USER'S MANUAL

SOTEC

SOTEC PHC-16

PHC-16
GUIDE TO OPERATIONS

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Meeting PHC-16
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Welcome to PHC-16, the world´s first truly personal computer.

PHC-16 is a full-featured IBM-compatible business computer.
It comes with:

    *   256K of memory, expandable to 1280K.

    *   5-1/4 inch physical (diskette) drive   and   3.5

         inch physical (diskette) drive plus a unique

         internal electronic RAM drive with up to 360K memory.

    *   Optional add-on physical (diskette) drive.

    *   Full 80 column, 25 line LCD screen.

    *   RS-232 serial and parallel printer connections.

    *   RGB and composite ports for optional monitors.

    *   Optional built-in modem.

    *   Optional add-on expansion unit.

    *   Reads from and writes to a 3.5 inch floppy disk.

With all these features, you might expect a desktop full of
equipment. Instead, PHC-16 is as portable as a briefcase. It´s
compact design, low weight, (only 12 pounds), and optional
battery pack, make it an ideal companion for the business person
on the go. Use it on a plane, train, boat, taxi, bus, or in your
hotel room. Take it home for the evening, or take it around the
world. It´s always ready.

Best of all, PHC-16 is easy to use. It uses Microsoft DOS and
runs most programs written for the IBM PC. Add your favorite
application software, and you´re off and running.

This manual, the PHC-16 Guide to Operations, gives you
instructions for setting up and operating your PHC-16. If you
have never operated a computer before, a section for the first
time user introduces you to a few helpful basics.

It is beyond the scope of this manual to tell you everything you
may need to know about computers, MS-DOS, BASIC, and application
programs. Since there are many books available for the IBM PC,
we have tried to give you a quick primer on PC operations while
concentrating only on those items that differ from IBM PC
operations.

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FAST START
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This section is only for those who have already opened their
PHC-16, are experienced using IBM PC or compatible computers and
PC or MS-DOS, and hate to read manuals. Follow these few steps
to get off to a fast start:

1. Press the keyboard release latch to detach the keyboard.

2. Install batteries in the keyboard. Press any key and make
    sure the light in the upper right corner comes on. The
    keyboard is wireless, but needs a clear path between the
    keyboard and computer.

3. Insert the AC adapter into the computer. Turn the AC
    adapter switch on.

4. Press the screen release latch and adjust the screen angle.

5. Insert the DOS diskette from the DOS manual, or any bootable
    diskette, into the PHC-16's physical (diskette) drive.
    MAKE SURE THE LABEL ON THE DISKETTE FACES TOWARD THE REAR OF
    THE COMPUTER AND THE NOTCH IS UP. Push the diskette into
    the slot until it clicks. Press in the button labeled
    "PUSH" at the top of the drive until it clicks.

6. Turn ON the PHC-16 power switch at the back and lower right of
    the computer. Press in the left side of the switch so the
    red line on the right side of the switch is showing.

7. Depending on the internal switch settings, the PHC-16
    either:

    *   Automatically sets up a RAM drive as Drive B, and
          installs DOS, or

    *   Displays a screen that lets you set up a RAM drive.
          Follow the instructions on the screen.

You are now up and running!

USING THE RAM DRIVE FOR A TWO DRIVE SYSTEM

The RAM drive enables the PHC-16 to work like a two-drive
system. Since the RAM drive is much faster than the physical
diskette drive, we recommend that you load your application
software program diskette onto the RAM drive and use the physical
drive for your data. Since the default drive is A, you can
toggle the drive designations of A and B between the physical and
RAM drives by pressing the CTRL, Left Shift, and D keys

simultaneously and continue to use A as the default drive. Or,
you can change the default drive to B. Here are some examples:

1. Your word processor programs are on one diskette and your
    data is on another. Insert your word processor program
    diskette in the physical drive and copy the files to the RAM
    drive like this:

        COPY *.* B:

    Remove the word processor diskette and insert the data
    diskette in the physical drive. Swap drive designations by
    pressing CTRL, ALT, and D at the same time. The RAM drive
    (your word processor) is now A and the physical drive (your
    data) is now B. Load your word processor (for Wordstar, for
    example, type WS and press ENTER) and operate as you would
    on any two-drive system.

2. Your spreadsheet is copy protected and won't copy to the RAM
    drive. Instead, copy your data (or only the files you need)
    to the RAM drive, and use the spreadsheet program diskette
    in the physical drive. REMEMBER TO COPY YOUR DATA BACK TO
    YOUR DATA DISKETTE WHEN YOU'RE THROUGH, BEFORE TURNING OFF
    THE PHC-16!

3. Your filer system is on one diskette and your data is on
    another. But once the filer programs load, that diskette is
    never read. Insert the filer system diskette in the physical
    drive and load it as you would normally. Swap drive
    designations, remove the program diskette, and insert your
    data diskette in the physical drive.

To display the help screen showing switch settings and keyboard
options press the CTRL, Left Shift, and T (for Teach) keys at the
same time.

CAUTION: BE SURE TO ALLOCATE ALL 360K TO THE RAM DRIVE BEFORE
USING THE DISKCOPY COMMAND! Although it appears that DOS has
copied the entire 360K disk, it has not and may result in missing
data or produce unpredictable results!

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Appendices

WARRANTY

CHAPTER 1

Getting Started

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Chapter 1 Getting Started
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A. Unpacking

You probably have already unpacked your PHC-16 computer box,
but check this list of items you should have found there:

        The PHC-16 Computer

        The AC Power Pack

        Four AA batteries for the keyboard

Remember to save your box and the packing material to use
if you ever need to ship your PHC-16.

WARNING: Transporting the PHC-16 without the cardboard
insert (or a scratch diskette) installed in the physical
(diskette) drive and the release button pushed in may invalidate
the physical (diskette) drive warranty.

B. Setting Up

1. The Keyboard

To release the keyboard, find the keyboard release latch and
press down. The keyboard is completely detachable. Remove it
and place it in front of your PHC-16.

Press down on the keyboard
release latch to detach the
keyboard.

