# R P C - 2 0 0 0

## Radio Packet Controller

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## INTRODUCTION

This manual describes the installation and operation of the HAL RPC-2000 Radio Packet Controller. This interface is specifically designed for the HAL DS-3200 Radio Data Communications Terminal or any fully IBM-compatible PC, PC-XT, or PC-AT device.

The RPC-2000 is a two channel radio packet controller that adds fast, error-free data communications to radio links. The RPC-2000 uses Packet Radio protocol based on AX.25 to provide error-free data communications at rates from 45 to 4800 BPS. Two switchable channels are included in the RPC-2000, providing error-corrected data communications capability on two radio systems. The standard configuration includes an onboard 7910 modem with a DE-9S connector for one packet channel. An optional 7910 modem or an external modem can be used with the DB-25P connector for the second packet channel. Thus, a high-performance HF modem such as the HAL ST-8000 may be directly connected to the RPC-2000 for optimum HF performance. The RPC-2000 does not require use of any of the asynchronous RS-232C serial I/O ports of the terminal or PC-compatible. Rather, the RPC-2000 makes use of the synchronous data ports of the system.

The RPC-2000 is driven entirely from disk-based software that runs in the DS-3200 or PC-compatible. This software is specifically designed to be very user friendly. All features and modes are chosen from on-screen menus. Communication parameters such as connect status, call signs, paths, data rate, and others are shown by on-screen status indicators.

The exclusive HAL CALLpath feature provides a user-programmable directory of frequently used call signs and connect paths. In addition, the RPC-2000 provides disk file transfer and storage. The mode, tones, and data rate of the internal modem(s) are controlled by keyboard commands.

The software is furnished with the RPC-2000 at no additional cost.

The RPC-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 RPC-2000 circuit board and Chapter 3 before attempting the use of the board and software.

MINIMUM HARDWARE REQUIREMENTS

The RPC-2000 Radio Packet Controller board is designed to be used in the HAL DS-3200 Radio Data Communications Terminal or in an IBM PC, PC-XT, or PC-AT computer.  The RPC-2000 will also work well with fully IBM-compatible computers.

Due to possible differences in the computer BIOS (Basic Input/ Output System) ROM integrated circuits used in IBM-compatible computers, HAL Communications Corp. cannot guarantee the RPC-2000 will work in ALL "IBM-compatible computers".

Minimum System Requirements:    PC-DOS or MS-DOS Version 2.1 or later.  Full-length (13 1/4") card slot.  Two 360K floppy disk drives or hard disk drive.  512K RAM.


MANUAL OVERVIEW

This manual describes the installation and operation of the HAL RPC-2000 Radio Packet Controller.  In the following chapters you will learn how to install, connect, and operate your RPC-2000.

Chapter 1 covers RPC-2000 installation;  this chapter should be CAREFULLY reviewed before installing the RPC-2000 into your DS-3200 or computer.  Also discussed is the installation of the system software.

Chapter 2 discusses connecting the RPC-2000 to your radio equipment and an external modem (if used).  RPC-2000 I/O ratings are also presented in this chapter.  PLEASE read this chapter carefully as possible damage to your DS-3200 or computer and your radio equipment can occur if the connections are incorrectly made.

Chapter 3 discusses loading system software and overall operation of the RPC-2000.

Chapter 4 summarizes user adjustments to the RPC-2000.

Chapter 5 provides some assistance should technical problems arise with the RPC-2000.

Chapter 6 contains the specifications, a brief technical description of the RPC-2000, and schematic diagrams.

The last section of this manual presents the HAL Communications Corp. 1 YEAR Limited Warranty.
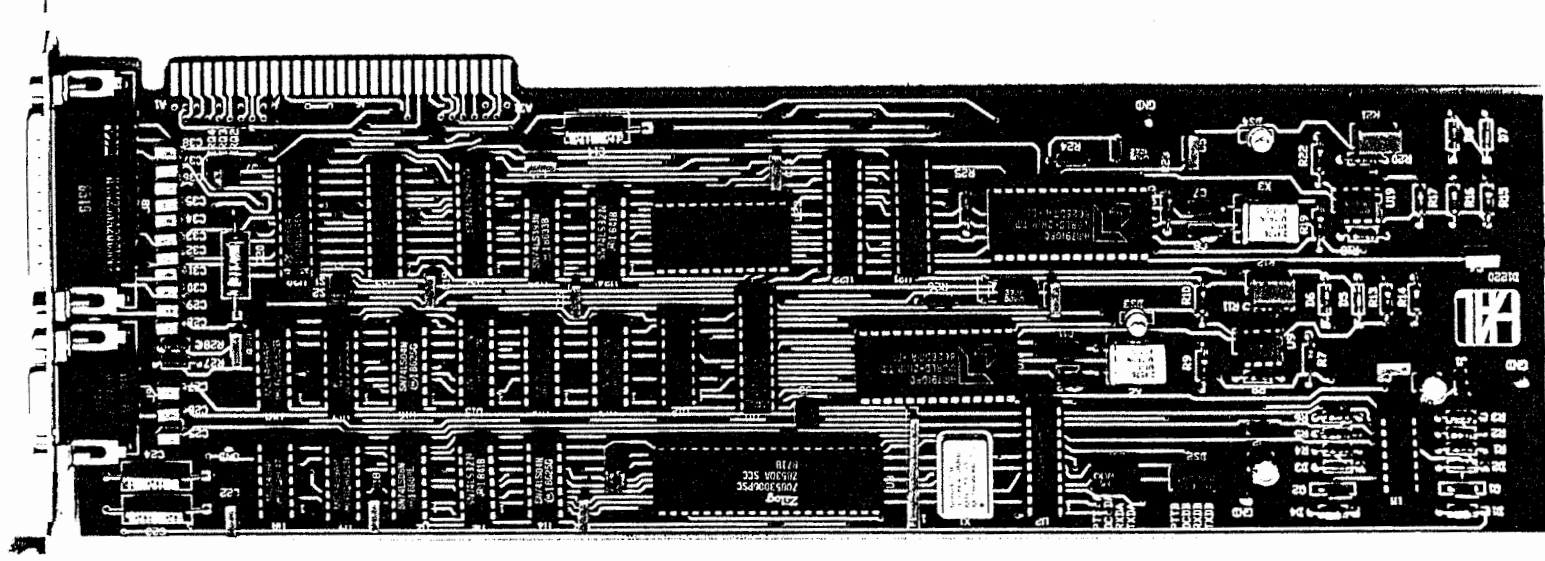
FIGURE 1. RPC-2000

CHAPTER 1
INSTALLATION


## 1.1   Unpacking


When unpacking your new RPC-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. immediately so
that the shortage may be rectified.   Please be sure to specify
the HAL part number!


Packing List:

        1 - 934-02000   RPC-2000 Circuit Board
        1 - 865-02001   RPC-2000 Software Diskette
        1 - 870-02001   RPC-2000 Instruction Manual
        1 - 333-20090   DE-9P Connector
        1 - 333-51218   DE-9P Connector Shell
        1 - 333-10250   DB-25S Connector
        1 - 333-51228   DB-25P Connector Shell
        2 - 333-74564   Connector Shell Hardware Kits


## 1.2   Options Available


The only option available for the RPC-2000 is the M2-RPC Second
On-Board Modem Option.   This consists of a 7910 I.C. modem
designed to plug into the U20 socket on the RPC-2000 circuit
board.   This optional modem I.C. is used for Channel A on the DB-
25P connector.   Please contact your HAL dealer or HAL
Communications Corp. directly for the M2-RPC.


## 1.3   Card Installation


The RPC-2000 is constructed on one full-length IBM plug-in card.
It may be inserted into any unused full-length card slot in the
DS-3200 Radio Data Communications Terminal or IBM PC, PC-XT, PC-
AT, or fully IBM-compatible computer.

## 1.3.1  Jumper Selections

Before installing the RPC-2000 in your DS-3200 or computer,
please check to see that the jumpers on the RPC-2000 circuit
board are set correctly.  The available jumpers are shown in
Table 1 and their positions are shown in Figure 2.

TABLE 1
RPC-2000 JUMPERS

| JUMPER | POSITIONS | FACTORY SETTINGS |
|--------|-----------|------------------|
| CHANNEL A PTT<br>TIME-OUT DEFEAT<br>(J1) | ON/OFF | OFF |
| CHANNEL B PTT<br>TIME-OUT DEFEAT<br>(J2) | ON/OFF | OFF |
| CHANNEL A<br>SELECT<br>(J3) | FACTORY PRE-SET | |
| EXTERNAL CLOCK<br>SELECT<br>(J4) | RESERVED FOR FUTURE USE | |
| ADDRESS SELECT<br>ADR (J5) | S1/S2 | S1 |
| INTERRUPT REQUEST<br>SELECT<br>IRQ (J7) | IRQ2/IRQ3/IRQ4 | IRQ2 |

FIGURE 2.  RPC-2000 PARTS PLACEMENT

*******************************************************************
NOTE:     The RPC-2000 has been tested in HAL DS-3200 Radio Data
Communications Terminals and in "standard" versions and models of
the IBM PC, PC-XT, PC-AT, and several fully  IBM-compatible
computers with standard video cards, disk controllers, and serial
communications cards.  However, HAL Communications Corp. cannot
assume responsibility (or non-operation) of the card when other
options are installed in the DS-3200 or computer.  If problems
are experienced, try removing extra option cards until correct
operation is observed.
*******************************************************************

Generally, the RPC-2000 will function normally if the following
conditions are met by the IBM-compatible computer in question:

    1.   Compatible ROM BIOS (Basic Input/Output System) routines.

    2.   Compatible IBM-buss structure.

    3.   Compatible interrupt routines.

1.3.2   HAL DS-3200 Radio Data Communications Terminal

Remove the 16 flat-head screws from the top cover.  Lift-off the
top cover.  The RPC-2000 may be installed in any of the long
slots available in the DS-3200.  Remove the card slot  cover from
the long slot chosen for the RPC-2000 installation.  Plug-in the
RPC-2000 and secure the card bracket with the screw originally
removed from the card slot cover.  Replace the top cover of the
DS-3200 with the 16 flat-head screws.

1.3.3   IBM PC, PC-XT, and PC-AT Computers

Remove the back panel screws which secure the top chassis cover.
Slide the cover forward and lift-away from the computer bottom
chassis.  The RPC-2000 may be installed in any of the long slots
available in the computer.  Remove the card slot cover from the
long slot chosen for the RPC-2000 installation.  Plug-in the RPC-
2000 and secure the card bracket with the screw originally
removed from the card slot cover.  Slide-on the top chassis cover
and secure with the back panel screws.

1.3.4   IBM-compatible Computers

Due to the rapid growth of the "PC-compatible" market, it is
impossible to list all of the possible chassis variations
available.  However, installation of the RPC-2000 in an IBM-

compatible most often is very similar to that of the IBM PC, in that the top cover chassis is removed in the same fashion. Some IBM-compatibles, however, may have a top cover which is hinged at the rear allowing easier access to the expansion slots.


1.4   Installation of the Optional 7910 Modem Chip (M2-RPC)


Remove the 7910 modem integrated circuit from the packing material. CAUTION: SOLID STATE DEVICES ARE VERY SENSITIVE TO STATIC ELECTRICITY. ALL WORK SHOULD BE ACCOMPLISHED IN AN AREA OF NO STATIC ELECTRICITY.

Carefully install the 7910 in the U20 socket. Pin 1 of the 7910 -- which is denoted by a dimple in the plastic cover -- should be oriented next to the Pin 1 silk-screened on the RPC-2000 printed circuit board. Please check that all pins are properly seated in the socket and that there are no bent pins.


1.5   RPC-2000 Software Installation


The software for the RPC-2000 is supplied on one 5.25" floppy diskette. You should make back-up copies of this diskette BEFORE attempting operation. It is HIGHLY RECOMMENDED that you place a write-protect tab on the HAL RPC-2000 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 RPC-2000 diskette should you wish the diskette to be a "bootable" one.

First, you must prepare a new diskette using the FORMAT/S command. This formats the diskette and places the DOS "hidden" files and COMMAND.COM on the diskette. Next, copy the RPC-2000 files from the master to the newly formatted diskette. Please refer to your DOS manual for proper procedures for your computer configuration. After copies have been made, store the master HAL RPC-2000 diskette in a safe location and use a copy of the master diskette for normal operation.

For a DS-3200 Radio Data Communications Terminal or an IBM-compatible computer with a hard drive, simply copy the RPC-2000 software diskette files to your hard drive. You may wish to make a sub-directory on the hard disk with the \MD DOS command. You could name the sub-directory \PACKET or \RPC, or whatever filename you wish.

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


After the RPC-2000 circuit board is installed in the DS-3200 or
IBM-compatible computer (but before connection to the radio
system), "boot" the RPC-2000 software.    After the program
"boots", you will see the title page with the software version
number.   Remember this version number!  We will need to know the
version number if you should call us with a software problem.

CHAPTER 2
CONNECTIONS


This chapter describes connecting the RPC-2000  Two-Channel Radio
Packet Controller to your radio station equipment.    PLEASE
CAREFULLY READ THIS CHAPTER BEFORE ATTEMPTING TO CONNECT THE RPC-
2000 TO YOUR TRANSCEIVER OR OTHER RADIO STATION EQUIPMENT.


