse code demodulator for CW reception; and (3) a type 103 and 202 modem for reception of data at 300 or 1200 baud. The software on the diskette and user choices from the keyboard select which demodulator output is decoded and displayed on the screen.

The RTTY demodulator follows proven HAL RTTY designs and is quite similar in circuitry and performance to the popular CT2100 and CT2200 Communications Terminals. A high-gain and wide-bandwidth limiter stage first removes all amplitude variations from the received signals. This constant amplitude signal is then filtered by separate active-filters tuned to the desired MARK and SPACE audio tones. The MARK and SPACE filter outputs are detected in an ideal-diode type of detector circuit and then recombined to pass through a three-pole active low-pass filter stage. The resulting digital signal is then processed in a high-gain slicer amplifier to restore the required sharp pulse transitions to drive the UART. Outputs of the MARK and SPACE filters are also detected and summed to give an output voltage to drive the autoprint threshold circuit. The MARK and SPACE filter outputs are also available on the DB-25 I/O connector for connection to a RTTY tuning indicator.

The Morse demodulator likewise uses HAL circuitry first introduced in the DS3100 and later used in the MR2000, CT2100, and CT2200 products. The received 800 Hz CW tones are first upconverted to an intermediate frequency of approximately 9 kHz. The signal is then passed through an active band-pass filter to reduce interference. A phase-locked-loop (PLL) circuit detects the CW signal. The PLL circuit provides automatic tracking of moderate frequency drift of the received signal and eliminates problems with critical tuning of the receiver. The output of the PLL is processed in an active low-pass filter and slicer stage.

The 103 and 202 modem tones are demodulated in a type 7910 "WORLD-CHIP" that contains all of the required processing circuitry for these two modes. The 7910 is a PLL-type of demodulator and is set to the desired mode by software commands contained in the PC-RTTY program. The 7910 also includes a tone generator circuit that is only active when 103 and 202 modems are used in phone line service.

When the PCI-2000 is used for radio communications, all transmit

tone frequencies are synthesized under software control from a master crystal oscillator. Thus, the transmit tone frequencies require no adjustments and are always on the required frequency. When the PCI-2000 is used for phone-line service (with suitable DAA), the synthesizer is turned off and the tone generator of the 7910 IC is used. These tones are also synthesized in the 7910.

The detected and processed serial RTTY signal is converted to the required parallel data format of the Personal Computer in the 8250 UART IC. The transmit and receive baud rates for serial RTTY are set by software commands to a baud-rate synthesizer in the 8250. There are therefore no adjustments required to set the baud rates. The UART I/O signals are also converted to RS232C levels and provided on the DB25 I/O connector for use with external modems.

Other I/O features, peculiar to the problems of radio communications are also provided on the PCI-2000. The push-to-talk (PTT) circuit of the transmitter-receiver is controlled by isolated relay contacts, eliminating problems with polarity and PTT current that can arise when a transistor switch is used. Separate CW key outputs are provided for either positive or negative voltage key circuits, assuring compatibility with both transceiver standards. An FSK output signal is provided to drive FSK input circuits on some commercial transceivers. Because of lack of manufacturer uniformity, options are included for the user to select polarity and voltage level of the FSK output signal. Finally, two undedicated switched outputs are provided that may be turned on and off by keyboard control (KY1 and KY2). These provide additional custom control capabilities for the user.