Keyboard Release Latch
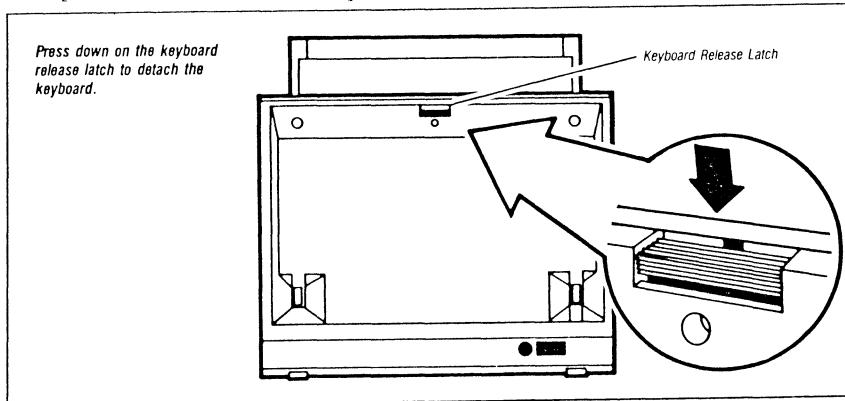
The keyboard has two elevation feet on the back. Pull them out
if you want your keyboard tilted slightly.

PHC-16 keyboard is not attached to the rest of the computer.
The keyboard sends signals to the computer by infrared light beam.
The illustration below shows how this infrared light works.

Keep the keyboard in front of
your computer and don't let
anything obstruct the light
beam.

Battery Compartment
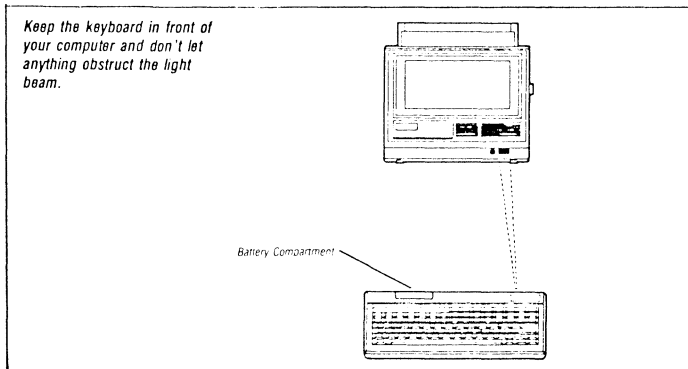
The keyboard is powered by four standard AA batteries. The
battery compartment is located in the upper left corner of the
keyboard. Find the small cover just above the gray function keys
and slide it off. Install the batteries included in your PHC-16
box, following the diagram on the inside of the battery
compartment. Replace the cover.

Press any key and the red light on the keyboard should come on.
If it doesn't come on now, or at any time you use your PHC-16,
the batteries are dead and must be replaced. We recommend
standard AA batteries available at most convenience stores.
Always replace all four batteries at the same time.

An optional keyboard cable is available to physically connect the
keyboard to the computer if you wish to do so. This cable is
coiled and can be extended to ten feet. You still need working
batteries to power the keyboard; the cable replaces the infrared
beam.

Tips for better computing with your infrared light beam:

*   Don't let anything block the beam when you are using
     the keys.

*   Don't turn the keyboard at too great an angle. The
     infrared beam will not make proper contact with the
     PHC-16.

*   Sometimes a key may appear to be stuck. This is rare
     and happens if the computer senses when the key is
     pressed, but not when it is released. This is not a
     mechanical error, but may occur because of some
     interference between the keyboard and the computer. If
     this happens, reposition the keyboard and press the key
     that seems stuck again.

2. The Screen

Find the screen release latch and PRESS IT IN lightly.   You can
feel it release. Now, pull the screen out until it's in
the best position for you.

Press the screen release latch
and adjust the angle of the
screen.

Screen Release Latch
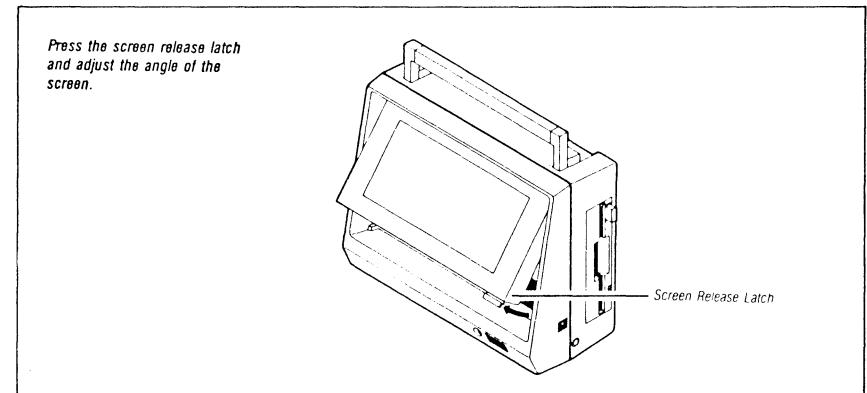
Caution: Make sure the screen panel is not forced up beyond it's
           limit. Also, never lift or move the computer by
           grasping the screen panel.