*************************************************************

FAILURE TO HEED THE ABOVE WARNING MAY PERMANENTLY DAMAGE THE RPC-
2000. THEREFORE, **PLEASE** STUDY THIS CHAPTER WELL!!

*************************************************************


2.1   Introduction


The  RPC-2000 has only two connectors on the rear  card  bracket.

The 25-pin DB-25P connector (J8) is used  for  CHANNEL  A.    As
configured from the factory, CHANNEL A is intended to be used
with a high-performance external HF modem such as the HAL ST-
8000.  An optional 7910 I.C. modem (M2-RPC) is available for use
on CHANNEL A in lieu of the external HF modem.  Please contact
your HAL dealer or HAL Communications Corp. directly for this
option.   Please note that for high-performance HF packet,  an
external modem is highly recommended.  When the M2-RPC option is
installed,  CHANNEL  A  could certainly be used on  HF  but  with
lesser performance.  Or, it could be used as a second separate
packet channel on VHF.

The 9-pin DE-9S connector (J9) is used for CHANNEL B.   CHANNEL B
is primarily designed for use on VHF packet.  The modem used for
this channel is a 7910 I.C. modem.

All I/O connections to the RPC-2000 are made via the   DB-25P
connector (J8) or the DE-9S connector (J9) on the rear panel of
the DS-3200 Radio Data Communications Terminal or IBM-compatible
computer AFTER installation of the RPC-2000.   ALL signals
required for direct connection to your radio system(s) or  an
external HF modem are supplied on these connectors.

The DB-25P (J8) and DE-9S (J9) connectors abide by the standard
RS-232C convention for I/O pin-outs, although not all pins are
supported.

TABLE 2.
RPC-2000 CHANNEL A
DB-25P (J8) I/O CONNECTIONS

| PIN | NAME | FUNCTION |
|-----|------|----------|
| 1 | GROUND | SIGNAL GROUND |
| 2 | TXD | TRANSMIT DATA |
| 3 | RXD | RECEIVE DATA |
| 4 | RTS | REQUEST TO SEND |
| 5 | CTS | CLEAR TO SEND |
| 6* | | |
| 7 | GROUND | SIGNAL GROUND |
| 8 | DCD | DATA CARRIER DETECT |
| 9* | | |
| 10* | | |
| 11* | | |
| 12* | | |
| 13* | | |
| 14 | TCA | TRANSMIT AUDIO CHANNEL A |
| 15 | ST | TRANSMIT TIMING (CLOCK) |
| 16 | RCA | RECEIVE AUDIO CHANNEL A |
| 17 | RT | RECEIVE TIMING (CLOCK) |
| 18* | | |
| 19 | APTT OUT | PTT OUTPUT CHANNEL A |
| 20 | DTR | DATA TERMINAL READY |
| 21* | | |
| 22* | | |
| 23* | | |
| 24* | | |
| 25* | | |

* Denotes this pin unused

TABLE 3.
RPC-2000 CHANNEL A
DB-25P (J8) I/O RATINGS

| PIN | NAME | MAXIMUM | FUNCTION |
|-----|------|---------|----------|
| 1 | GND | | SIGNAL GROUND |
| 2 | TXD | +/-12VDC | RS-232C SIGNAL (OUT) |
| 3 | RXD | +/-12VDC | RS-232C SIGNAL (IN) |
| 4 | RTS | +/-12VDC | RS-232C SIGNAL (OUT) |
| 5 | CTS | +/-12VDC | RS-232C SIGNAL (IN) |
| 6* | | | |
| 7 | GND | | SIGNAL GROUND |
| 8 | DCD | +/-12VDC | RS-232C SIGNAL (IN) |
| 9* | | | |
| 10* | | | |
| 11* | | | |
| 12* | | | |
| 13* | | | |
| 14 | TCA | 0 DBM | TRANSMIT AUDIO CHANNEL A (OUT) -30 DBM TYPICAL |
| 15 | ST | +/-12VDC | TRANSMIT TIMER |
| 16 | RCA | 0 DBM | RECEIVE AUDIO CHANNEL A (IN) -30 DBM TYPICAL |
| 17 | RT | +/-12VDC | RECEIVE TIMER |
| 18* | | | |
| 19 | APTT OUT | O.C.** | CHANNEL A PTT OUT |
| 20 | DTR | +/-12VDC | RS-232C SIGNAL (OUT) |
| 21* | | | |
| 22* | | | |
| 23* | | | |
| 24* | | | |
| 25* | | | |

* Denotes this pin unused

** Open collector transistor switch to ground (Type VN10KM)

TABLE 4.
RPC-2000 CHANNEL B
DE-9S (J9) I/O CONNECTIONS

| PIN | NAME | FUNCTION |
|---|---|---|
| 1 | RCB | RECEIVE AUDIO CHANNEL B |
| 2 | GND | SIGNAL GROUND |
| 3* | | |
| 4 | BPTT OUT | CHANNEL B PTT OUTPUT |
| 5* | | |
| 6* | | |
| 7 | GND | SIGNAL GROUND |
| 8 | TCB | TRANSMIT AUDIO CHANNEL B |
| 9 | GND | SIGNAL GROUND |

* Denotes this pin unused

TABLE 5.
RPC-2000 CHANNEL B
DE-9S (J9) I/O RATINGS

| PIN | NAME | MAXIMUM | FUNCTION |
|---|---|---|---|
| 1 | RCB | O DBM | RECEIVE AUDIO CHANNEL B (IN) -30 DBM TYPICAL |
| 2 | GND | | SIGNAL GROUND |
| 3* | | | |
| 4 | BPTT OUT | O.C.** | CHANNEL B PTT OUT |
| 5* | | | |
| 6* | | | |
| 7 | GND | | SIGNAL GROUND |
| 8 | TCB | 0 DBM | TRANSMIT AUDIO CHANNEL B (OUT) -30 DBM TYPICAL |
| 9 | GND | | SIGNAL GROUND |

* Denotes this pin unused

** Open collector transistor switch to ground (Type VN10KM)

```
*******************************************************************
IMPORTANT NOTICE:    AVOID SHORTING ANY OF THE RS-232C I/O LEVELS
ON EITHER THE DB-25P OR DE-9S CONNECTORS.   TO DO SO, COULD RESULT
IN DAMAGE TO THE RPC-2000 OR THE SWITCHING POWER  SUPPLY   OF   THE
DS-3200 OR IBM-COMPATIBLE COMPUTER.
*******************************************************************
```

## 2.2  RPC-2000 Channel A Connector Pin-Out

Figure 3  below shows the Channel A signal definition on the DB-
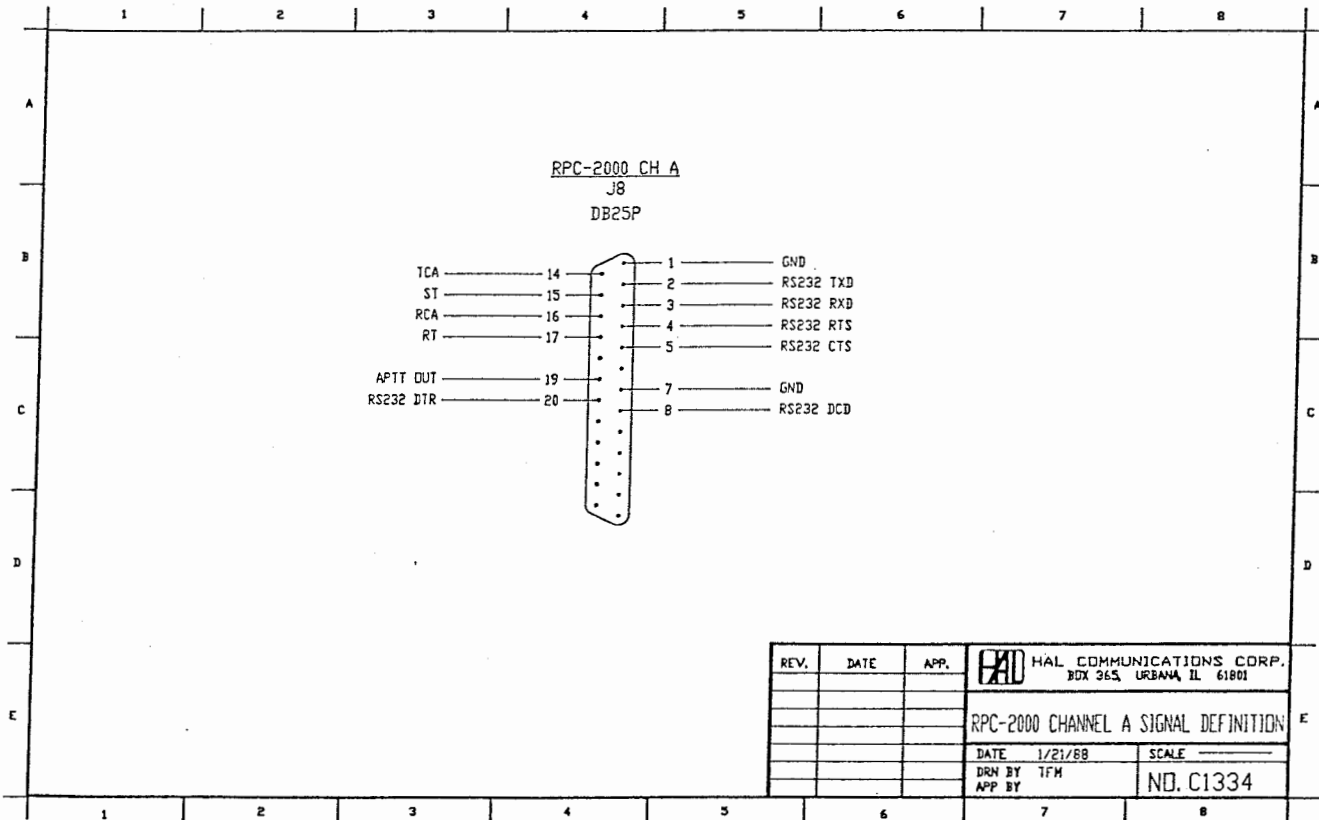25P connector (J8).



FIGURE 3.   RPC-2000 CHANNEL A CONNECTOR PIN-OUT

## 2.3  RPC-2000 Channel B Connector Pin-Out

Figure 4 below shows the Channel B signal definition on the DE-9S
connector (J9).
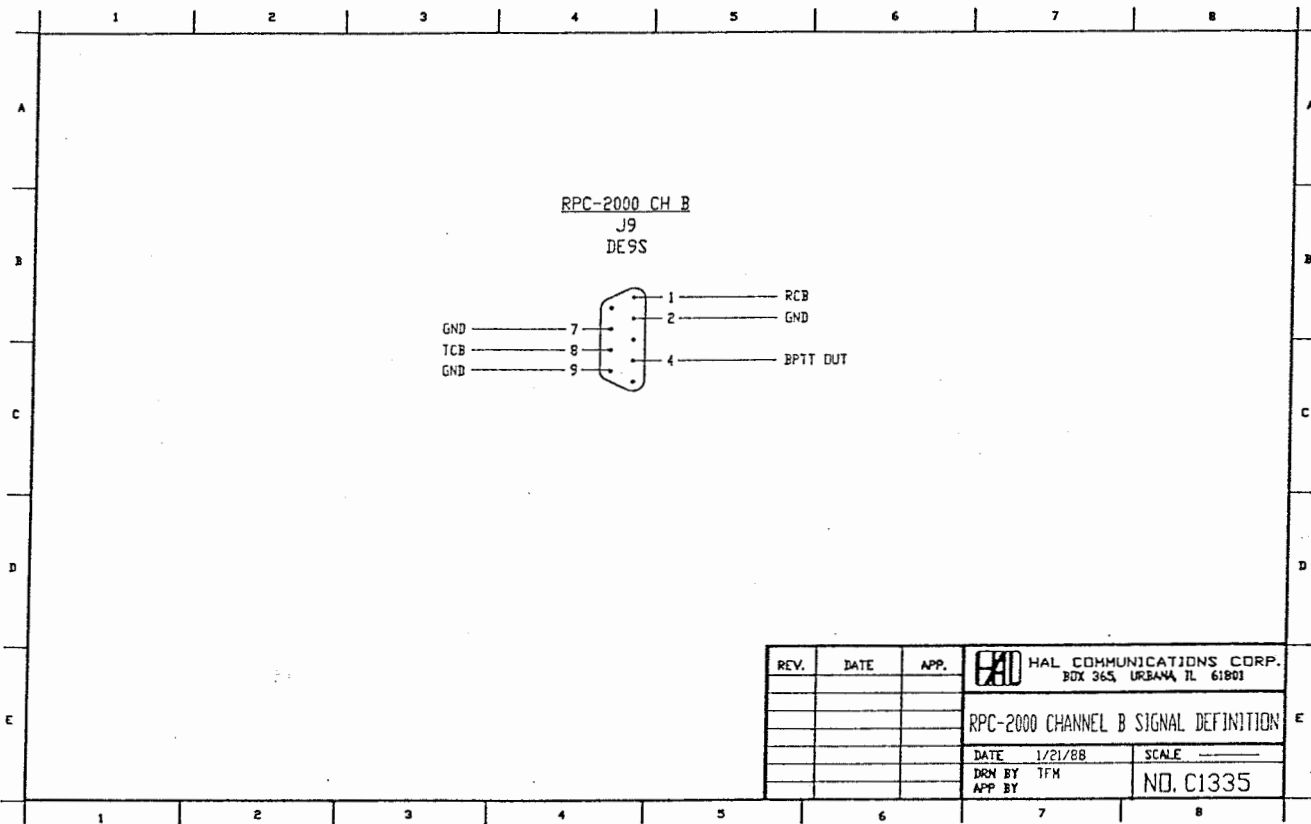


FIGURE 4.   RPC-2000 CHANNEL B CONNECTOR PIN-OUT

## 2.4  Connecting the RPC-2000 to Your Radio Equipment

It is HIGHLY recommend that ALL cables between the RPC-2000 and your radio equipment be shielded.  Also, a separate LOW-INDUCTANCE RF ground should be connected between the DS-3200 or IBM-compatible computer and the radio equipment.  The shield braid from RG-8 or RG-213 coaxial cable serves this function quite well.  Do NOT use small gauge wire for RF grounding purposes, as the wire will act as an antenna at normal HF operating frequencies.