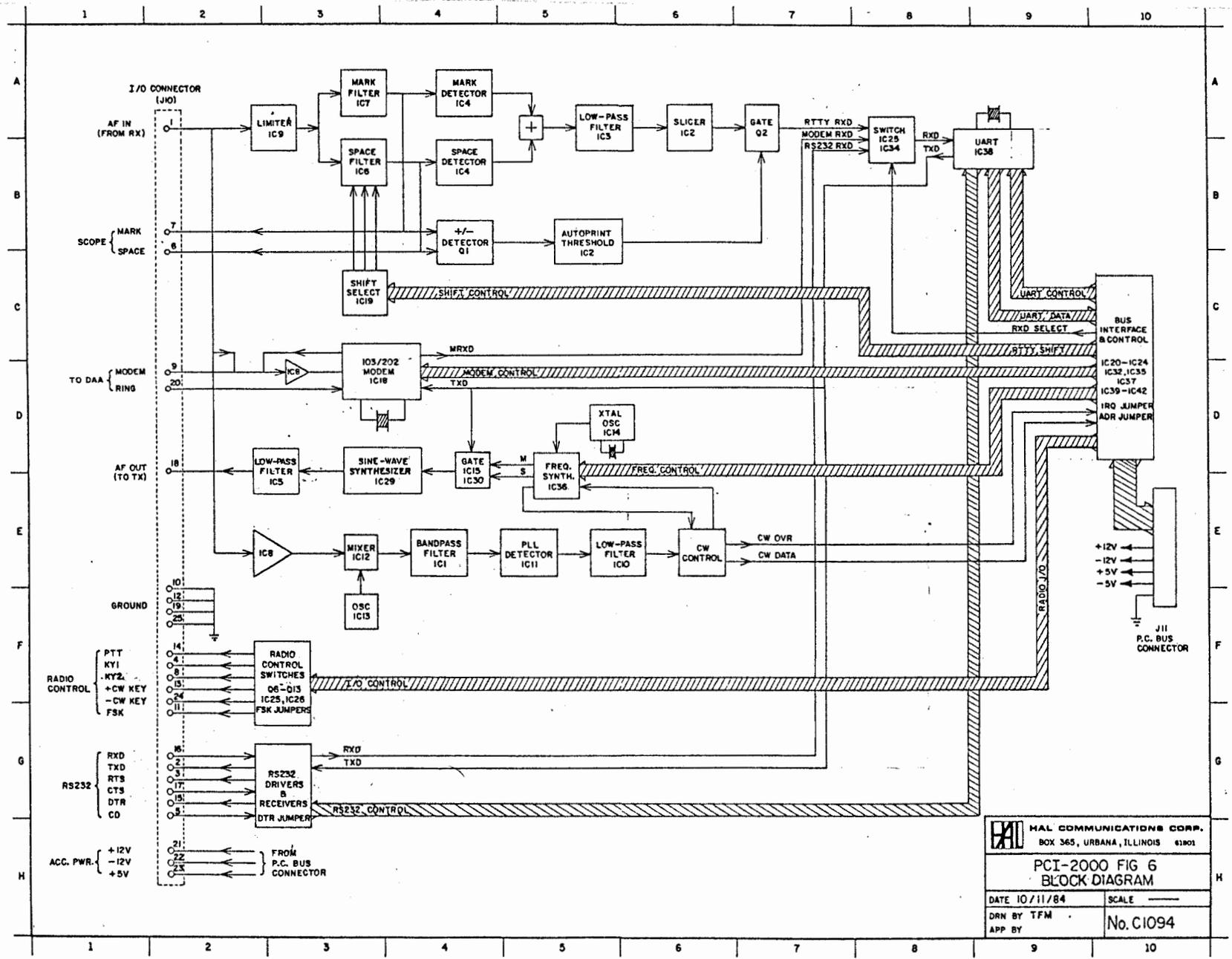
Since the PCI-2000 is designed to work with radio communications systems, special care has been taken to minimize problems of RFI both to the receiver and from the transmitter. All I/O terminals have RF by-pass capacitors and the four-layer printed circuit board of the PCI-2000 greatly reduces the chances for interference to the receiver from high-speed digital signals in the computer.

### 6.3 Diagrams

The following is a cross listing of Figure numbers and HAL drawing numbers of PCI-2000 Diagrams:

	FIGURE	HAL DWG	TITLE
6	C1094		PCI-2000 BLOCK DIAGRAM
7	A1508		PCI-2000 BUS INTERFACE CONTROL
8	A1509		PCI-2000 CW DEMODULATOR
9	A1510		PCI-2000 MODEM & UART
10	A1511		PCI-2000 RTTY DEMODULATOR
11	A1512		PCI-2000 I/O CONTROL
12	C1095		PCI-2000 PICTORIAL

FIGURE 6. PCI-2000 BLOCK DIAGRAM



	HAL COMMUNICATIONS CORP. BOX 365, URBANA, ILLINOIS 61801	
	PCI-2000 FIG 6 BLOCK DIAGRAM	
DATE 10/11/84	SCALE	
DRN BY TFM	No. C1094	
APP BY		