C. A Quick Tour of PHC-16

Now that your PHC-16 is set up, let's take a quick look at all the external switches and plugs. We'll talk about each of these in different places in this Guide to Operations. But this illustration lets you find your way around PHC-16 and can help as a quick reference later.
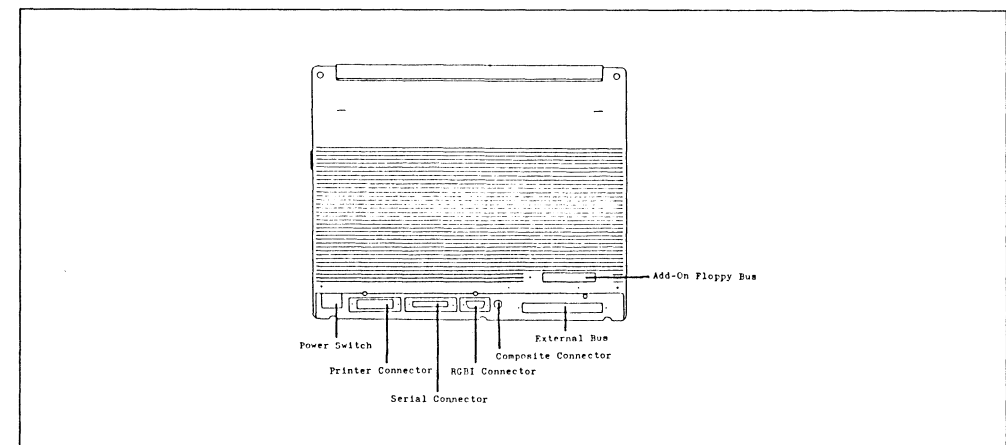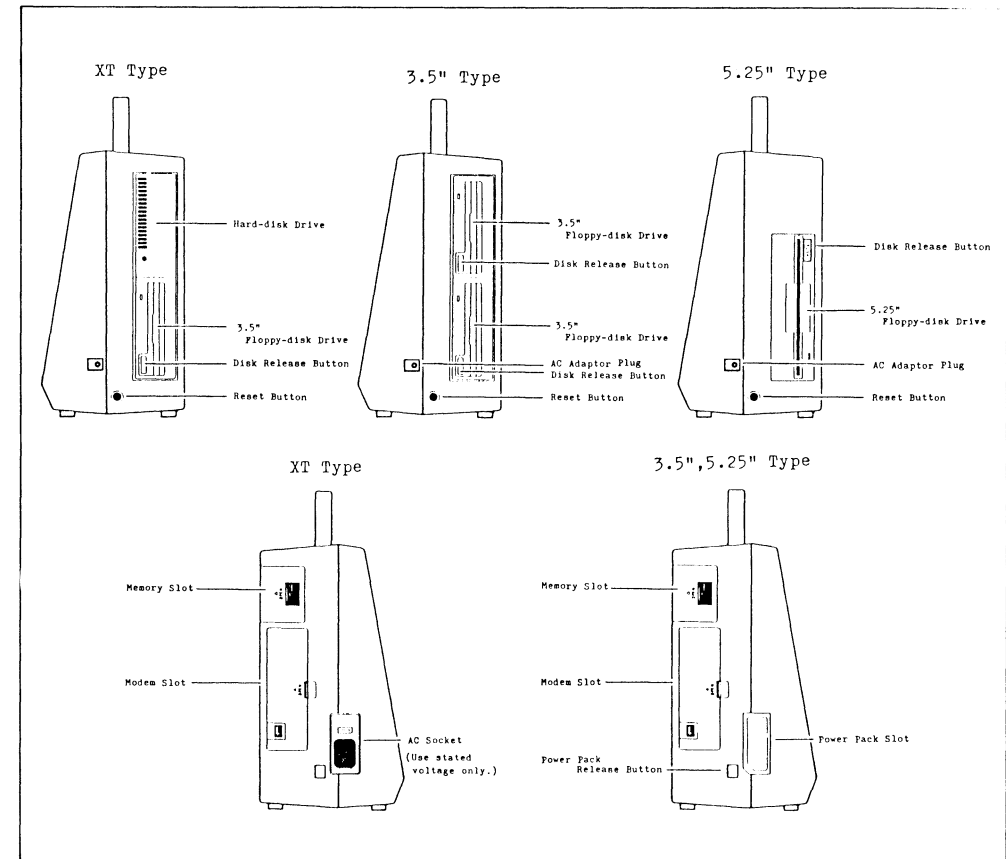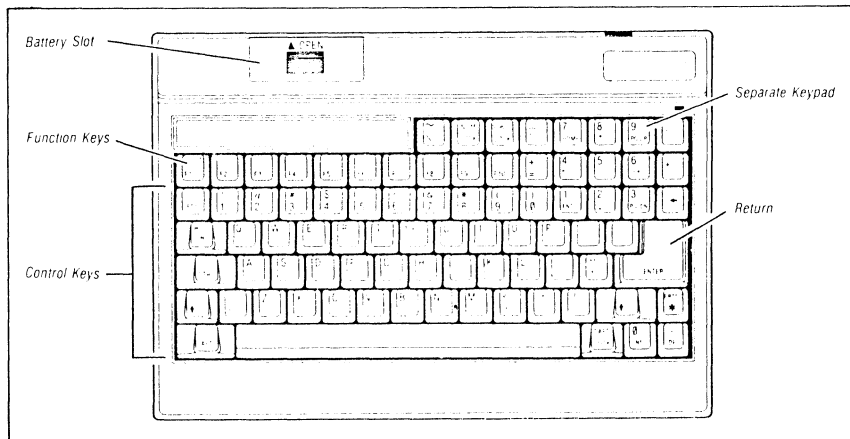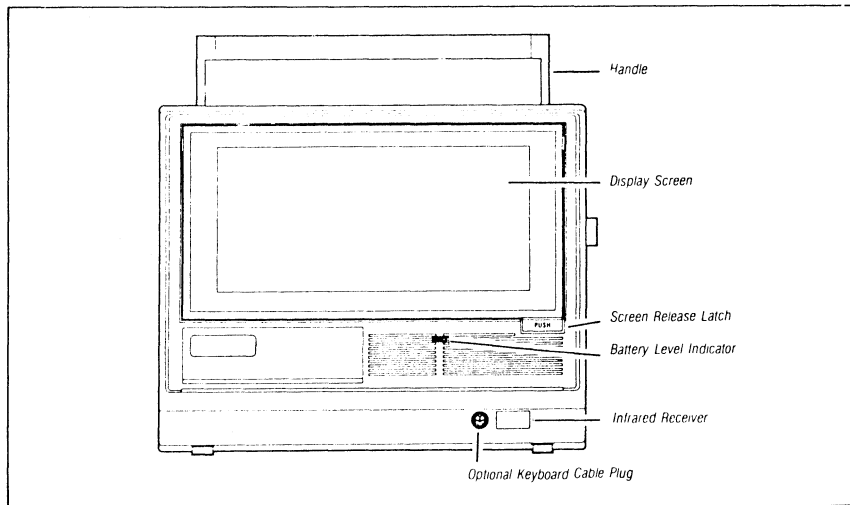
D. For the First Time User

If PHC-16 is the first microcomputer you have used, this section
introduces you to a few basics.

We don't want to bore you with the history of computers or bury
you with technical computerese. But we do want you to understand
enough about how your PHC-16 works so that you can logically
work your way through new situations and use your computer more
efficiently. If you are already familiar with computers, you may
want to skip this section.

1. How Your Computer Works

Your PHC-16, like any computer, has a single purpose: to
manipulate data. A computer is not very smart--its mathematical
ability is no better than that of a pre-school child. But it is
so astonishingly fast that it can process in seconds what might
take humans days or weeks. And it can store data more
conveniently and compactly than we have traditionally done with
paper. These attributes, and its portability, make the PHC-16 a
very powerful and productive business tool.

Every computer system is built around the Central Processing Unit
This is the box, big or little, that holds the processing chips
and electronic circuits. The Central Processing Unit, as the name
implies, does the processing or computing.

Your body is like a computer system. Your brain receives
information from your senses, analyzes it and sends instructions
to your muscles. In this way you communicate with your
environment. In a similar manner, your computer system needs
devices to communicate with you, to receive instructions and data
from you and to send the results back to you in a form you can
understand. These devices are call peripherals. Here's a simple
diagram of a computer system:

Most computer systems consists of these parts.