Make up your interface cables with the highest-quality shielded cable you can can afford -- AND make them as short as possible. Do not have an excess length connecting the RPC-2000 and your radio station equipment.

Also, use shielded connector shells for the DB-25 and DE-9 connectors.

## 2.4.1  Connecting Channel A to an External HF Modem

The RPC-2000 Channel A DB-25P connector (J8) may be connected  to an external HF modem for higher-performance packet radio operation on the HF bands.   Your modem of choice should be capable of running at a data rate of 300 BPS for HF packet operation.   The modem should also have tunable shift and tones for ease of use.

The HAL ST-8000 HF Modem meets all of the above requirements. You may also have access to other high-performance HF modems which may meet this requirement.  Nevertheless, using a true HF modem on the front end of the RPC-2000 will make HF packet operation much more reliable.

Figure 5 describes the cable interface from the DB-25P connector (J8) on the RPC-2000 to the Terminal Data connector on the ST-8000.

The ST-8000 operationally should be set as follows to permit operation with the RPC-2000 for HF packet:

A.  Set the INPUT baud rate to 300 baud (BPS) on the front panel.

B.  Set the DETECTOR MODE to AM mode M/S position.

C.  Switch ANTISPACE to OFF.

D.  Make sure REGEN is OFF.

E.  Set the PRINT SQUELCH to the threshold point.

F.  Make sure that the POLARITY switch is in the NORMAL
    position.

G.  The presently accepted SHIFT for packet operation on HF
    is 200 Hz.  Please refer to the paragraph below regarding
    TONE SETS.

Presently, no "standard" tone set has emerged for HF packet
operation.   Instead, there appears to be as many as four (4)
different tone sets being used on HF packet at the present time.
The only consistent factor among these four (4) tone sets is the
use  of the CENTER FREQUENCY to specify the tones.

Listed in TABLE 6 below are the typical tone sets in use on HF
packet.

TABLE 6.
TYPICAL HF PACKET TONE SETS

| MARK | SPACE | CENTER FREQUENCY (Hz) |
|------|-------|-----------------------|
| 1600 Hz | 1800 Hz | 1700 |
| 2000 Hz | 2200 Hz | 2100 |
| 2025 Hz | 2225 Hz | 2125 |
| 2110 Hz | 2310 Hz | 2210 |

Therefore, please select the TONE SET of your choice.   Set the
tone frequencies on the ST-8000  with the MAIN TUNING KNOB.

*****************************************************************
PLEASE REMEMBER TO USE SHIELDED CABLE FOR INTERFACING THE RPC-
2000 TO THE ST-8000 HF MODEM.
*****************************************************************

FIGURE 5. RPC-2000 CHANNEL A CONNECTIONS TO THE ST-8000



RPC-2000 CH A
J8
DB25S

ST-8000 TERMINAL DATA
J9
DB25P
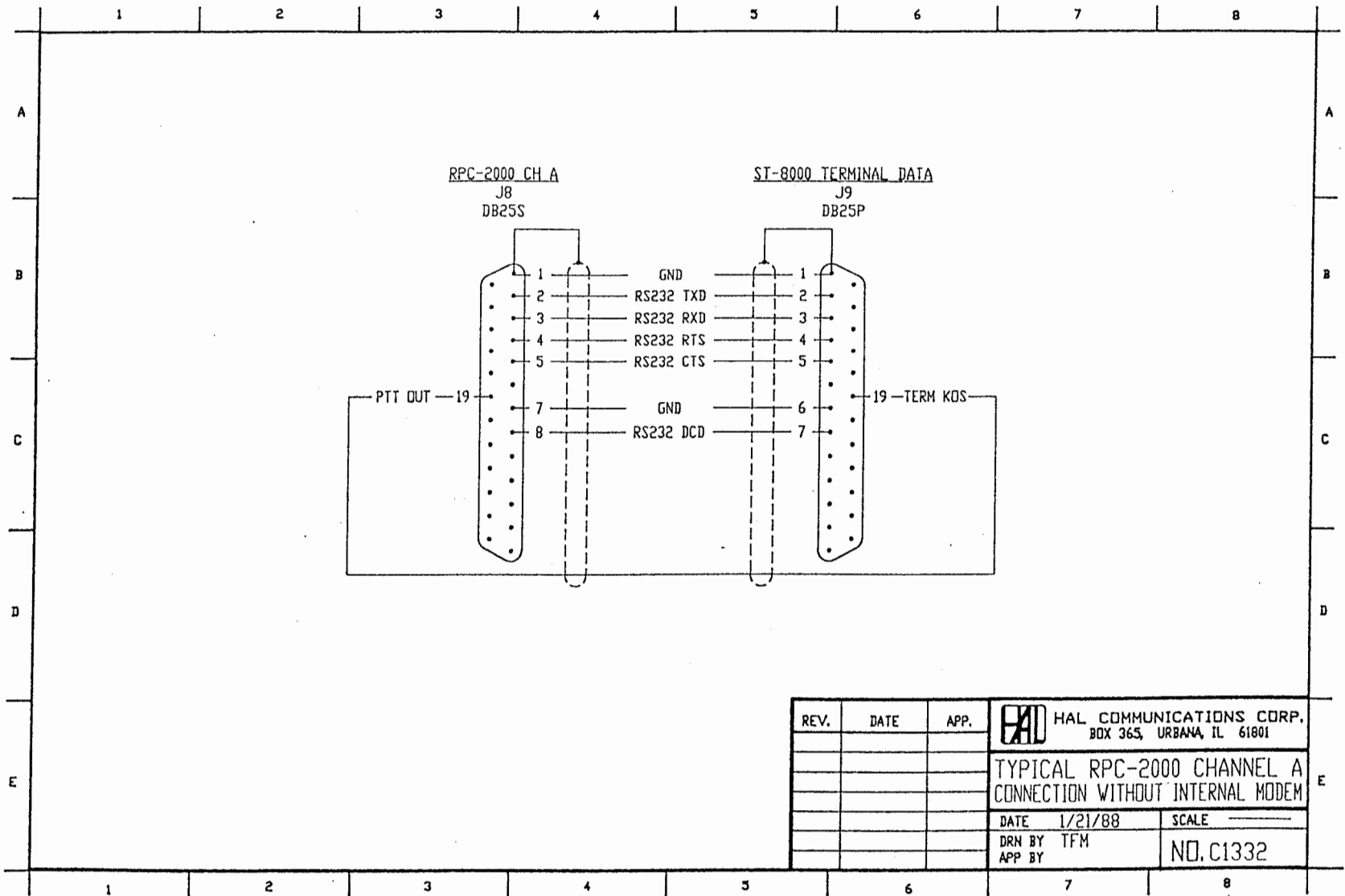
| RPC-2000 | | ST-8000 |
|---|---|---|
| 1 | GND | 1 |
| 2 | RS232 TXD | 2 |
| 3 | RS232 RXD | 3 |
| 4 | RS232 RTS | 4 |
| 5 | RS232 CTS | 5 |
| PTT OUT —19 | | 19—TERM KOS |
| 7 | GND | 6 |
| 8 | RS232 DCD | 7 |

| REV. | DATE | APP. | HAL COMMUNICATIONS CORP. |
|---|---|---|---|
| | | | BOX 365, URBANA, IL 61801 |

TYPICAL RPC-2000 CHANNEL A
CONNECTION WITHOUT INTERNAL MODEM

| DATE | 1/21/88 | SCALE | |
|---|---|---|---|
| DRN BY | TFM | | NO. C1332 |
| APP BY | | | |

2.4.2   Connecting Channel A to a VHF Radio with M2-RPC Option
        Installed


If you have purchased the M2-RPC Option for the RPC-2000, you may
connect Channel A to a VHF radio for packet operation.    Of
course, you could also connect Channel A to your HF transceiver
for HF packet operation.    This configuration for HF operation
would provide lesser performance than with the external HF modem.

FIGURE 6.   RPC-2000 CHANNEL A (M2-RPC INSTALLED) TO A VHF RADIO

## 2.4.3  Connecting Channel B to a VHF Radio

The RPC-2000 Channel B DE-9S connector (J9) is primarily designed to connect to a VHF transceiver.
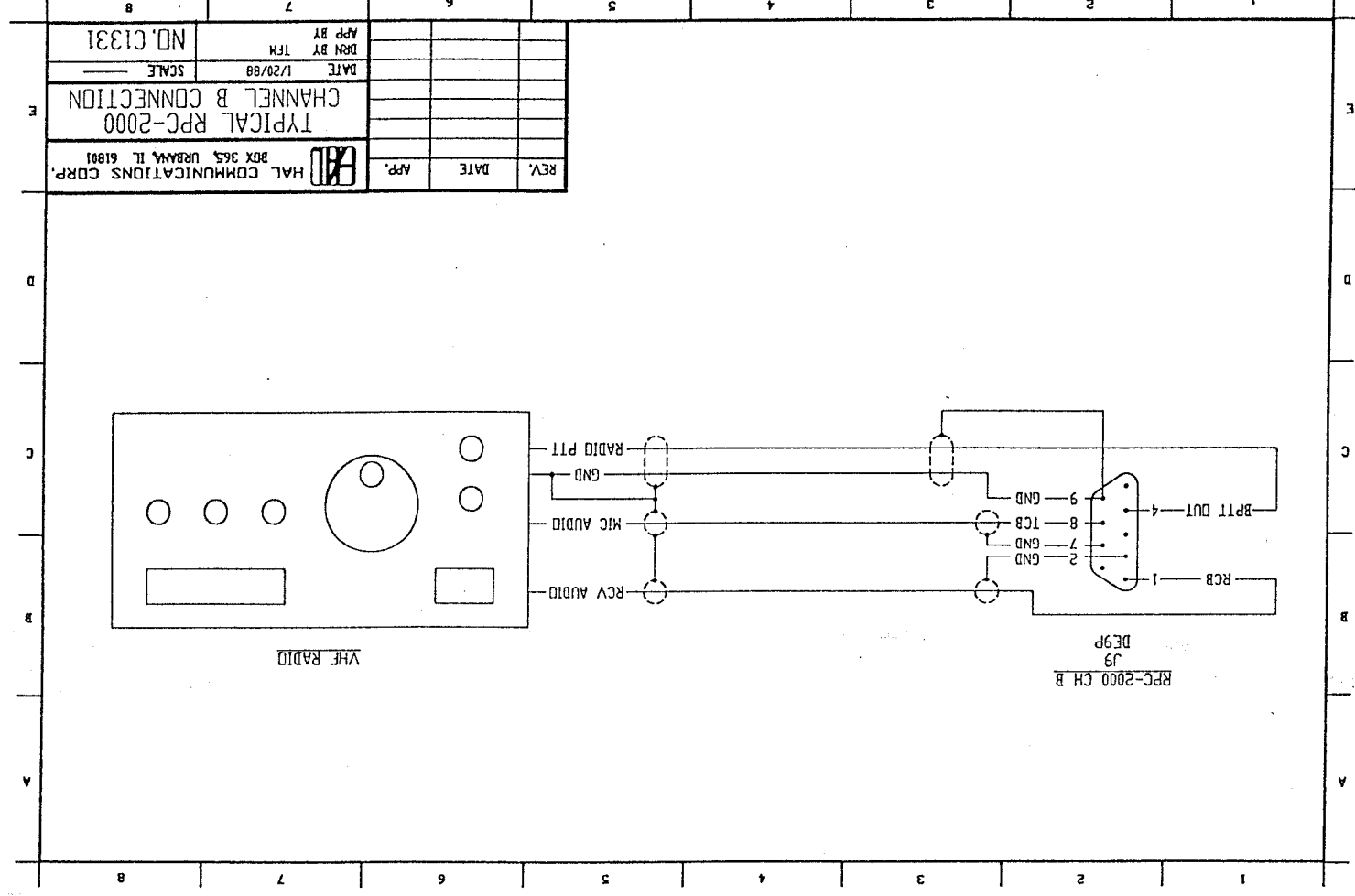


FIGURE 7.  RPC-2000 CHANNEL B CONNECTIONS TO A VHF RADIO

## 2.5   Radio Equipment Connector Pin-Outs

Please refer to you radio equipment instruction manual for
correct pin-out for the push-to-talk (PTT) and audio lines.
Also, please check on the TYPE of connector used at the radio.
Most often these connectors are either of the 4-pin mic, 6-pin
mic, 8-pin mic, 12-pin mic, or RCA phono jack type of connectors.