FIGURE 8. PCI-2000 CW DEMODULATOR

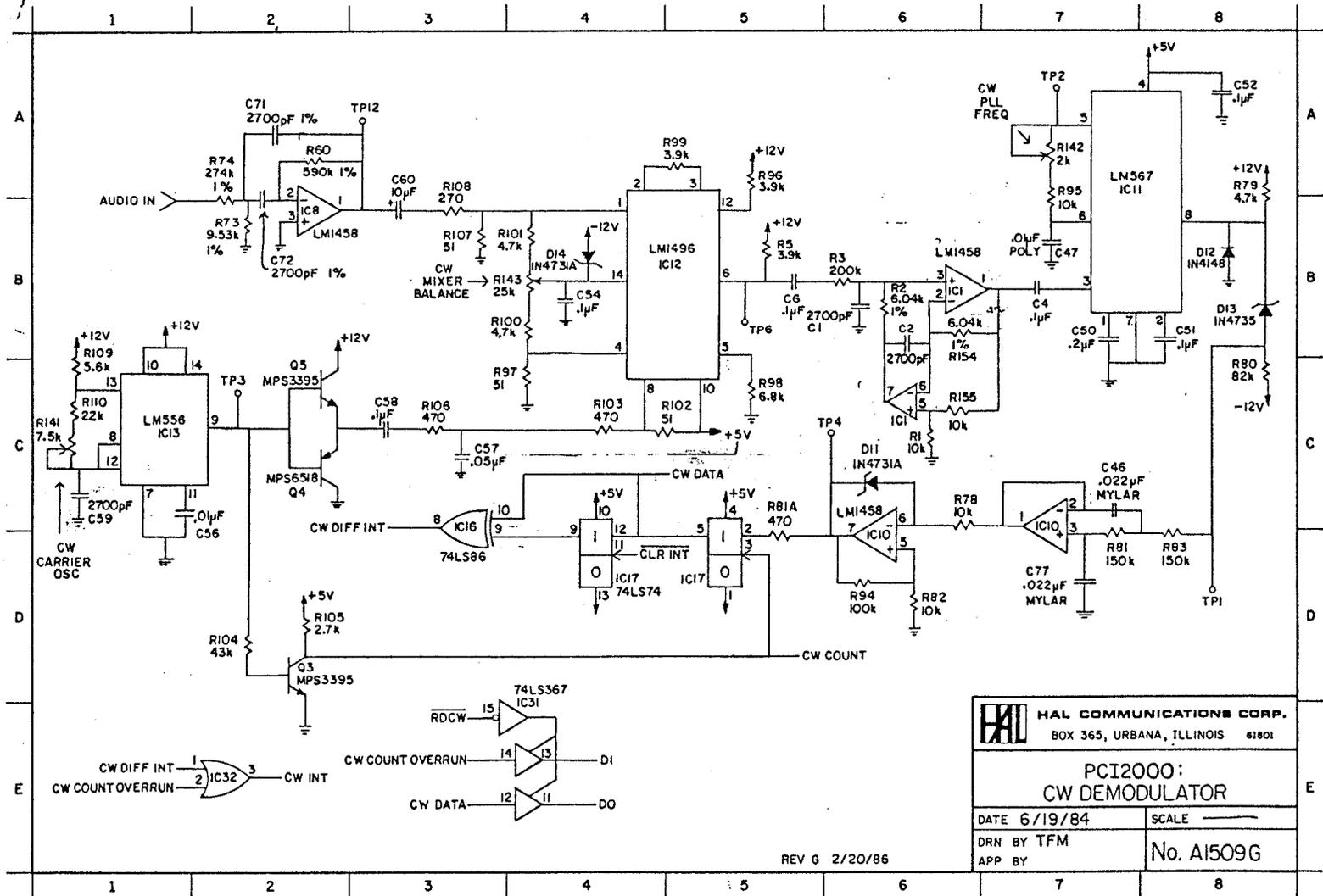