Printer   CPU   Modem   Telephone
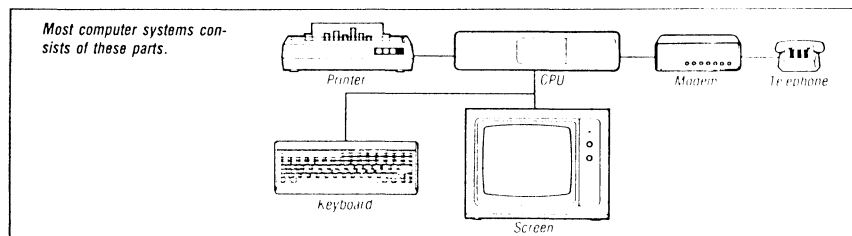
keyboard

Screen

Your PHC-16 has two built-in peripherals: a keyboard for you to
enter data and a screen for you to see the results. You can add
a printer to print the results on paper, and you can add a modem
so your PHC-16 can exchange information with other computers
over telephone lines. With a modem, for example, you could
compose memos or write reports in your hotel room and send them
by telephone to your home office thousands of miles away.

2. Software

Your computer system is called hardware and the instructions that
tell the computer what to do are called software. These
instructions are grouped together in programs to do a certain
job, like word processing, and are usually called application
programs.

There are some other software programs that make the computer
system work, called system software. The most important system
software you will use is the operating system. The operating
system manages your data and instructions for application
software as they move through the computer system.

3. How Data is Stored

Inside the computer is an area called internal memory where data
is stored while the computer manipulates the data. The computer
can transfer data into and out of internal memory very quickly.
This is called reading and writing.

But your computer's internal memory is limited. You need a way
to store large amounts of data. Your PHC-16 uses diskettes.
These are sometimes called floppy disks. Diskettes store data
permanently, and you can use as many diskettes as necessary to
store your data. Other computers use cassette tapes or hard
disks.

Data storage capacity is measured in kilobytes or K. A byte is
one character of data. One kilobyte, or K, equals not 1000 bytes
or characters as the name "kilo" implies, but 1024 bytes.

The internal memory of your computer is divided into two sections.
One area is reserved for portions of the operating system and
hardware instructions. This area is called Read Only Memory, or
ROM. The other section of memory is a working storage area where
the computer stores instructions and data. This area is called
Random Access Memory or RAM. RAM in your PHC-16 can be
subdivided, or partitioned, into working storage RAM and a RAM
drive.

4. Things to Know About the Keys

Think of your keyboard as a sophisticated typewriter. It has
all the regular keys, plus some others. Most of the keys work
just like a typewriter, but there are a few exceptions.

Keys that Look Alike

On typewriters, the letter O and the
number zero are interchangable. Not
so with computers. Make sure you type
the right character in commands and
file names. On your keyboard and on
your screen the zero has a diagonal
line through it.

The computer also knows the difference
between a lower-case L and the number 1.
Sometimes the computer requires you to
enter only numbers or only letters. Be
careful to use the right key.

The Spacebar

Find the spacebar on your keyboard. The
spacebar works like one on a regular
typewriter, but it also has special functions.
Blanks are important to a computer and
the spacebar is used to enter those
blanks.

The Shift and Caps Lock Keys

PHC-16 has two shift keys marked with up
arrows and located about where you would
find them on a regular typewriter. Use
either shift key to type upper-case letters
or to type the symbols in the upper portion
of the number keys. Use the Left Shift key
with the CTRL key to perform special features.

The Caps Lock key is located just below the
right shift key and works like the
shift lock key on a typewriter. It lets you
type only capital letters until you press it
again. Unlike a typewriter, it only affects
letter keys. You still have to press the
shift key to use the symbols in the upper
portion of the number keys. To turn off the
Caps Lock, press the key again.

The Function Keys

Notice the darker gray keys across the top left side of your
keyboard. These keys take on different "functions" epending
on the software you are using on your computer.

The Arrow Keys and Numeric Keypad

The medium gray keys in the upper
right corner of your keyboard serve two
functions. The four keys marked with arrows
are called the Up, Down, Left, and Right
Arrow keys, and allow you to move the cursor
around your screen.
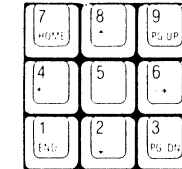
When you press the key marked NUM LOCK, the
numeric keypad is ON. This means that
the number keys in the upper right corner of
your keyboard become a numeric keypad,
similar to the keys on a calculator. Press
the NUM LOCK key again to turn the numeric
keypad OFF.

The ENTER Key

The large key on the right side of your
keyboard is used when you have finished
typing a command. After you press ENTER,
the computer starts processing the command you
just typed. The ENTER key also works like a
carriage return on a typewriter. For this
reason it's called the RETURN key on some
computers.
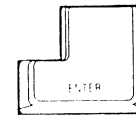
5. About Diskettes and the Physical Drive

The PHC-16 uses 5-1/4 inch diskettes. Diskettes are
sometimes called floppy disks. PHC-16 uses double-sided, double
density diskettes.

A permanent, protective black jacket holds the diskette.
And diskettes are stored in paper envelopes that provide
additional protection.

Information and software, the instructions to the computer, are stored on diskettes. The computer can read the existing data on the diskette, or you can add more data in unused space on the diskette.

Because important information is stored on diskettes, they must be protected. Follow these cautions:

* Do not try to remove the permanent black jacket.

* Do not touch the exposed surface of the diskette (see illustration). It is important that this surface stay clean. A speck of dust or a fingerprint could destroy data.

* Always return your diskettes to the paper envelopes. This helps protect them.

* Store all diskettes away from heat and magnetic field sources such as telephones and dictating equipment.

* Always make copies of your diskettes for additional protection. These are called back-up copies. Instructions for making backup copies are found in Chapter 4: Operations.

* Always label your diskettes with a felt-tipped pen. Pencils or pens could damage the diskette. Use the adhesive labels that come with a box of diskettes.

* Do not leave diskettes in a parked car on a very hot day or expose them to temperatures below 50 F (10 C).

* Do not bend diskettes.

To use a diskette, insert it in the PHC-16 physical (diskette) drive with the notch up and the label facing away from you. The drive is the slot on the right side of your computer.