AGAIN, please used shielded wire for all of the RPC-2000
interfacing, including the wiring to a VHF radio system.   It is
possible that audio hum will occur if unshielded wire is used.

CHAPTER 3
OPERATION


This section of the manual discusses how to use the software
supplied with the RPC2000.    The RPC-2000 is very easy to use
because of its structure.    The two main modes of operation are
Command mode and Converse mode.    The Command mode is arranged as
a command tree so that the operator does not have to remember
each of the individual commands.    An expert user function allows
the operator to simply type in the first letter of branch
commands.    This will save time as the user becomes more familiar
with operation of the RPC-2000.    Help pages are always available
to assist the operator as well.    The Converse mode displays
actual communications.    We shall first cover how to load the
software and then proceed to the command tree and actual
operation.    Operation examples are given to help aquaint the
inexperienced packet operator with the system.


3.1   Loading the Software


A few easy steps are required to start the RPC-2000.    These steps
are much the same as you would perform for any other program and
will become very familiar after some practice.    Be sure that you
have followed the instructions in Section 1.5 of this manual and
have the DOS system files on the copied RPC-2000 diskette.    The
software is loaded like any other PC program by typing the EXE
filename "PACKIT".    The steps for booting the software are
outlined in Table 7.

TABLE 7
BOOTING THE SOFTWARE

1.   With the PC power turned OFF, install the RPC-2000 circuit board in the computer as discussed in Chapter 2.

2.   Insert the RPC-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!   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 (hr:min:sec).   Then enter date as requested (mo-day-yr).

6.   Type the filename "Packit".   After a short delay while the program is being loaded, the title page will be displayed.   Note that a version number is displayed on this page.   Write down this version number for future reference.   The PC Packet program also requires that a configuration file be present on the disk.   If this is the first time that you are booting the program, it will create the configuration file automatically.   The program also checks to see which interrupt level is available for use on your PC for the packet system.   It selects the interrupt level and indicates on the screen which level has been selected.   During all of these initial operations, the program keeps you informed of what it is doing.   If you have a problem, pay particular attention to what the messages say and make a record of them, as they will assist the in locating the problem.

7.   When all of the startup procedures are complete, the main command level will be displayed on the screen.


3.2  The Command Tree

The RPC-2000 program presents a command tree through which you select all modes of operation and parameters.   A diagram of the command tree is shown in Figure 8.   Presented below are the definitions of the commands in the order that they appear on the screen as you work through the command tree.   It is recommended that you read through these as an introduction to the structure of the RPC-2000 and refer back to this section as needed for clarification of any commands which you do not understand.

NOTE: TO CHOOSE A COMMAND FROM THE COMMAND TREE, EITHER MOVE THE SELECTOR BLOCK TO THE COMMAND WITH THE ARROW KEYS AND TYPE "CR" (CARRIAGE RETURN) OR SIMPLY TYPE THE FIRST LETTER OF THE COMMAND YOU WANT.   THE ABILITY TO SIMPLY TYPE THE FIRST LETTER WILL SPEED UP OPERATION AS YOU GAIN EXPERIENCE WITH THE RPC-2000.

FIGURE 8. THE COMMAND TREE

Title Page

xfer    quit    reset    init    link

files — sendf fsave dirl Input

unprot

monit — monon allmon dcon conm lcall budlst

xmt

sdel — axhang, delax, waitd, frack, retry, txdel

pform — cron, lfadd, paclen

echars — pass, sendpac

Input (Converse Mode)

quit — Y, N

init — cstat, dlglp, xmtok, maxfr, select — mycal chnl addr intlev

link — connect, disconnect, hbaud + smodem, vers, autset — okcon parms calpth
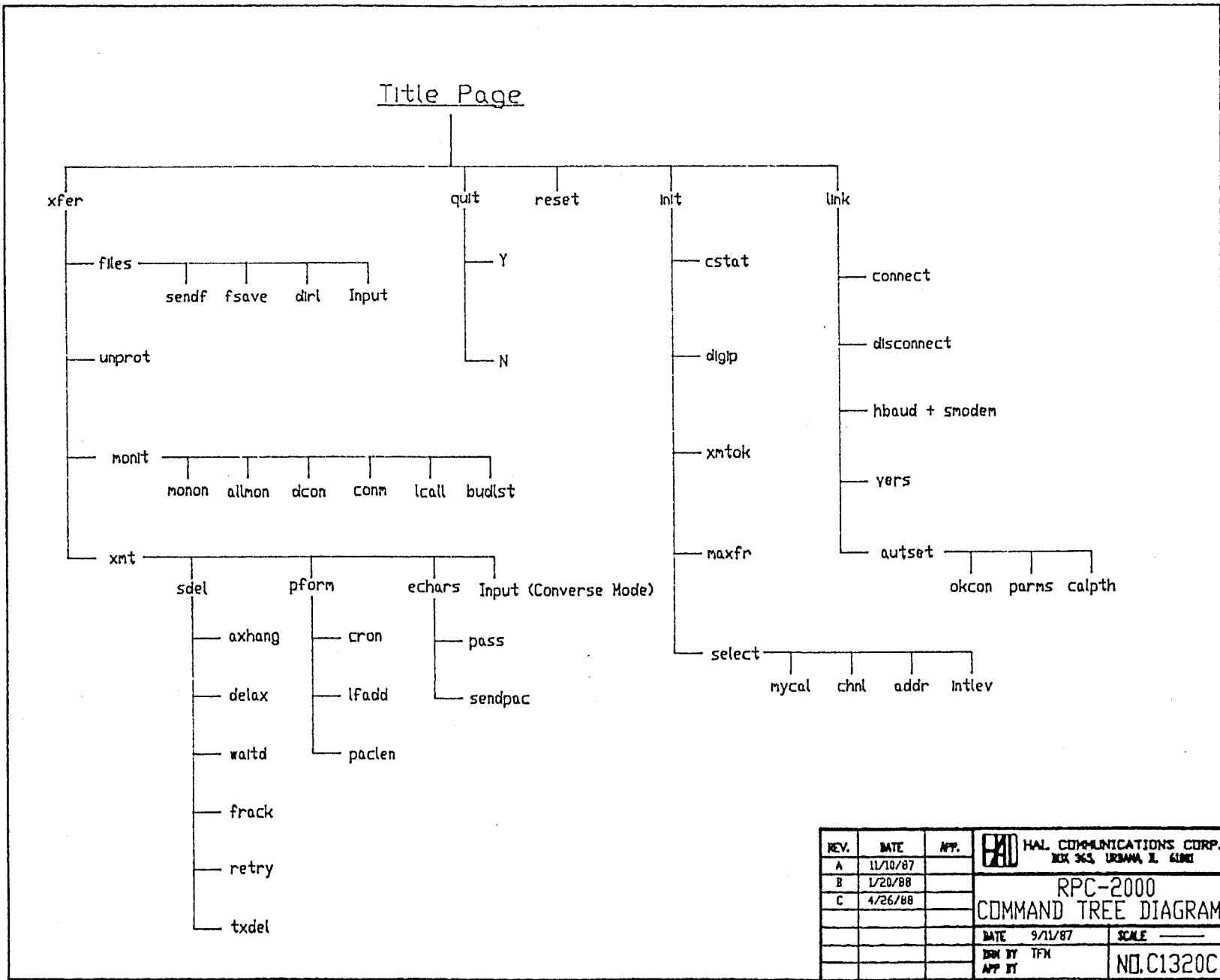
| REV. | DATE | APP. | HAL COMMUNICATIONS CORP. BOX 365, URBANA IL 61801 |
|------|---------|------|---------------------------------------------------|
| A | 11/10/87 | | RPC-2000 |
| B | 1/20/88 | | COMMAND TREE DIAGRAM |
| C | 4/26/88 | | |

| DATE | 9/11/87 | SCALE |
|------|---------|-------|
| DRN BY TFH | | |
| APP BY | | NO. C1320C |

The Main command level is displayed on the screen after booting
the software.  The commands available at this level are:
           link      xfer      init      reset      quit

Link -  Link status commands: Control the status of the link and
     set/access main communication parameters. Link commands are:
           cnct      disc      hbaud      vers      autset

     Cnct -  Connect to the station whose call is entered. A call
          can be any letters, numbers, or combinations of both up
          to 6 characters long.  A substation may be selected by
          typing a dash and the substation number after the call.
          Up to 15 substations are allowed for any callsign.  The
          main station is always assigned the suffix "-0" to
          indicate that it is the primary station for that call-
          sign.  F1 through F10 callpaths may be used.  If it is
          desired to operate through a digipeater, or through
          several digipeaters, the proper format for entry of the
          callsigns is:  XXXX via YYYY,ZZZZ-3,ABCD,EFGH-12
          The destination call comes first, followed by a space,
          the word "via" and another space.  Then comes the call
          of the first digipeater station, a comma, and the call
          of the second digipeater, etc.

     Disc -  Disconnect from the current link. (May also use
          Alt-D at any time in the RPC-2000 program.)

     Hbaud - Select the data transfer rate (45 to 9600 baud) by
          incrementing with the space bar; then select a valid
          modem standard for that baud rate.  The available modem
          standards are:
          For 45-300 baud:
               Bell 103 H (2025Hz/2225Hz - 200Hz shift) DEFAULT
               Bell 103 L (1070Hz/1270Hz - 200Hz shift)
               V.21 High  (1650Hz/1850Hz - 200Hz shift)
               V.21 Low   ( 980Hz/1180Hz - 200Hz shift)
               V.23 M 1   (1300Hz/1700Hz - 400Hz shift)
               V.23 M 2   (1300Hz/2100Hz - 800Hz shift)
               Bell 202   (1200Hz/2200Hz -1000Hz shift)
          For 600 baud:
               Bell 202   (1200Hz/2200Hz -1000Hz shift) DEFAULT
               V.23 M 1   (1300Hz/1700Hz - 400Hz shift)
               V.23 M 2   (1300Hz/2100Hz - 800Hz shift)
          For 1200 baud
               Bell 202   (1200Hz/2200Hz -1000Hz shift) DEFAULT
               V.23 M 2   (1300Hz/2100Hz - 800Hz shift)

     Vers - Select the current version of AX.25 protocol to use.
          Versions available are 1.0 and 2.0.  If version 2.0 is
          selected, then the RPC-2000 will also communicate with
          a station which calls using Version 1.0, however, all
          outgoing connects will use version 2.0 protocol.  If
          Version 1.0 is chosen, then the RPC-2000 will only
          communicate with stations using AX.25 Version 1.0
          protocol.

Autset - Set automatic type variables. Autoset commands are:
      okcon      parms      calpth

   Okcon - Toggle auto connect enable: When ON allows the
      RPC-2000 to automatically connect to a calling
      station.  When OFF, no one may connect with this
      RPC-2000.  Toggle ON and OFF with space bar.

   Parms - Read or write configuration file (parameters).
      R causes RPC-2000 to read the stored configuration
      file, and W stores the currently set parameters to
      the configuration file.

   Calpth - Display the current callpath settings (F1-F10);
      after the display of all callpaths is shown, you
      may change any one of them by typing the function
      key for that callpath.  The RPC-2000 then allows
      you to select the callpath (including up to 8
      "digipeaters"), the channel, baud rate, and the
      desired modem configuration for that callpath.
      The ESC key sets the configuration for that
      callpath to the current system configuration.

Xfer - Select more transfer commands & levels. Xfer commands are:
    xmit      monit      files      unprot

  Xmit - Transmit commands and levels.  The xmit commands are:
     Input      sdel      pform      echars

   Input - Change to I/O mode.  This command allows you to
      branch from the command tree into the Converse
      mode.  It performs the same function as the F2 key.

   Sdel - Set system delays.  The Sdel commands are:
      axhang     delax     waitd     frack
      retry      txdel

    Axhang - Set the hang time delay in 100 ms
       intervals from 0 to 20. If the RPC-2000 has
       heard packets transmitted on the channel in
       the most recent Axhang period, then it will
       not wait the additional Delax time between
       keying the transmitter and sending data. This
       is most useful in repeater operations where
       the repeater stays up a certain hang time
       after the last transmission. Packet channel
       efficiency is increased by not waiting for
       the additional Delax time before sending.
       Default Axhang time is 0.

Delax - Set any additional transmitter delay in
        10 ms intervals from 0 to 180.  This delay is
        typically included to allow for delays in
        repeater operations.  Once the PTT line of
        the transmitter is actuated, the RPC-2000
        will wait Txdel plus Delax UNLESS the Axhang
        time has not been exceeded since the last
        activity on the channel. In this case, the
        RPC-2000 only waits TXdel before sending.
        Default Delax is 0.
Waitd - Set the default wait time in 10 ms
        intervals from 0 to 250.  This is the amount
        of time which the RPC-2000 waits to send
        after the end of the last activity on the
        channel.  Waitd is designed to avoid the
        situation of packets from different stations
        colliding on the channel. Default Waitd is
        100 (times 10ms, or 1 second).