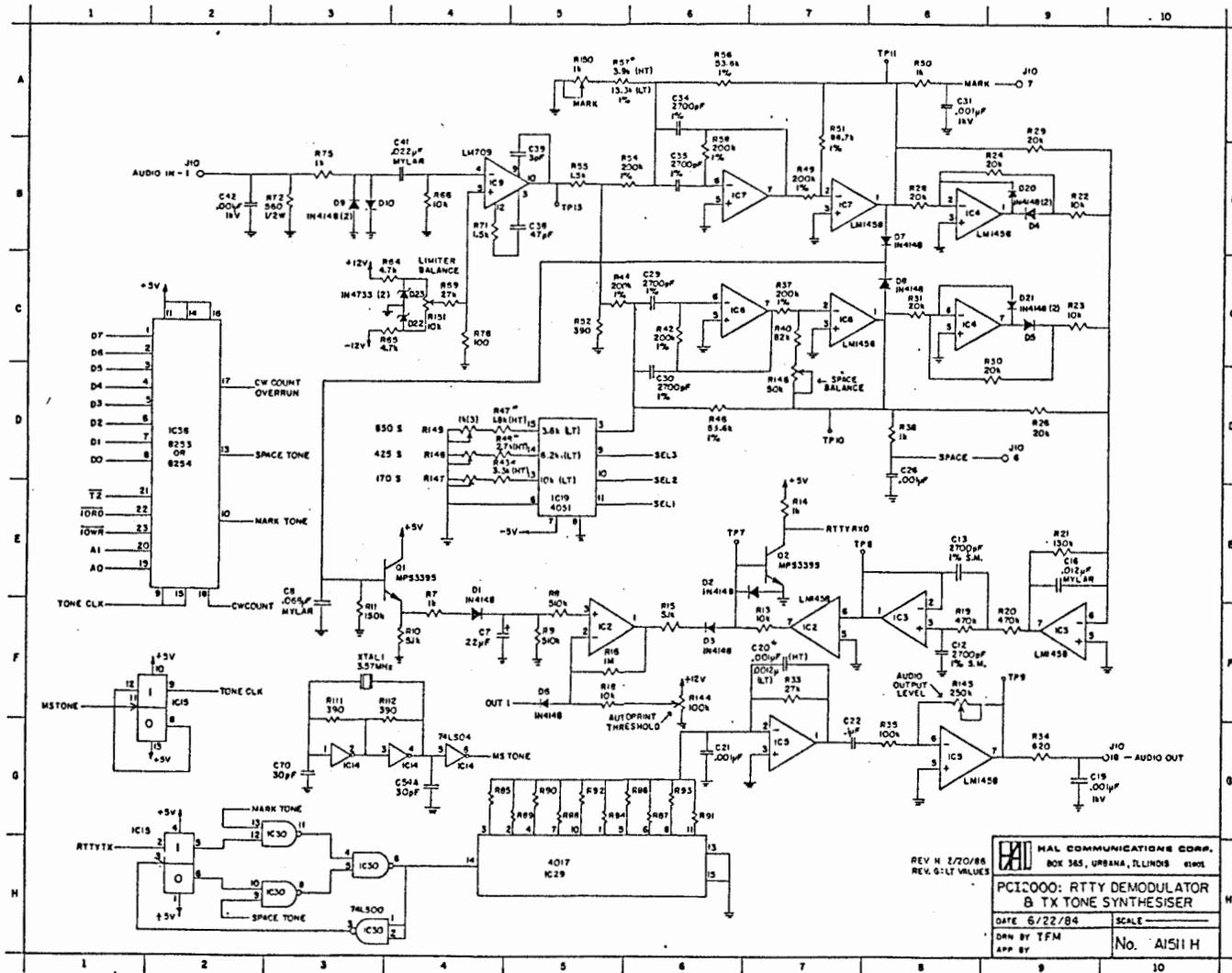