Slide the diskette into the disk drive until it clicks. Then press the little square button until it clicks.
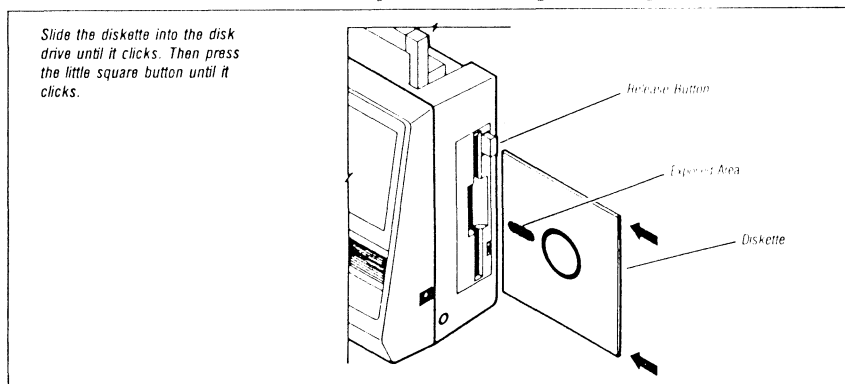
While the RAM drive (discussed in the next section) is electronic, the diskette drive is mechanical. To avoid confusion between the two drives, this manual always calls the diskette drive the physical drive.

To insert the diskette in the physical drive, follow these steps:

1. Press the release button (labeled PUSH) at the top of the physical drive. Then remove the white cardboard protector from the PHC-16 physical drive. Grasp the flap and pull it out.

2. Hold the diskette with the LABEL FACING THE BACK OF THE COMPUTER AND THE NOTCH UP, and slide it into the physical drive.

3. When it is all the way in the slot you will hear a faint click.

4. Press the release button (labeled PUSH) at the top of the physical drive until you hear another click. This is like closing the door to the physical drive.

6. An Electronic Drive -- The RAM Drive

PHC-16 includes a built-in electronic drive that works just like the mechanical diskette drive, and gives you the versatility and convenience of a two-drive system. This electronic drive is called a RAM drive because it uses a portion of RAM. PHC-16 lets you set aside up to 360K of RAM to use to store programs and data, just like the diskette drive. When you start up, PHC-16 asks you to designate how much RAM to allocate to the RAM drive. You may assign from 0 to 360K in 8K increments. Or, you can turn switch SW2-1 ON so that PHC-16 will automatically allocate the full 360K to the RAM drive whenever you start up.

When using the RAM drive, remember to always copy any data you want saved to a diskette before you turn the power off. All RAM memory, including the RAM drive, is lost when power is turned off.

Caution: Be sure to allocate all 360K to the RAM drive before using the DISKCOPY command. Using DISKCOPY to copy to a RAM drive of less than 360K may cause data loss or unpredictable results.

For detailed instructions on using the RAM drive, see the section on "Using the RAM Drive" in Chapter 4: Operations.

E. Turning the Power ON and OFF

Now that your PHC-16 is unpacked and set up, and you've learned the keys and some important terms and concepts, you're ready to turn your PHC-16 on and put it to work.

Your PHC-16 operates on either household AC electricity, or with a battery pack. The AC power pack is standard equipment and was shipped with your PHC-16. The battery power pack is optional.

1. Inserting the Power Source

Both the AC pack and the optional battery pack are inserted in exactly the same place and in the same way:

    1. Make sure the on/off switch on the back of the PHC-16 is
        OFF (press down on the right side of the switch so the
        red line does not show). It should come shipped turned
        OFF, but check to make sure.

    2. Insert the power pack (either battery or AC) into the
        power slot located on the left side of PHC-16. The
        power pack can only be put in one way. If it doesn't
        go in at first, flip it over.

    3. Push the power pack all the way in until you hear it
        click.

    4. Turn the power pack switch ON.

Slide the power pack all the way into the slot on the left side of the Datavue until it clicks.
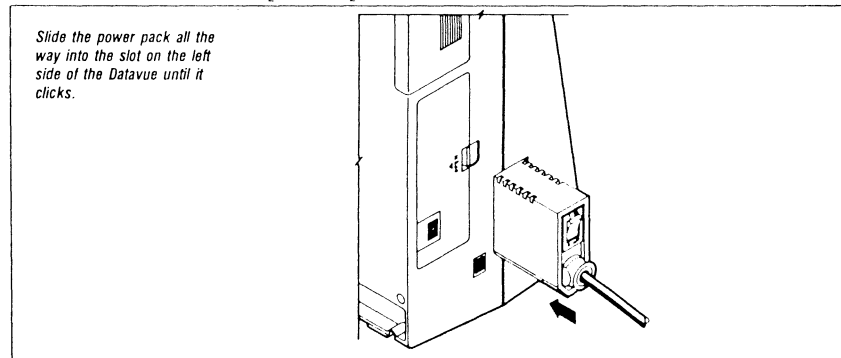
2. Removing the Power Pack

To take out either the standard AC pack or the optional battery power pack, follow these steps:

    1. If you have been using the computer, make sure all data
        has been saved, and that any data on files in the RAM
        drive has been copied back to a diskette.

    2. Remove any diskette in the physical drive.

    3. Turn the on/off switch on the back of the PHC-16 OFF.

    4. Turn the power pack switch OFF.

    5. Find the gray button just to the left of the power pack
        and press it. The power pack should pop out of its
        slot part way.

    6. If nothing happens, use your other hand to press in
        slightly on the power pack while you press the gray
        button. This releases the pressure on the catch and it
        should pop out part way.

    7. Pull the power pack the rest of the way out.

Remove any diskettes and turn the Datavue power off.
Press the release button to release the power pack and slide it all the way out.

Release Button
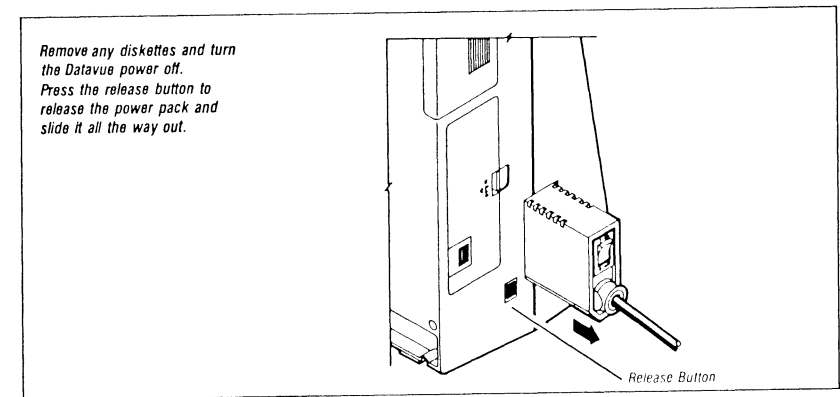
F. Start Up

PHC-16 is easy to turn on. Follow these steps:

    1. Install either the AC adapter or the battery power pack
        as described in the steps above. If you are using the
        AC adapter, plug it into an electrical outlet.