Frack - Set the frame acknowledge delay time in
        1 second intervals from 1 to 15.  This is the
        amount of time that the RPC-2000 waits for an
        acknowledgement of a frame before it sends
        the frame again. Default Frack is 6 seconds.

Retry - Set the maximum number of retrys before
        stopping from 0 to 15 times.  If the RPC-2000
        does not receive an acknowledgement for a
        frame in Frack seconds, it sends the frame
        again.  This is repeated Retry times before
        timing out.  Default Retry setting is 4.

Txdel - Set the normal transmitter delay in 10 ms
        intervals from 0 to 120.  This is the delay
        time between actuating the PTT line of the
        transmitter and the beginning of the transmit
        data stream from the RPC-2000. It is designed
        to allow a transceiver to switch modes from
        receive to transmit. Default Txdel is 40
        (times 10ms, or 400ms).

Pform - Packet format setting commands.  These are:
        cron       lfadd       paclen

Cron - Allow the sendpac character to be sent if
       ON.  Do not send the sendpac character at the
       end of a packet if OFF.  Toggle between OFF
       and ON with the space bar.  "CR" is used in
       the command name because CR is the most often
       used sendpac character. Default is ON.

Lfadd - Append each CR in a packet with LF if this
        option is ON.  Toggle between OFF and ON with
        the space bar.  In some instances, it is
        desirable to send linefeeds with each CR
        (carriage return) character to allow for a
        receiving terminal at the other end of the
        link which only goes to a new line when it
        sees the LF character.  Default is OFF.

Paclen - Set the maximum number of characters per
        packet from 1 to 256. If the RPC-2000 does
        not see a Sendpack character before reaching
        Paclen characters to be sent, the packet is
        ended at Paclen characters.  Any further
        characters will be in the next packet.
        Default Paclen is 256.

Echars - Set the edit characters.  The options are:
        pass      senpac

Pass - Select the pass character (from 00 to 7F
        hex). If there are control characters which
        are used in the program and are not normally
        allowed to pass as data (ALT-D, for example)
        they may be preceeded with the pass character
        and this will allow them to be passed through
        as data.  The Default Pass character is 16
        hex (Ctrl-V, or SYN character).

Senpac - Select the sendpacket character (from 00
        to 7F hex).  This is the character that, when
        typed, will cause the packet to be sent.  The
        Default Senpac character is 0D hex (CR).

Monit - Set monitor variables.  The commands are:
        monon      allmon      dcon      conm      lcall
        budlst

Monon - Select the ability to monitor frames ON or OFF
        by toggling with the space bar.  When Monon is OFF
        only the connect data is displayed.  When Monon is
        ON, the other monitor features selected below are
        active. The Default setting is ON.

Allmon - Set the ability to display connected packets
        ON or OFF.  When OFF, only unconnected packets are
        displayed. When ON, both connected and unconnected
        packets are displayed.  This is most useful when
        you only want to monitor packets not routed to a
        specific station.  For instance, three stations
        may carry on a discussion by sending to a default
        unprotocol address such as CQ.  If they have this
        parameter set to OFF, they will not copy traffic
        between two other stations which are connected.
        The Allmon Default setting is ON.

Dcon - Select the display of control frames while
       monitoring.  The options are Super, Off, and
       Normal.  Toggle through the modes with the space
       bar.  Super mode displays all control frames as
       well as data frames.  Off displays no control
       frames.  Normal displays all control frames except
       supervisory frames(RR, RNR, and REJ frames as
       defined by AX.25). Operation will be slowed if
       Super is selected.  The Default mode is Normal.

Conm - Select the monitoring of other packets while
       connected, ON or OFF.  When ON, you will display
       other packets as well as those from the station
       to which you are connected.  When OFF, you will
       only display packets from the station to which you
       are connected while you are connected.  Default
       is ON.

Lcall - Enter call list.  This is a list of callsigns
        for selective monitoring.  It is used by the next
        command - Budlst - to monitor ONLY these calls or
        to EXCLUDE these calls.  The Default is All, which
        is a special entry that includes ANY call.  The
        other special entry available is None which will
        exclude any call.

Budlst - Ignore or display packets from stations in the
         call list. The Default is DISPLAY.

Files - File transfer commands.  The commands are:
        sendf      fsave       dirl       input

Sendf - Send a file.  Enter the name of the file and
        follow with a CR to begin sending.  Stop sending
        by re-entering sendf and answering Y to cancel
        sending.  The name of the file may contain the
        path for location of the file as well, i.e.,
        B:\root\dir\file.ext.

Fsave - Save data to a file by entering the filename,
        the disk write time, and selecting whether saving
        of transmit data is ON or OFF.  The received data
        is stored to disk under the filename, and the
        filename may contain the complete path name, i.e.,
        A:\root\dir\file.ext.  Transmit data is or is not
        stored according to the setting of the parameter.
        Data is saved to disk at the end of the disk write
        time to prevent all data from being lost if a
        system failure occurs during reception of a long
        file. Stop saving by re-entering fsave and
        answering Y.

Dirl - List the current directory.

Input - Change to Converse mode. (Same as F2 key.)

Unprot - Select the default destination callsign, if no
    other call has been entered through the Link command
    level. Simply type in the callsign and CR. For example,
    if you enter the Converse mode with Xmtok ON and begin
    typing, this data will be sent to the Unprot callsign.
    The Unprot callsign is, therefore the address to which
    packets are sent when you are not connected.   These
    packets require no acknowledgement.   The Default Unprot
    address is CQ.

Init - These are the initialization commands.   They are:
            cstat      digip      xmtok      maxfr      select

    Cstat - Display the current state.   The 16 States as defined
        by AX.25 protocol are:
        S1 - Disconnected              S11- Waiting Acknowledge
        S2 - Link Setup                     and Device Busy
        S3 - Frame Reject              S12- Waiting Acknowledge
        S4 - Disconnect Request             and Remote Busy
        S5 - Information Transfer      S13- Waiting Acknowledge
        S6 - REJ Frame Sent                 Both Devices Busy
        S7 - Waiting Acknowledge       S14- REJ Sent & Device Busy
        S8 - Device Busy               S15- REJ Sent & Remote Busy
        S9 - Remote Device Busy        S16- REJ Sent & Both
        S10- Both Devices Busy              Devices Busy

    Digip - Select the ability of this station to function as a
        digipeater.   Toggle ON or OFF with the space bar.   When
        ON, this station can be used as a relay point for other
        stations. When OFF it cannot. Default setting is ON.

    Xmtok - Toggle transmit enable ON or OFF with the space bar.
        If you do not wish for this station to be able to
        transmit for some reason, this feature should be set to
        OFF.   If ON, any time you enter the Converse mode and
        begin typing characters, they will be sent as packets
        to the Unprot address, unless you are connected with
        another station.   The Default setting is ON.

    Maxfr - Set the maximum number of outstanding frames that
        this station will allow (from 0 to 7).   This figure
        determines the maximum number of packets which can be
        sent without receiving an acknowledge. The Default
        setting is 3.

    Select - Select the permanent type parameters.   These are:
            mycal      chanl      addr      intlev

        Mycal - Select this device's station call. The call
            follows the same rules as a connect call.   It can
            be up to 6 characters in length and can be a sub-
            station by adding a dash and a number from 1 to
            15 as a suffix.   The main station for this call
            is automatically assigned the suffix "-0" if no
            other suffix is added.

Chanl - Select either channel A or B.  Channel B is the
       standard internal modem.  Channel A is for use
       with an external modem or for the optional second
       internal modem channel if installed.  The Default
       case is channel B.

Addr - Select the hardware base address S1 or S2.  PC
       systems typically allow two synchronous port
       addresses called S1 (address 03A0 hex) and S2
       (address 0380 hex).  Choose S1 or S2 so as not to
       conflict with any other synchronous communications
       device installed in the PC.  The Default is S1.

Intlev - Choose the interrupt level for this device.
       The choices are level 2, 3, or 4.  Use level 3 or
       4 on an AT-type machine.  The default setting is
       level 2, which may be changed by moving the board
       jumper as described in Chapter 1.

Reset - When selected, reset clears transmit and receive buffers,
    closes any open files, and resets the protocol to the
    default parameters.

Quit - When selected, allows you to exit the RPC-2000 program if
    you select Y at the prompt.  If you select N, the program
    returns you to the main command level.


3.3  Operating the RPC-2000


The command tree makes operation of the RPC-2000 very simple,
even for the novice user.  Still, there are certain things which
should be carefully set before trying to set up communications
with another station.  HELP IS AVAILABLE BY TYPING THE F1 KEY OR
BY TYPING ALT-H.  The Help page gives special key operations
which may be used in the present mode.  Special key operations
which are common to all modes include:

        F1 or Alt-H - Display Help Page
        F2          - Toggle Command/Converse Mode
        Alt-R       - Quick Reset
        Alt-D       - Send a Disconnect
        Alt-S       - Show the Status Page
        ESC         - Backup command
        Enter       - Forward command (to select a displayed
                      command)

Other special key operations are specific to the mode you are in.

## 3.3.1  Initial Setup


To begin, first set the permanent type parameters of the RPC-2000 system by either moving the selector block to init and typing CR or by simply typing "i" for init.   Once the initialization commands are displayed, choose "select" by either moving the block followed by CR, or by typing "s".   The RPC responds with the Select level commands:

          mycal        chanl        addr        intlev

Select Mycal.   When prompted to do so, type in the callsign of your station.  The callsign can be up to 6 letters, numbers, or a combination of the two.  Up to 15 substations are allowed per callsign by the RPC-2000.  This means that actually 16 different packet controllers may use the same callsign with each having a distinct substation number.   The main station always has the suffix "-0" to indicate that it is not a substation.  Substations use the suffixes "-1" through "-15" as desired.  The call should be typed in with no spaces; and if a substation, a dash followed by the substation number (1-15, with no leading zeros).   If you do not assign a substation number, the RPC assumes that you are the main station for that call and automatically assigns "-0" as the suffix.   Enter a "CR" to end the call and set Mycall in memory.

Select Chanl.   If you are using the internal modem, select channel B.   If you are using and external modem, or if you wish to use the optional second internal modem (if installed), select channel A.   You may toggle between channel A and B by pressing the space bar.   Once you have made your selection, enter a "CR" to set that selection in memory.

Select Addr.   Choose either Synchronous port assignment S1 or S2, keeping in mind that you may have other devices installed in your system which may use one of these ports.   You may toggle between S1 and S2 with the space bar.

Select Intlev.   Set the interrupt level for your RPC-2000 for use in your system.  Do not use level 2 in an AT-type machine.   Do not use level 3 or 4 in an XT-type machine (or in the DS3200). After selecting the interrupt level, enter a "CR".

The permanent parameters are now set and should be stored to disk as described below:

     Return to the main command level with the "ESC" key.
     Select Link.
     Select Autset.
     Select Parms.
     Type "w" to write paramaters to disk.

3.3.2  Linking Directly With Another Station


If your station is set up for operation and the permanent
parameters are programmed as described in Section 3.3.1, you are
now ready to try a link with another station.  Most of the other
setup commands of the RPC-2000 can be left in their default state
as set at the factory until you gain more experience and wish to
change them.

Return to the main command level with the "ESC" key.  Select the
Link command.  If you DO NOT wish to communicate at the factory
default setting of 1200 baud, Bell 202 modem tones, then change
the data rate and modem setting by selecting Hbaud from the Link
command level.  After you have selected the appropriate data rate
and modem information, return to the Link command level with the
"ESC key.

From the Link command level, select Connect.  The RPC-2000 will
now gives you instructions for entering callsigns and repeater
calls.  If you are going to call a single station which is within
radio range, you simply type in the callsign of that station
(which can be up to six letters and numbers, followed by a
substation number if desired).

Example:  We wish to call station XXXX.
    After setting Hbaud parameters, return to Link level
    commands with the ESC key.  Choose Connect.  Enter the
    callsign XXXX.  When you are ready to connect, type a
    "CR" (carriage return) and the RPC-2000 will attempt to
    connect to station XXXX.  Once the connection has been
    made, the message "Connected to XXXX" will appear on the
    status line at the bottom of the screen and the program
    will switch to the converse mode.  You may stop the
    call by typing Alt-D at any time or by selecting the
    Disconnect command from the command tree.


3.3.3 Linking Through "Digipeaters"


You may wish to link to another station using a relay point or
"digipeater" in order to reach the destination station. A
"digipeater" is another packet controller which is set to allow
itself to be used as a relay point.   Using specific relay points
will involve telling the RPC-2000 how to make the call. From the
Link command level select Connect.  The RPC-2000 now gives you
instructions for entering the callsign and digipeater calls.

Example:  We wish to call station XXXX using digipeater stations
    YYYY and ZZZZ-3, in that order, as they provide the radio
    path to station XXXX.  After setting Hbaud parameters, go to
    the Link level using the ESC key.  Choose Connect.  Enter
    the destination callsign, a space, "via", another space, and
    the digipeater callsigns in the order that they will be used.