FIGURE 10. PCI-2000 RTTY DEMODULATOR



REV H 2/20/86  
 REV. 0:LT VALUES

HAL COMMUNICATIONS CORP. BOX 365, URSINA, ILLINOIS 61025	
PCI2000: RTTY DEMODULATOR & TX TONE SYNTHESIZER	
DATE 6/22/84	SCALE
DNW BY TFM	
APP BY	No. AIS11H



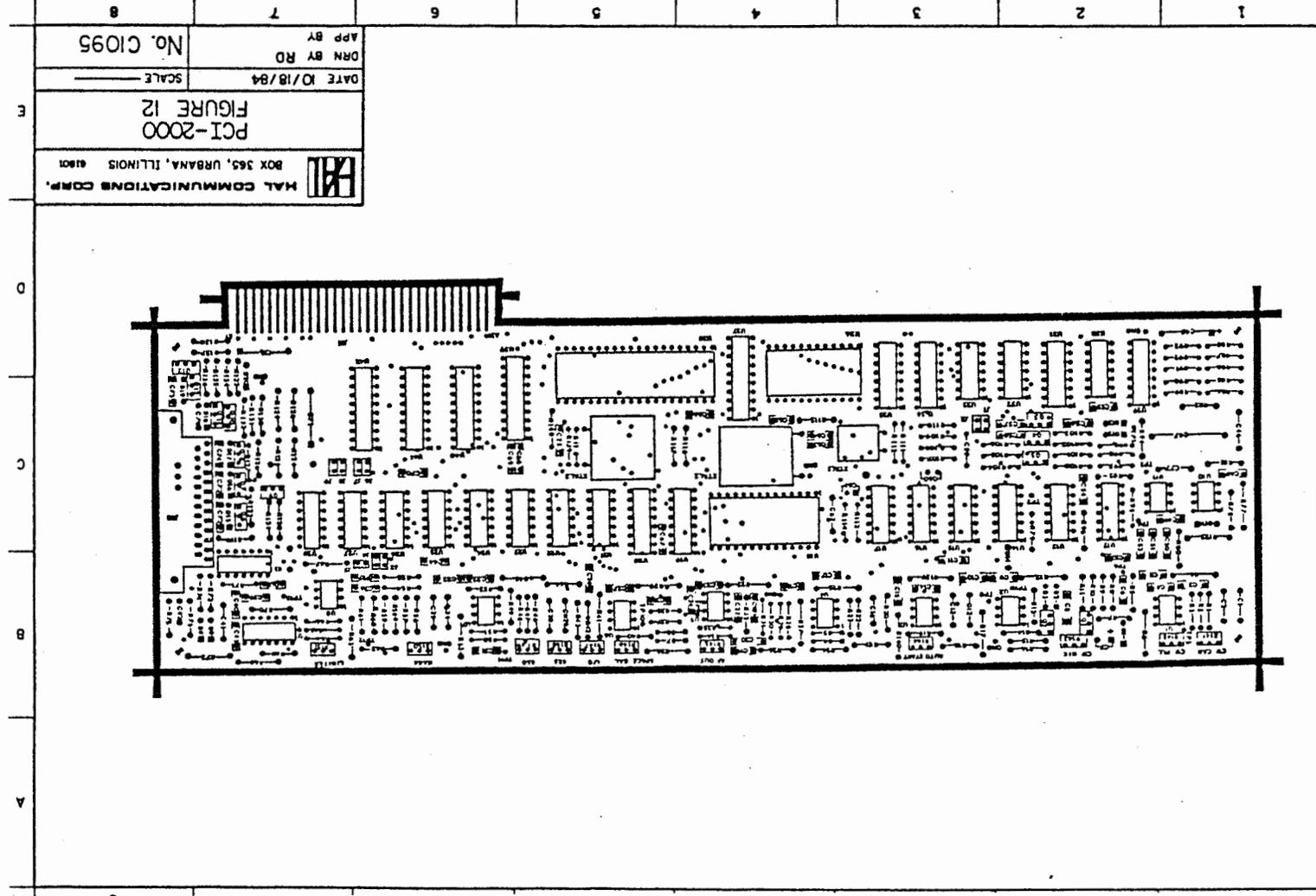


FIGURE 12. PCI-2000 PARTS PLACEMENT

## LIMITED WARRANTY

HAL Communications Corp. of Urbana, Illinois, hereby warrants to the original retail purchaser only that the product herein described and sold shall be free from defects in materials and workmanship for a period of one year from the date of sale to the original retail purchaser.

In the event of a defect in materials or workmanship during the warranty period, HAL Communications Corp. will, at its own expense, repair the defective unit and replace any defective parts. Cost of shipping the unit to HAL Communications Corp. shall be paid by the purchaser, as well as costs of removal and reinstallation of the unit. HAL Communications Corp. will bear the shipping costs incurred in returning the unit to the purchaser (48 contiguous United States only).

To obtain service under this warranty, the original purchaser should do the following:

1. Notify, as soon as possible, the Customer Service Department of the original selling dealer or HAL Communications Corp., Box 365, Urbana, Illinois 61801, either in writing or by telephone, of the existence of a possible defect.
2. At the time of notification, identify the model and serial number, date of purchase, place of purchase, and the possible defect.
3. Hold the unit until a written return authorization is received.
4. Return the unit, freight prepaid, upon the receipt of the written return authorization with a copy of the original bill of sale.

Correct installation, use, maintenance, and repair are essential for proper performance of this product. The purchaser should carefully read the technical manual. The purchaser will be billed for labor and shipping charges determined by HAL to be in working order when received "for repair".