    2. Turn the on/off switch on the power pack ON.

    3. Turn the on/off switch on the back of PHC-16 ON (press
        in on the left side of the switch so that the red line
        on the right is showing).

If your PHC-16 has less than 768K, you should immediately see a display like this on your screen:

```
┌─────────────────────────────────────────────────────────────┐
│   USE THE ←AND →KEYS TO INCREASE OR DECREASE RAM DISK MEMORY  │
│         MEMORY IS RE-ASSIGNED IN 8K INCREMENTS                │
│   HIT THE ENTER KEY [above the PrtSc key] WHEN THE SETUO IS CORRECT │
│                                                               │
│                      MAIN MEMORY                              │
│ - - - = = = = = = = = = = = = = = = = = = = = = = ▲ ▲ ▲       │
│                                                               │
│                     EXTENDED MEMORY                           │
│  = REPRESENTS 8K OF MAIN MEMORY      ● PEPRSENTS 8K OF RAM DISK MEMORY │
│  ◆ REPRESENTS 8K OF EXTENDED MEMORY  ▲ REPRESENTS 8K OF RESERVED MEMORY │
│                                                               │
│    MAIN MEMORY = 448K [ 64K MIN]   RAM DISK MEMORY =  0K [360K MAX] │
│ EXTENDED MEMORY =  0K [640K MAX]   RESERVED MEMORY = 24K [ 24K MAX] │
│                                                               │
│                   [1K = 1024 BYTES]                           │
│                                                               │
│          DATE: 10-02-1985   TIME: 12:41:52                    │
│                                                               │
│                BATTERY LEVEL = 100 %                          │
└─────────────────────────────────────────────────────────────┘
```

If this message does not appear:

*   Check the setting of switch SW2-1. If it is ON, this screen displays for only a few seconds.

*   Sit down in front of your computer and adjust the tilt of the screen.

*   Press the CTRL, Left Shift, and S keys at the same time to adjust the LCD palette and alter the intensity of different parts of the display. Choose the one that is best.

*   Press the CTRL, Left Shift, and Up Arrow keys at the same time to increase the contrast on the screen. Press the CTRL, Left Shift, and Down Arrow keys at the same time to decrease the contrast on the screen.

*   Review the steps outlined above to make sure you did everything right.

*   Be sure the computer is plugged in.

*   If you are still having trouble, turn to Chapter 5: Problem Solving for more things to check.

1. The PHC-16 Memory Screen

The screen you see when you first turn on your computer allows you to allocate a portion of RAM (up to 360K) to the RAM drive. This procedure is called partitioning memory.

If you are using PHC-16 for the first time, you do not have to partition memory right now. You can skip the rest of this section and come back to it later when you have a better idea of how you want to use your computer. Return to this section when you're ready to set up your RAM drive.

If you already know how you want to divide up the memory, use the right and left arrow keys. The plus symbol indicates 8K increments of RAM allocated to the RAM drive. To increase RAM drive memory (and decrease working storage), press the Left Arrow key. The plus symbols increase from right to left. To decrease RAM drive memory (and increase working storage) press the Right Arrow key.

2. Managing Memory

Depending on how you bought your PHC-16, the amount of memory in your computer is one of the following:

    256K
    768K
   1280K

The first 640K of memory is called "main" memory. Anything over 640K is called "extended" memory. For practical purposes, both may be considered RAM, or "working storage."

You'll see two lines across the middle of your screen. One is made of squares and the other is made of diamonds. Each square indicates 8K of main memory and each diamond indicates 8K of expanded memory. As you allocate RAM to a RAM drive, these squares or diamonds will be replaced by plus symbols, and the amounts of memory allocated will be displayed on the summary lines below.

You can, and certainly will want to, reserve some RAM for a RAM drive. The RAM drive turns your PHC-16 into a much more versatile, two-drive computer.

If you have the standard 256K of memory, however, you must manage
your memory carefully. With 256K, the maximum size your RAM
drive can be is 192K.   This is less than your diskette drive
(360K) and only leaves 64K for working storage--too little for
most software available today.

Increasing memory to 768K or 1280K gives ample RAM for a full RAM
drive and enough working storage to run the larger and more
complex software appearing on the market.

If you have ample memory for a full 360K RAM drive, you probably
will want to turn switch SW2-1 ON so that your full 360K RAM
drive will automatically be allocated every time you start up.
With this switch ON, you´ll see this memory allocation
screen briefly when you start up, but you won´t be able to change
the RAM drive memory allocation.

Another feature you´ll want to use if you have enough memory is
reserved memory. Turning switch SW2-5 ON will reserve 24K of
RAM to save your screen so that when you return from using a CTRL
Left Shift feature, your screen will be as you left it.
Otherwise, you return to a blank screen. PHC-16 uses part of
the 24K as a data buffer for the remote (dumb) terminal mode.
With this switch ON, the three rightmost squares or diamonds on
the screen will be replaced with three pyramid symbols, and the
reserved memory line will read 24K. These CTRL Left Shift key
functions are explained fully in the next chapter.

3. Ready to Go

When you´re through partitioning memory, make sure your DOS
diskette (or any bootable application software diskette) is in
the physical drive and press ENTER. DOS loads, responds with
copyright information and the date and time, and displays the A>
prompt. Remove the DOS diskette, insert your favorite software,
and begin

CHAPTER 2

Customizing Your PHC-16

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Chapter 2 Customizing Your PHC-16
=======================================
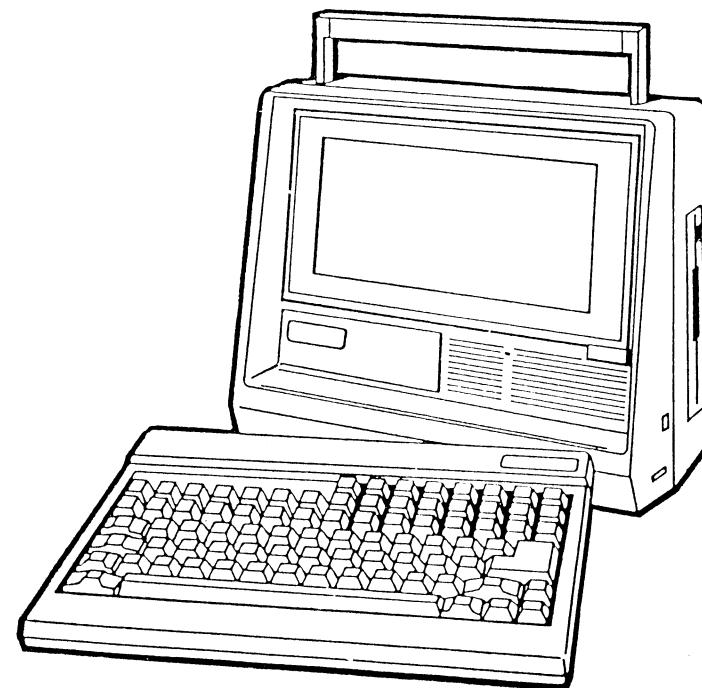
PHC-16 lets you tailor your computer to your own needs, through
switches (also called DIP switches) and features used by pressing
the CTRL key, the Left Shift key, and another key, all at the
same time. Switches are also used to tell PHC-16 what optional
equipment you have installed.