Separate the digipeater calls with commas.   The entry should
be made like this:  XXXX via YYYY,ZZZZ-3
If you make a mistake in entry and the sequence is not
correct, type the ESC key.  If the sequence is correct,
type a CR and the RPC-2000 will begin to transmit the link
attempt to station XXXX through the selected digipeaters.
You may stop the call by typing ALT-D (for disconnect).
If the link is made, the RPC-2000 reverts to Converse mode
and indicates that the you are linked with the station.


### 3.3.4  The Callpath Command


Callpath allow you to store commonly used destination callsigns,
relay stations used, the channel used (A or B), and the modem
standard desired for this callpath.   To store a call sequence in
Calpath, return to the Link command level and select Autset. Then
select Calpath.   Callpath sequences F1 through F10 will be
displayed on the screen.  Select the callpath you want to program
by typing one of the function keys (F1-F10). Enter the call
sequence exactly as you would from the Connect command and end it
with a CR.   Then select the channel for this call, the baud rate
desired, and the modem standard to be used. (You may choose to
set the channel, baud rate, and modem standard as set in the
default parameters.  In this case simply type the ESC key when it
is time to select a channel and the parameters for the callpath
being set will duplicate those of the default settings.) You  may
toggle between the various options for these parameters using the
space bar.   When the parameter is set for the desired option,
simply type a CR to enter that option as part of the callpath
information.   After typing the CR at the end of the modem
standard parameter, the callpath entry will be complete and you
may exit from Calpath with the ESC key.  If you realize that you
made a mistake in entry, simply re-enter Autset and Calpath, and
choose the same callpath again.   You may now correct your
mistake.

After you have determined that you will be using a specific
callpath often, you will want to store it to disk for later use.
Simply select the Parms command and respond with "W" to write
parameters to disk.   CAUTION: Be sure that other settable
parameters are programmed the way you want them to boot up from
the disk, because Parms stores all settable parameters to disk!

Example:  We decide that the call sequence used in Section 3.3.3
          will be used often and that it should be programmed as one
          callpaths.  Return to the Link commands with ESC.   Select
          Autset and Calpath.  Callpaths F1 through F10 are displayed.
          Select the function key F1.  Now enter the call sequence in
          the same order as in Section 3.3.3: XXXX via YYYY,ZZZZ-3
          followed by a CR. Once the call has been entered, we want to
          select channel B in order to use the internal modem. Toggle
          the modem options with the space bar until B is displayed.
          Enter a CR and the selection moves on to baud rate.  We wish

to run 1200 baud, so toggle the baud rate options with the space bar until 1200 is displayed.  Set 1200 with a CR.  We wish to use the Bell 202 modem standard, so toggle the modem options with the space bar until Bell 202 is displayed.  Now enter a last CR and the programming of the callpath is complete.  Store the callpath to disk with the Parms command using the "W" option to write to disk.  Be sure that all settable parameters are programmed the way you want them to boot up from the disk!


## 3.3.5  Operation Using Repeaters


Repeaters are very useful in extending the range of packet radio communications from your station.  There are special considerations which should be taken into account, especially when operating through repeaters designed for voice operation. Voice operation repeaters are usually designed to stay active for a short time after the last transmission ends.  This "hang" time should be taken into account when setting up the RPC-2000 for repeater use.  The Axhang delay is designed to accommodate the hang time of repeaters in the packet system.  If the RPC-2000 hears channel activity within the last Axhang amount of time before it is ready to send, it does not include any extra delay for bringing up the repeater.

The extra delay is Delax and is inserted if no activity was heard on the channel within the last Axhang amount of time.  The total amount of time between actuating the PTT circuit and the sending of data is, therefore, Txdel plus Delax, IF no activity has been heard within the most recent Axhang amount of time.

The settings of Axhang and Delax will depend on the specific parameters of the repeater you will be using.

CHAPTER 4
USER ADJUSTMENTS


The RPC-2000 Radio Packet Controller has only two controls which
are user-adjustable.  These are the two modem audio output level
potentiometers R-12 and R-21.


4.1  Modem Audio Output Level Adjustments


Please refer to Figure 2 in Chapter 1 for the location of the
audio output level potentiometers.

R-12 is used to control the audio output level from the Channel B
7910 integrated circuit modem.  This controls the audio output to
the DE-9S connector used typically for the VHF radio connection.

R-21 is used to control the audio output from the optional
Channel A 7910 integrated circuit modem.  This controls the audio
output level to the DB-25P connector used for HF or secondary VHF
connection.

Each output level potentiometer is factory set for an audio
output level of -30 dbm.

Each output level is adjustable from a range of -30 dbm to 0 dbm.

Our experience has shown that the factory setting of -30 dbm is
very satisfactory for most transceivers.  If you should have a
transceiver which requires a higher level of audio drive, you
should adjust R-12 or R-21 accordingly.

Required test equipment for this procedure is a A.C. voltmeter
capable of measuring audio frequencies, such as the HP 400F
voltmeter.  The audio output should be set to -30 dbm into a 600
ohm resistive load.


These are the ONLY user adjustments on the RPC-2000.

CHAPTER 5
IN CASE OF DIFFICULTY

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


5.1   Care and Feeding of Your RPC-2000


Your RPC-2000 is the latest of many generations of terminals and
modems manufactured by HAL Communications Corp.   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 RPC-2000 and
software.   The following suggestions are offered to help preserve
a long operating life for your RPC-2000.


Environment:


Electronic equipment is very susceptible to variations in
temperature and relative humidity, as well as to dust and dirt
accumulations.   The RPC-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 HAL DS-3200 Radio Data
Communications terminal or IBM PC-compatible computer will cause
the INTERNAL temperature of the terminal or computer and the RPC-
2000 to rise considerably above the ambient room temperature.
This can cause complete circuit failure.

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 terminal or 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 RPC-2000 are designed to operate at considerably higher
temperatures than we humans; do not be overly concerned 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 instruction manual, be sure to make several copies of the
RPC-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 RPC-2000 have maximum
voltage ratings as given in Table 3 and Table 5 and  Chapter 6 of
this instruction manual.  If these ratings are exceeded for even
a short period of time, considerable damage to the RPC-2000 and
the HAL DS-3200 Radio Data Communications terminal or IBM-
compatible computer may result.  Therefore, be very careful --
KNOW the ratings of the RPC-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.    Improper connection of either the DE-9S connector or the
      DB-25P connector.

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 or
      computer during electrical storms.  However, such things
      are unpredictable and the RPC-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 RPC-2000,
it is by nature a complicated device.  Therefore, there may be
times when it first appears that the RPC-2000 or the 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 the RPC-2000
"unresponsive", it is actually doing what it has been instructed
to do.  Familiarity with the RPC-2000 software will quickly
reduce the chances of "cockpit error" during operation.


5.3   RFI Problems


The RPC-2000 has been designed to minimize radio frequency
interference problems.  I/O connections to the DE-9S and DB-25P
connectors are by-passed and the circuit board is particularly
designed to keep computer noise to a minimum.  However, addition

of the RPC-2000 will NOT reduce radio noise that emanates from a poorly shielded IBM-compatible computer.  Connecting cables directly to the terminal or computer 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 a terminal or computer:

1.  Use SHIELDED cables for ALL connections in the radio system.
    This includes all wires to the RPC-2000 AND other wires
    between transceiver and accessories in the station.

2.  Use COAXIAL CABLE as your transmission line from the radio
    to the antenna.  Open-wire or twin-lead transmission line
    and the use of antenna tuners (transmatches) are generally
    NOT compatible with computer devices.

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 highly recommended.
    Connecting the cabinets together is MUCH more important to
    RFI reduction than installing a wire to a copper ground rod
    which is driven into the ground near the station site.
    This provides a reasonably good D.C. ground, but does little
    as a RF ground. (The "driven ground rod technique" is impor-
    tant for A.C. 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 major
    RF problems.

5.  Make sure that the A.C. power line cords of the transmitter
    and linear amplifier (if used) include bypass 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 terminal or computer keyboard cable can act as an
    antenna and be the "path" into or out of the terminal or
    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 Communications Corp. free  of charge.

## 5.4  Repair Procedures

In the event that your RPC-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; the dealer 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 (V1.x) of the software.

2.   How long have you owned the RPC-2000?

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 mode and data rates are associated with the failure?
     Does it only happen in receive, transmit, or both?

6.   Are there any extenuating circumstances? (Lightning, spilled
     liquids, or 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 the dealer 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 our
receiving department and be prepared to work on it when it
arrives.

MOST IMPORTANT:  INCLUDE IN THE BOX A SHORT NOTE DESCRIBING THE
PROBLEM AS BEST POSSIBLE.

Whenever possible, return the unit via UPS to the factory address
as listed below.  Please insure 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 are paid by HAL (48 contiguous states only).
You will be charged for return shipping costs on non-warranty
repairs.

The factory "SHIP TO" address is:

    HAL Communications Corp.
    ATTN:  Repair Department
    1201 West Kenyon Road
    Urbana, IL  61801


Because of the complexity of the circuitry used in the RPC-2000,
we do NOT recommend that you personally undertake repair of the
circuit board.  For the convenience of field repairs, however, we
have included a summarized circuit description and schematic
diagrams in Chapter 6.

CHAPTER 6
TECHNICAL DESCRIPTION

## 6.1  Specifications

Radio Ports:

| | |
|---|---|
| Number: | 2 |
| Type: | 1 - 300/1200 BPS Internal Tone Modem |
| | 1 - RS-232C Serial I/O Port to External HF Modem |
| Option: | 1 - Additional 300/1200 BPS Internal Tone Modem |

Internal modem:

Packet Radio Channel B
DE-9S Connector (J9)
Type 7910 I.C.
300/1200 BPS
300 BPS:  1270/1070 Hz or
          2225/2025 Hz
1200 BPS: 1200/2200 Hz

Input:  -30 dbm to 0 dbm,
        600 ohms
Output: -30 dbm to 0 dbm,
        600 ohms, adjustable

Tx Control:  Key to ground,
             250 ma maximum

RS-232C I/O Port:

Packet Radio Channel A
DB-25P DCE Connector (J8)
45 to 4800 BPS
TXD, RXD, CTS, RTS, DTR, DCD, and SG

Optional Modem:               M2-RPC
                              Type 7910 I.C.
                              Same specifications as Internal
                              7910 I.C. Modem.  Used as Packet
                              Radio Channel A.


Compatibility:                HAL DS-3200 Radio Data Communica-
                              tions Terminal, IBM PC, PC-XT, or
                              PC-AT.  Other IBM-compatible
                              computers will work if hardware
                              ROM BIOS routines are compatible.
                              Minimum system:  PC DOS or MS DOS
                              V2.1 or later.  512K RAM.  Two
                              floppy disk drives or hard drive.


Mechanical:                   One full-size IBM PC circuit
                              board; 13.25" (33.66 cm) x 4.00"
                              (10.16 cm) with 62 contact edge
                              connector.
                              Software furnished on one 5.25"
                              DSDD 360K diskette
                              .75 lbs (.34 kg) net, 3.0 lbs
                              (1.36 kg) shipping weight


        Specifications are subject to change without notice.


HAL Communications Corp. offers a list of recommended accessories
that one may consider to use with the RPC-2000.  These include:

  DS-3200 Radio Data Communications Terminal
  ST-8000 HF Modem
  PCI-2000 Personal Computer Interface
  SPT-1 SPECTRA-TUNE Tuning Indicator


If you should have any questions regarding RPC-2000 system
compatibility or questions on the technical specifications,
please do not hesitate to contact the HAL Customer Service
Department at (217) 367-7373 8:00A.M.- 5:00P.M., M - F.

## 6.2  Circuit Description Overview

This section summarizes the hardware of the RPC-2000.  For each area of hardware description, please refer to the applicable schematic diagram.

### 6.2.1  PC Buss Interface Circuitry

Please refer to schematic diagram A1673 (Figure 9).

This circuitry interfaces signals to the DS-3200 Radio Data Communications Terminal or IBM-compatible computer PC buss structure.

The 74LS245 (U28) is the data buss bi-directional buffer.  Two 74LS244 chips (U26) and (U27) buffer the address and control signals from the DS-3200 or PC.  A section of a 74LS04 (U16) and a 74LS30 (U17) decodes the RPC-2000 card address.  A 74LS32 (U5), 74LS08 (U6), and 74LS138 (U15) generate the chip selects for the various parts on the RPC-2000 circuit board.

### 6.2.2  Timer and Interrupt Circuitry

Please refer to schematic diagram A1674 (Figure 10).

This circuitry generates the timer outputs and interrupts.

A 74LS393 (U25) divides the DS-3200 or PC clock rate to the proper rate for the timer chip U23, a 6420320 I.C.  U23 is used for various system timing functions.  The Serial Communications Controller (SCC) interrupt and the timer outputs from U23 are combined into one interrupt line by a 74LS32 (U24).  A section of a 74LS04 (U16) converts the SCC interrupt from an ACTIVE LOW interrupt to an ACTIVE HIGH interrupt that the DS-3200 or PC understands.  A 74LS244 (U22) is used to read the interrupt sources and also to check on the state of the Push-to-Talk (PTT) control lines.