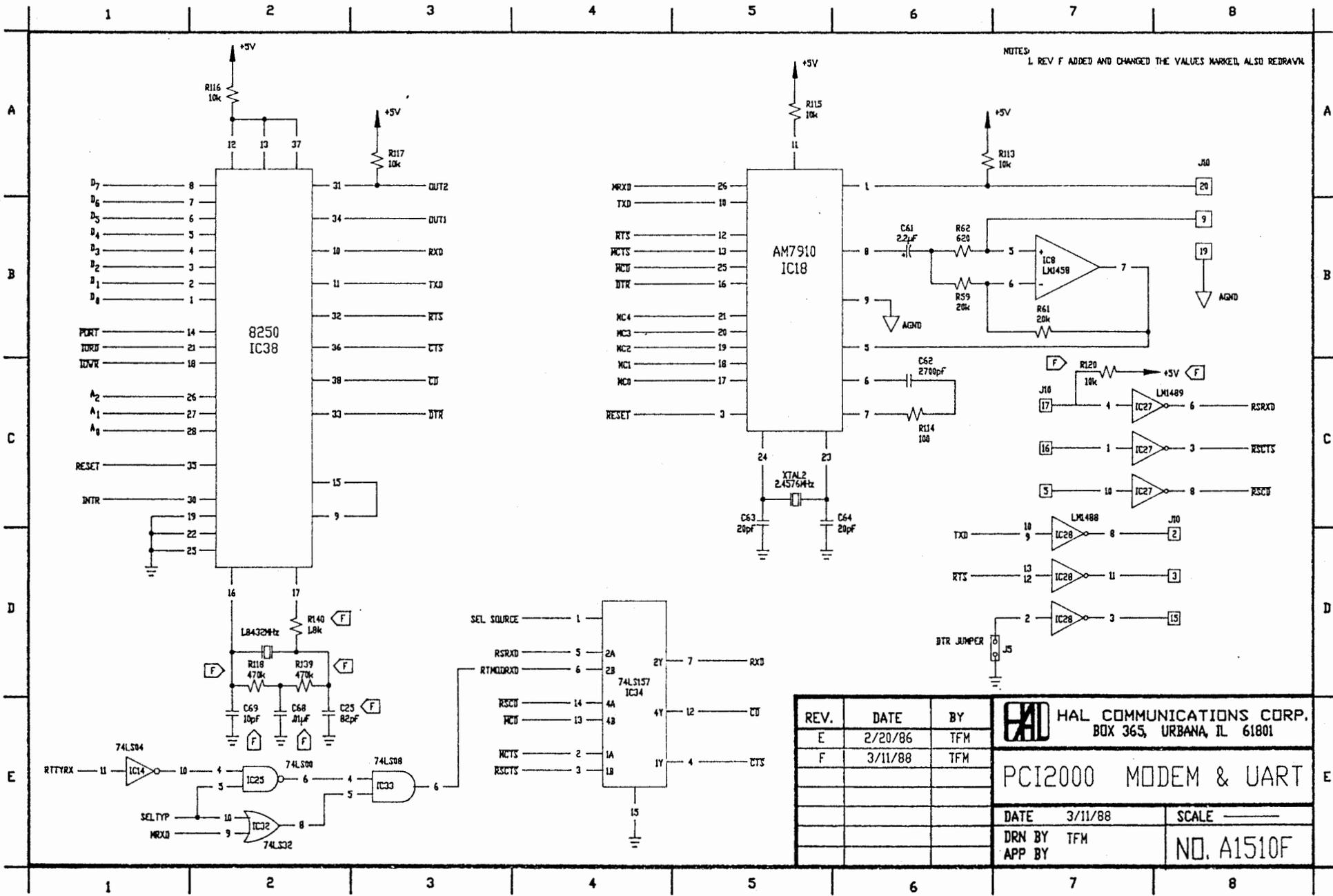
This warranty does not apply to any defect which HAL Communications Corp. determines is due to any of the following:

1. Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts;
2. Misuse, abuse, neglect, improper operation or improper installation (including operation without a proper safety ground connection).
3. Accidental or intentional damage.

All implied warranties, if any, are limited in duration to a period of one year from the date of purchase by the original retail purchaser. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)

HAL Communications Corp. disclaims any liability for incidental or consequential damages arising out of the use of, or inability to use, this product. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above may not apply to you.)

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.