This chapter explains the switch settings and the customizing
features available.

A. Help When You Need It

PHC-16 offers a unique help (teach) screen that gives a summary
of all the customizing features and a diagram of the factory switch
settings.

To see this help screen, press the CTRL, Left Shift, and T (for
Teach) keys at the same time. The following screen appears.

```
                         SW1-1 OFF┐        OFF┐         ON ┐
        S W 1            SW1-2 ON  ├256K RAM OFF┤512K RAM ON ┤640K RAM OR MORE
                         SW1-3 ON  ┘        ON ┘         OFF┘
   1 2 3 4 5 6 7 8   ON  SW1-4 ON=NO 8087 COPROCESSOR INSTALLED
                         SW1-5 ON┐ NO         OFF┐40x25    ON ┐80x25  OFF┐80x25
   ↓ ↑ ↑ ↑ ↑ ↑ ↓ ↑   OFF SW1-6 ON┘ MONITOR   ON ┘COLOR    OFF┘COLOR  OFF┘B/W
                         SW1-7 ON┐ 1 DISK     OFF┐2 DISK   ON ┐3 DISK OFF┐4 DISK
        S W 2            SW1-8 ON┘ DRIVE      ON ┘DRIVES   OFF┘DRIVES OFF┘DRIVES
                         SW2-1 ON=AUTO BOOT MAXIMUM RAM DISK [360K OR 720K MAX]
   1 2 3 4 5 6 7 8       SW2-2 ON=MAKE RAM DISK ACTIVE
                     ON  SW2-3 ON=DO ROM AND RAM CHECKS [USE OF LCD IS FORCED]
   ↓ ↑ ↓ ↓ ↑ ↓ ↓ ↓       SW2-4 ON=USE EXTERNAL VIDEO CARDS IN EXPANSION I/O UNIT
                     OFF SW2-5 ON=KEEP 24K OF HIGH RAM FOR CTRL-L SHIFT FUNCTIONS
                         SW2-6 ON=720K RAM DISK FORMAT, OFF=360K RAM DISK FORMAT
        S W 3            SW2-7 --- RESERVED
                         SW2-8 --- RESERVED
   1 2 3 4 5 6 7 8       SW3-1 --- RESERVED
                     ON  SW3-2 ON=ENABLE POWER SAVING MODE ON FLOPPY DISK DRIVE
   ↑ ↑ ↓ ↑ ↑ ↑ ↑ ↑       SW3-3 ON=2ND FLOPPY DISK DRIVE IS INTERNAL
                     OFF SW3-4 ON=INTERNAL VIDEO RAM IS BEING USED [B8000-BFFFF]
                         SW3-5 ON┐ USA  OFF┐TYPE 2 ON ┐TYPE 3 OFF┐TYPE 4
DIP SWITCH SETTINGS      SW3-6 ON┘ FONT ON ┘FONT   OFF┘FONT   OFF┘FONT
                         SW3-7 ON=INTERNAL RAM USED [40000-7FFFF], OFF=EXTERNAL
FACTORY SETTING          SW3-8 ON=INTERNAL RAM USED [80000-AFFFF], OFF=EXTERNAL
[FOR 256K UNIT]               ------ PRESS ANY KEY TO CONTINUE ------
```

Press any key to display the second screen:

```
+-----------------------------------------------------------------+
|      HOW TO USE THE CTRL KEY WITH THE LEFT SHIFT KEY TO ALTER THE SYSTEM |
|                                                                 |
| CTRL LEFT_SHIFT     T     TO TEACH HOW TO SETUP AND USE THE COMPUTER     |
| CTRL LEFT_SHIFT + and - TO INCREASE AND DECREASE KEYBOARD AUDIO FEEDBACK |
| CTRL LEFT_SHIFT     D     TO SWAP DRIVE A: TO DRIVE B: [AND BACK AGAIN]  |
| CTRL LEFT_SHIFT     S     TO CHANGE THE LCD COLOR PALETTE ON THE SCREEN  |
| CTRL LEFT_SHIFT     I     TO INVERT THE BLACK/WHITE ON THE LCD           |
| CTRL LEFT_SHIFT     C     TO TOGGLE BETWEEN UNDERLINE AND BLOCK CURSORS  |
| CTRL LEFT_SHIFT     W     TO SEE THE WORLD CLOCK                         |
| CTRL LEFT_SHIFT     R     TO ACTIVATE THE REMOTE TERMINAL MODE           |
| CTRL LEFT_SHIFT  ↑  5  ↓  TO INCREASE, PRESET, OR DECREASE SCREEN CONTRAST |
| CTRL LEFT_SHIFT  9 6 3 [IN THE KEYPAD] FOR BACKLIGHT UP, MIDDLE, DOWN    |
| CTRL LEFT_SHIFT     O     TO TOGGLE BACKLIGHT ON/OFF                     |
| CTRL LEFT_SHIFT     M     TO SELECT THE LCD OR EXTERNAL MONITOR DISPLAY  |
| CTRL LEFT_SHIFT     B     TO CHECK THE BATTERY LEVEL                     |
|                                                                 |
|                   --- PRESS ANY KEY TO RETURN ---               |
+-----------------------------------------------------------------+
```

This screen provides:

  *   a summary of all the customizing features discussed in
       the previous section.

  *   a diagram of all the switches and a list of what each
       switch does.

You can see this screen whenever you want, even if you are using
application software. When you are through using the help
screen, press ENTER.

Caution: The switch settings shown on this screen are FACTORY
SETTINGS. They may not match the actual settings of your
switches. To see the actual settings, remove the cover from the
modem compartment and look at the switches. Your actual settings
will be displayed.