### 6.2.3  Serial Communications Controller (SCC) Circuitry

Please refer to schematic diagram A1675 (Figure 11).

This circuitry includes the Serial Communications Controller (SCC) and RS-232C I/O line drivers and receivers.

A Z8530A (U3) is the serial communications controller (SCC) chip. The SCC has internal baud rate generators.   Two 74LS393

integrated circuits (U13) and (U14) are dividers used to generate the proper transmit baud rate based on the receive baud rate generated by the SCC.  The Channel A output from the RPC-2000 can be selected for RS-232C I/O or the optional 7910 internal modem. A 74LS167 (U12) selects which source the receive signals come from -- RS-232C or optional modem.  Two MC1489 integrated circuits (U7) and (U18) and a MC1488 (U8) are the RS-232C I/O line drivers and receivers.


## 6.2.4  Push-to-Talk (PTT) and System Indicator Circuitry


Please refer to schematic diagram A1676 (Figure 12).

This circuitry includes the Push-to-Talk (PTT) control circuitry and the system indicators.

A 74LS14 (U1) and a 74LS04 (U4) control the PTT output line. These outputs have a timer that turns the output off if it is not refreshed from time to time.  Installing jumpers (J1) and (J2) defeats this function.  A 74LS244 (U2) drives the two quad LED packs that are on the RPC-2000 circuit board.  These LED's indicate the state of TXD, RXD, DCD, and PTT for each of the RPC-2000 channels.  Two 74LS374 integrated circuits (U11 and U21) are used to set the AM7910 modem integrated circuits (U10) and (U20). The MC0 to MC4 outputs determine in which mode the AM7910 modems operate.  (U11) and (U21) also control the PTT outputs. Additionally, (U11) is used to select the RS-232C/modem data for Channel A.


## 6.2.5  AM7910 Modem Circuitry


Please refer to schematic diagram A1677 (Figure 13).

This circuitry includes the AM7910 integrated circuit (U10), the optional M2-RPC AM7910 integrated circuit (U20), and related output circuits including audio output indicator and level adjustments.

The two AM7910 integrated circuits (U10) and (U20) are the modem chips.  Two LM1458 integrated circuits (U9) and (U19) are used to drive the audio output from the modem chips and to drive the two color LED's (DS3) and (DS4) on the RPC-2000 circuit board.  The two color LED's are present to indicate activity on the receive audio line to the modem chips.  Potentiometer R-12 is used to adjust the level of audio output for Channel B;  potentiometer R-21 is used to adjust the audio output form Channel A when the M2-RPC optional AM7910 modem is installed.

## 6.2.6  RPC-2000 Connector Pin-Outs and Connector RF Bypassing

Please refer to schematic diagram A1678 (Figure 14).

This contains the connector pin-outs for the DE-9S connector (J9) and the DB-25P connector (J8).  Also, included are the monolithic RF bypass capacitors.

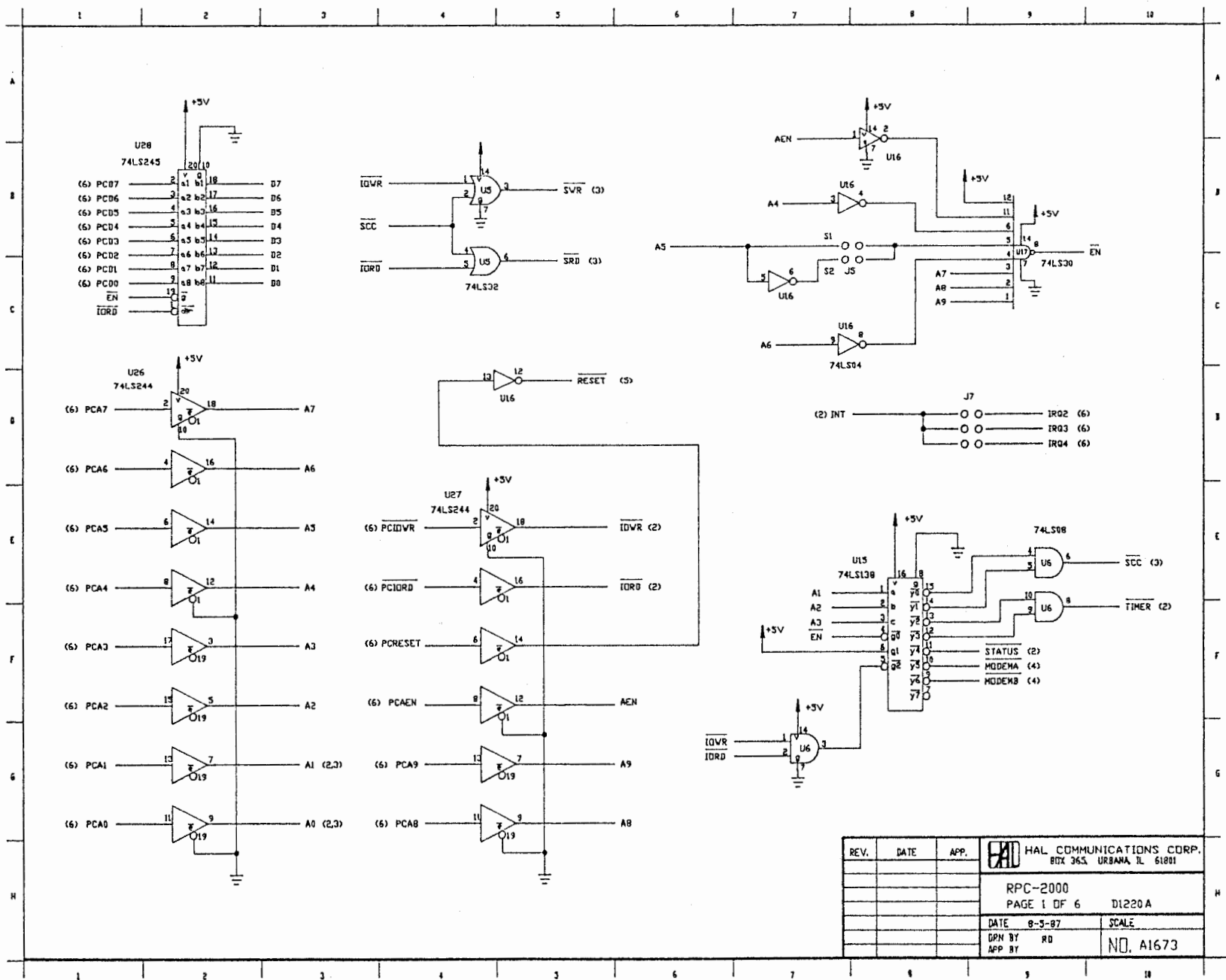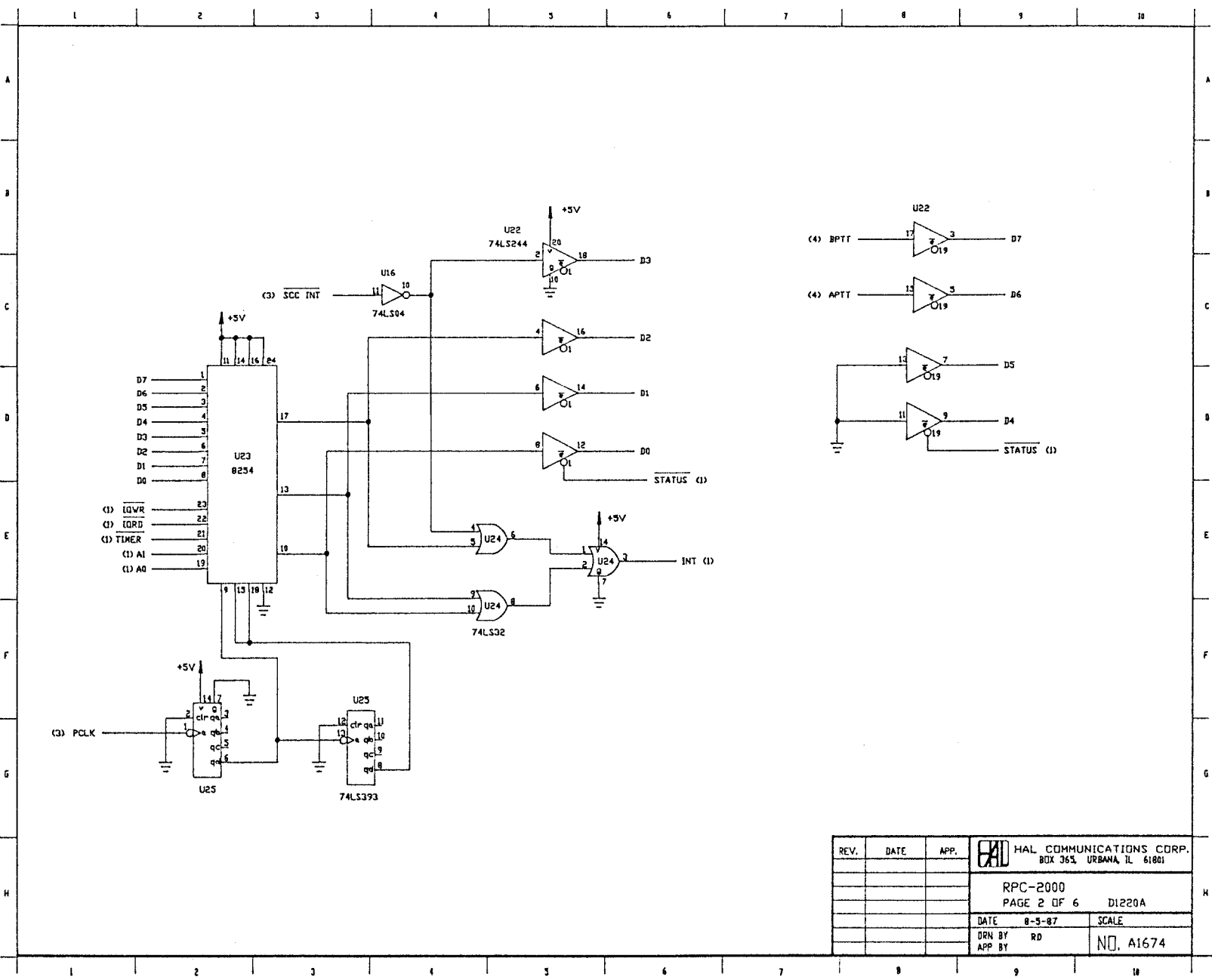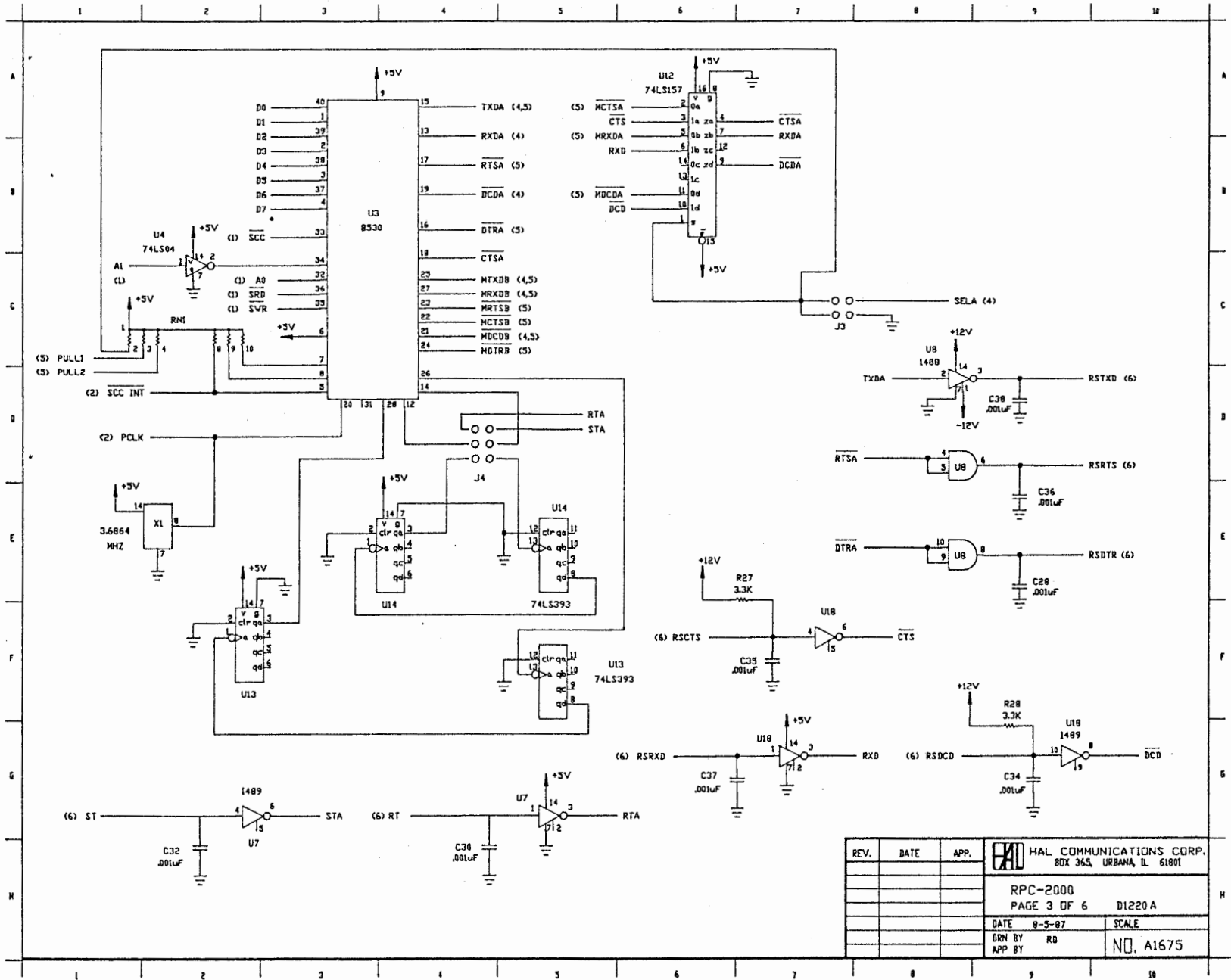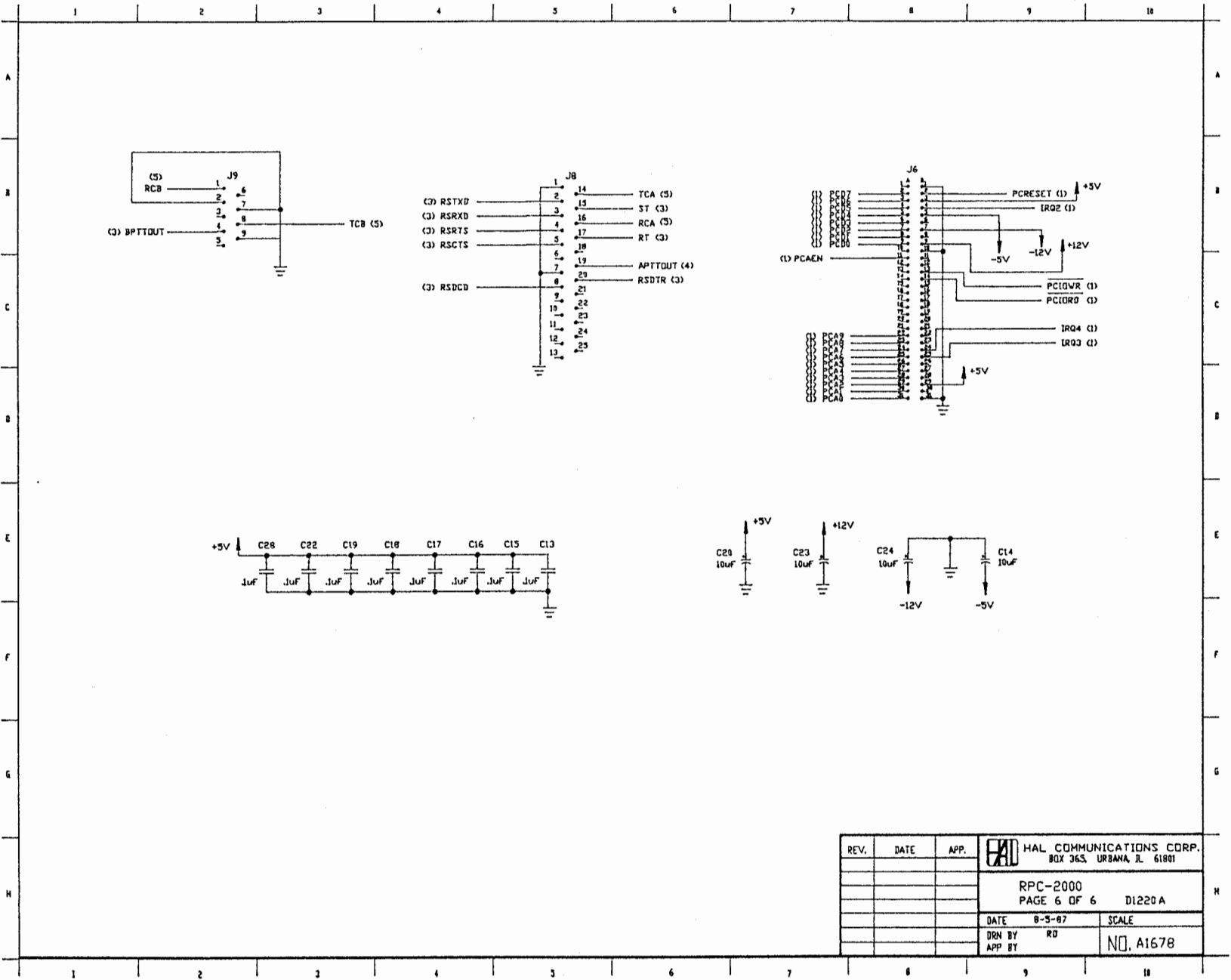FIGURE 9. PC BUSS INTERFACE CIRCUITRY