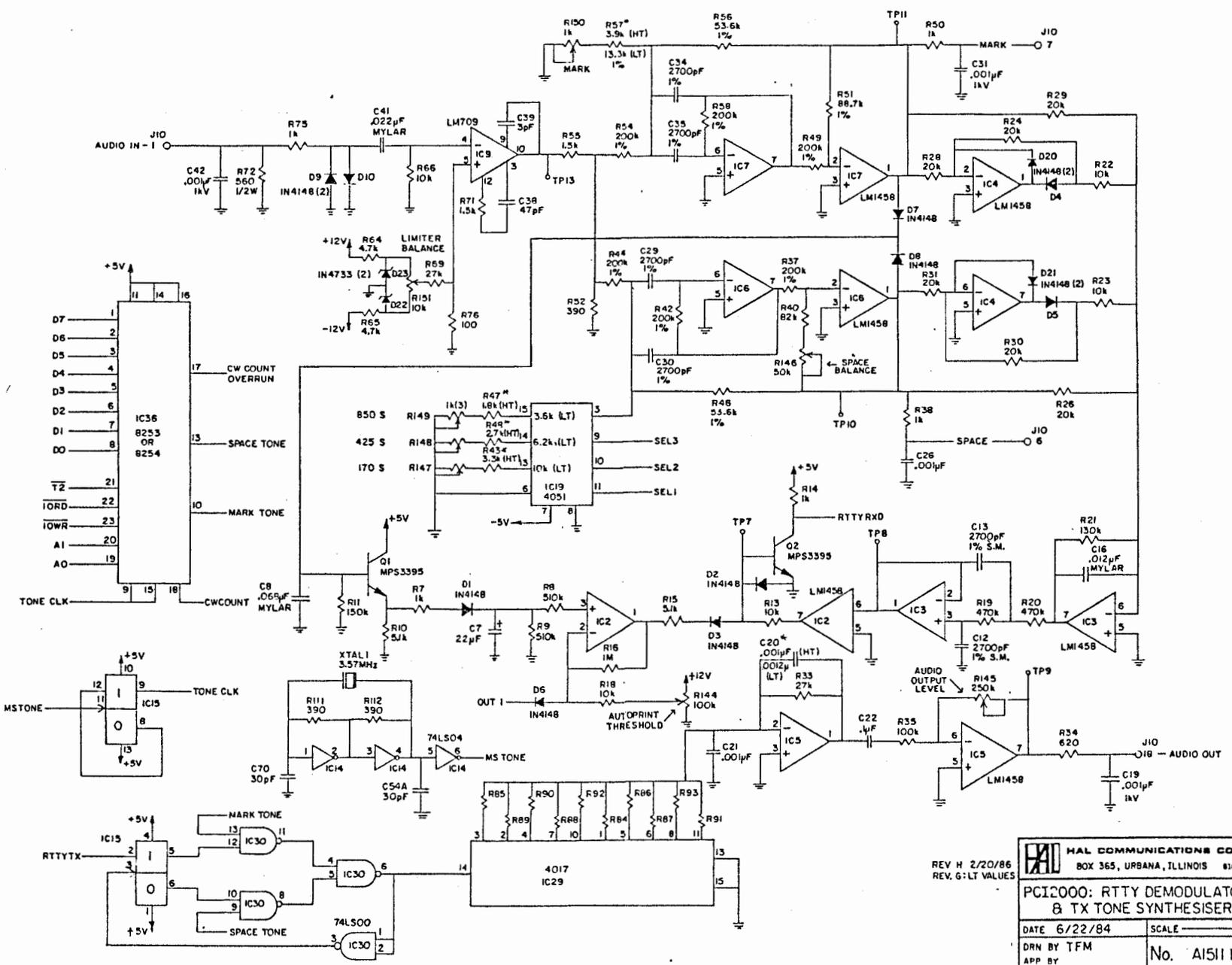
NOTES:  
L REV F ADDED AND CHANGED THE VALUES MARKED, ALSO REDRAWN

REV.	DATE	BY	HAL COMMUNICATIONS CORP. BOX 365, URBANA, IL 61801	
E	2/20/86	TFM	PCI2000 MODEM & UART	
F	3/11/88	TFM		
			DATE 3/11/88	SCALE
			DRN BY TFM	NO. A1510F
			APP BY	





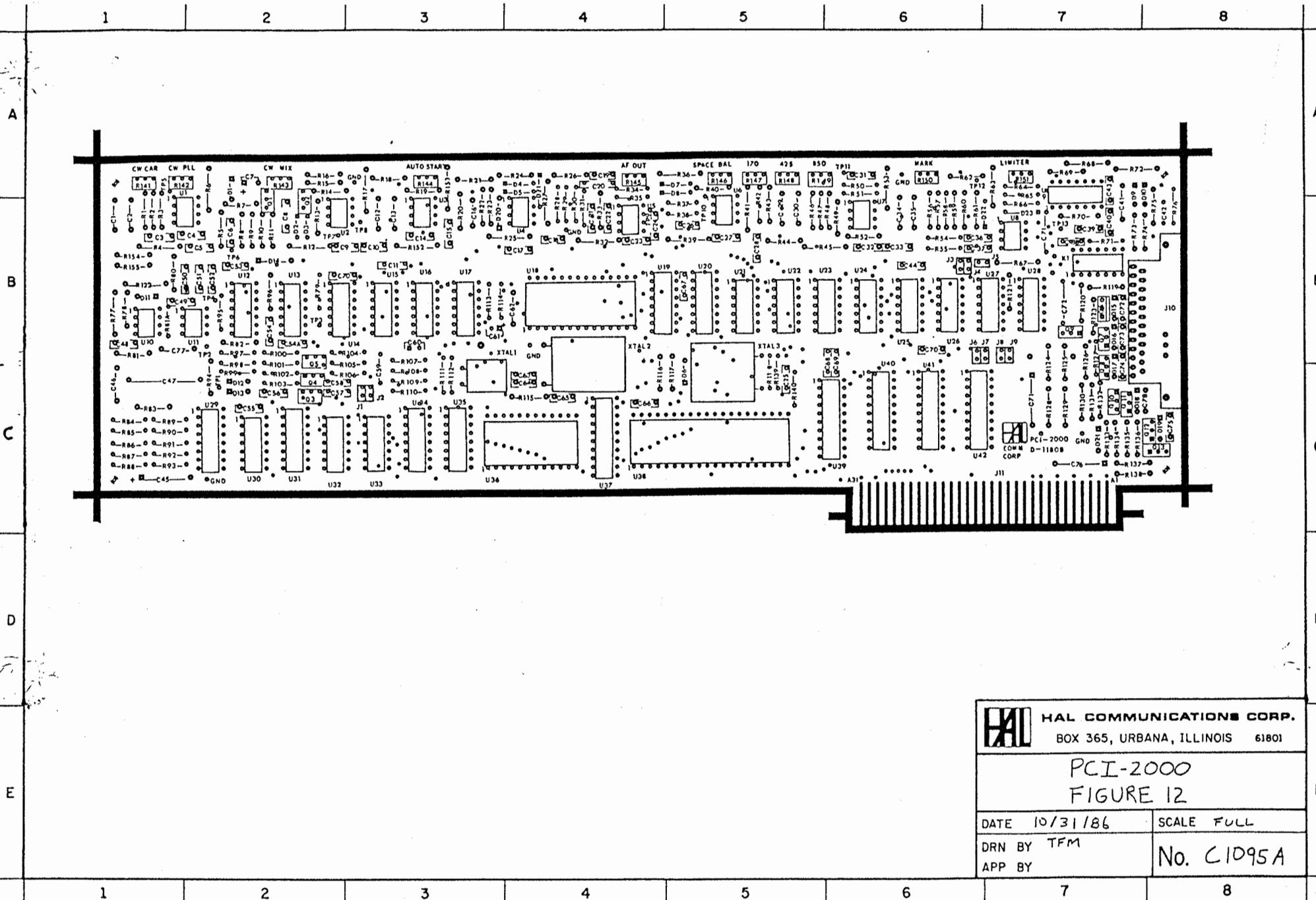
A  
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H



REV H 2/20/86  
REV. G: LT VALUES

HAL COMMUNICATIONS CORP. BOX 365, URBANA, ILLINOIS 61801	
PC12000: RTTY DEMODULATOR & TX TONE SYNTHESIZER	
DATE 6/22/84	SCALE _____
DRN BY TFM	No. A1511 H
APP BY _____	





 <b>HAL COMMUNICATIONS CORP.</b> BOX 365, URBANA, ILLINOIS 61801	
PCI-2000 FIGURE 12	
DATE 10/31/86	SCALE FULL
DRN BY TFM	No. C1095A
APP BY	