FIGURE 10.    TIMER AND INTERRUPT CIRCUITRY

FIGURE 11.   SERIAL COMMUNICATIONS CONTROLLER (SCC) CIRCUITRY

FIGURE 12. PUSH-TO-TALK (PTT) AND SYSTEM INDICATOR CIRCUITRY
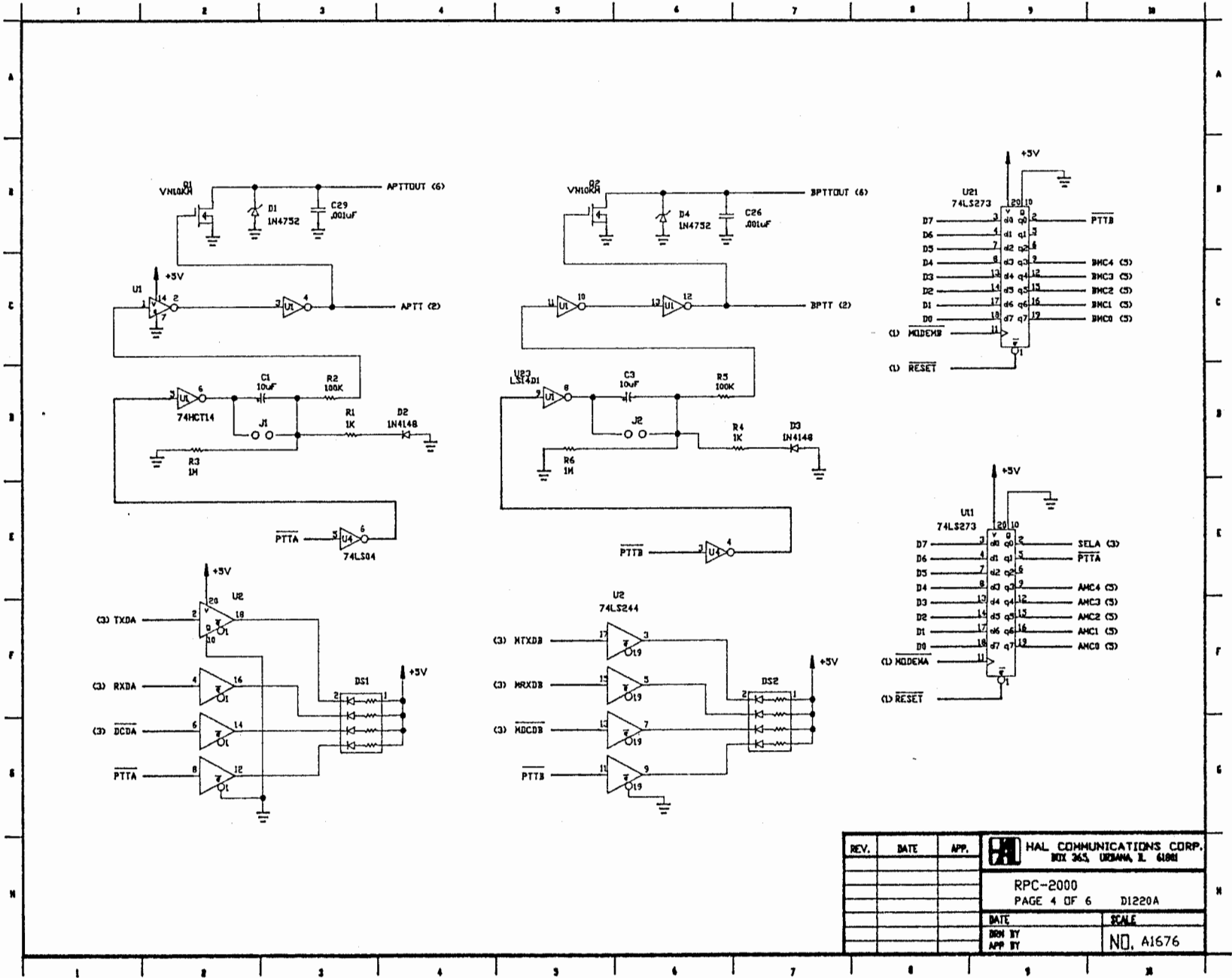
FIGURE 13. RPC-2000 AM7910 MODEM CIRCUITRY
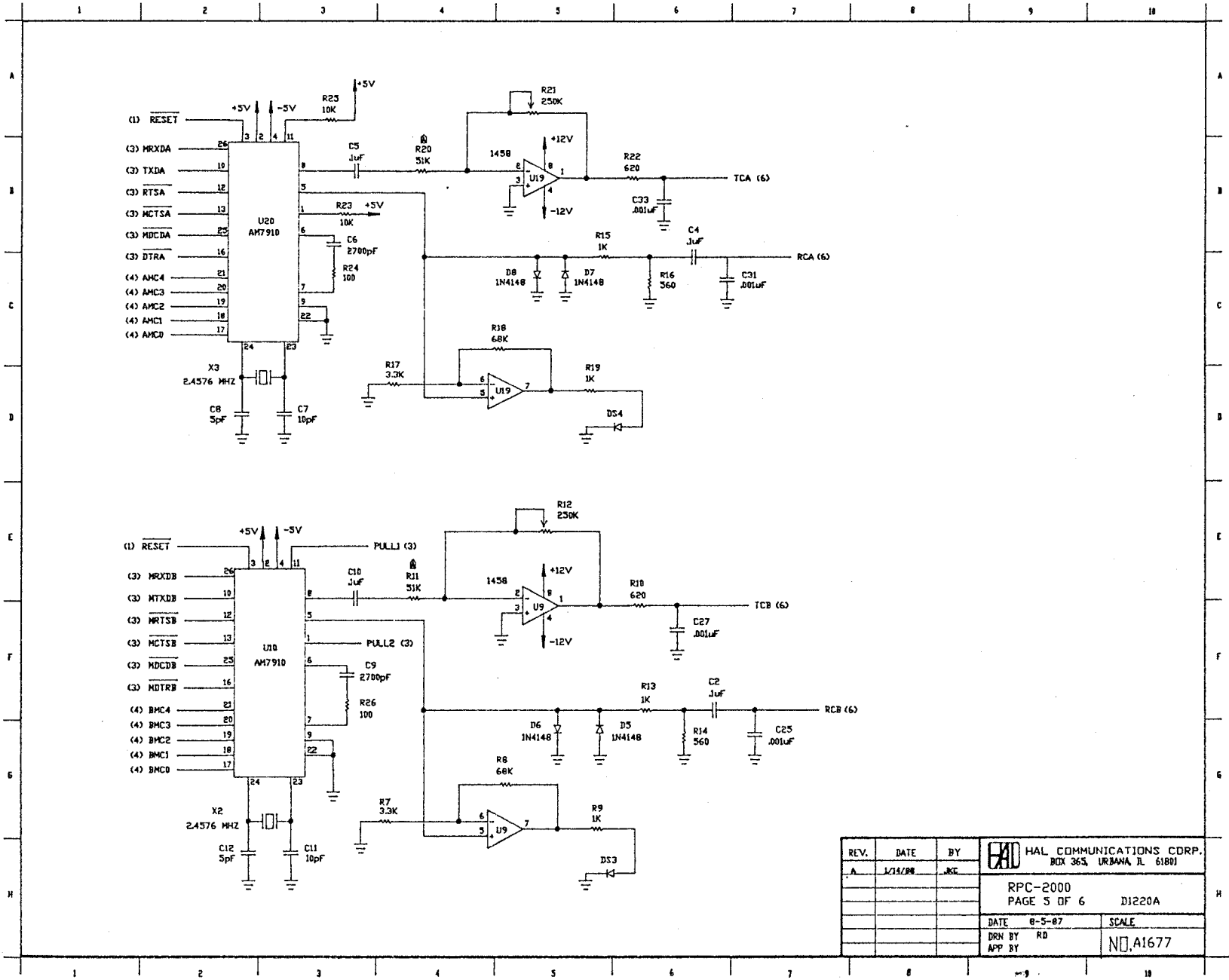
FIGURE 14.    CONNECTOR PIN-OUTS AND RF BYPASSING

## LIMITED WARRANTY

HAL Communications Corp. of Urbana, Illinois, hereby warrants to the original 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 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., P. O. Box 365, Urbana, IL 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 for the equipment.

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 on any unit 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 installation, or improper operation (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 limitation or exclusion 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.