B. Switches

There are three switch blocks, each containing eight slider
switches, located in the modem compartment on the left side of
the computer. Remove the cover to see the switches:

These switches are set at the factory, and won't need to be
changed if you're just starting to use your PHC-16. After you
become familiar with your PHC-16 and want to tailor it to your
needs, or to add options, you may want to change some settings.

To change a switch, use a pencil, ballpoint pen, bent paper clip,
or other pointed object. Always move the switch gently, sliding
it up for ON or down for OFF.

The rest of this section shows the factory settings for each
switch block, and explains what each switch does.

Switch Block 1

```
+-------------------------------------------------------+
|   +---------------------------+                        |
|   | 1 2 3 4 5 6 7 8 |   OFF                            |
|   | ↓ ↑ ↑ ↑ ↑ ↓ ↑ ↑ |          [Factory setting]       |
|   +---------------------------+   ON                   |
+-------------------------------------------------------+
```

A. MEMORY INSTALLED
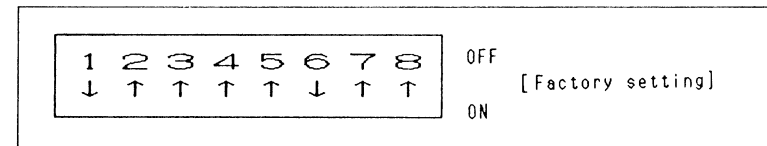
                           640K
SWITCH   256K   512K   or More

SWITCH	256K	512K	640K or More
1	OFF	OFF	ON
2	ON	OFF	ON
3	ON	ON	OFF

B. COPROCESSOR INSTALLED?

SWITCH	YES	NO
4	OFF	ON

C. MONITOR TYPE & INITIAL SET-UP MODE

SWITCH	NONE	COLOR 40x25	COLOR 80x25	MONO 80X25
5	ON	OFF	ON	OFF
6	ON	ON	OFF	OFF

D. NUMBER OF PHYSICAL DRIVES INSTALLED

SWITCH	1	2	3*	4*
7	ON	OFF	ON	OFF
8	ON	ON	OFF	OFF

(* Not available at this time)

Switch Block 2

```
 _____
|  _____     |
| | 1 2 3 4 5 6 7 8 |  OFF          |
| | ↓ ↑ ↓ ↓ ↑ ↓ ↑ ↑ |      [Factory setting]
| |_____|  ON          |
|_____|
```
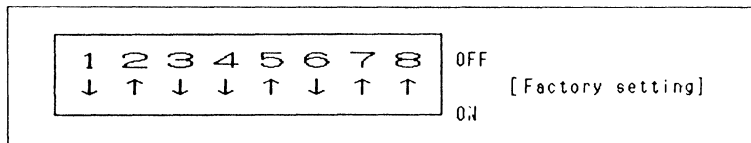
SWITCH	ON	OFF
1	Automatically take maximum RAM for RAM drive (up to 360K)	Display memory allocation screen on start up for manual allocation.
2	Allow RAM drive to be used.	Turn RAM drive OFF.
3	Do ROM & RAM check during start up and display on LCD.	Skip ROM & RAM checking during start up (saves time).
4	Use external video cards in the expansion unit.	Use monitor through PHC-16 LCD or RGB & composite jacks.
5	Keep 24K of high RAM to save last screen while performing CTRL-Left Shift features.	Do not reserve RAM. Return from CTRL-Left Shift features to a blank screen.
6	720K RAM drive format *	360K RAM drive format.
7	Not used	
8	Not used	

(* Not available at this time)

Switch Block 3

```
 _____
|  _____             |
| | 1 2 3 4 5 6 7 8 |  OFF                  |
| | ↑ ↑ ↓ ↑ ↑ ↑ ↑ ↑ |        [Factory setting]
| |_____|  ON                  |
|_____|
```
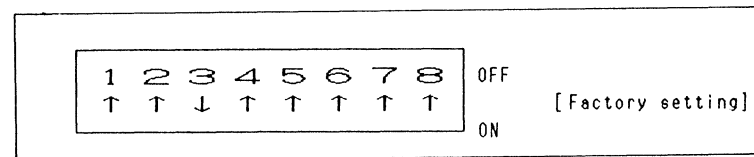
SWITCH	ON	OFF
1	Not used	
2	Only supplies power to physical drive when needed. Saves battery power.	Supplies power to physical drive all the time. May be required for some software.
3	Second physical drive is internal.*	Second physical drive is external.
4	Internal video RAM is being used.	Internal video RAM is not being used (external must be available).

FONT SELECTION

	USA	TYPE 2	TYPE 3*	TYPE 4*
5	ON	OFF	ON	OFF
6	ON	ON	OFF	OFF

SWITCH	ON	OFF
7	First optional bank of internal RAM is being used.	External RAM is being used instead.
8	Second optional bank of internal RAM is being used.	External RAM is being used instead.

(* Not available at this time)

C. Audio Feedback

Audio feedback is a beep that sounds whenever you press a key. You can vary the volume of the beep from a clearly audible sound to none at all. To adjust the audio feedback follow these steps:

1. Press the CTRL, Left Shift, and Plus Sign keys at the same time and hold them down.

2. You can hear a beep sound that increases in volume as you hold the three keys down.

3. Release all three keys and press any of the keys on your keyboard. The beep you hear is called the audio feedback. If you decide you don't like this feedback, you can decrease the sound again.

4. To decrease or eliminate the audio feedback, repeat the
    steps above except press the key marked with a minus
    sign (-) instead of the plus sign. In other words,
    press the CTRL, Left Shift, and the minus (-) keys at
    the same time. The beep decreases. Release the keys
    when the feedback reaches the volume you want.

To Increase Beep   To Decrease Beep

This audio feedback adjustment works any time you are using
PHC-16, no matter what kind of software you are using. The
audio feedback setting is stored in the PHC-16 and remains the
same until you change it.

D. Screen Adjustments

1. LCD Palette

There are six LCD palettes, or settings, for character intensity.
Application software displays different shades and intensities
depending on how it's programmed and the characteristics of the
monitor used. The palette adjustment lets you select the best
display for your PHC-16 LCD screen. Keep pressing CTRL, Left
Shift, and S to cycle through the palettes until you find the
best one for your software.
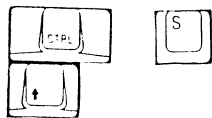
2. Screen Contrast

You can also adjust the contrast on your screen. Press
the CTRL, Left Shift, and Up Arrow keys at the same time to
increase the contrast. Press the CTRL, Left Shift, and Down
Arrow keys at the same time to decrease the contrast. Press the
CTRL, Left Shift, and 5 (on the numeric keypad) keys at the same
time to return to the default (middle) setting.
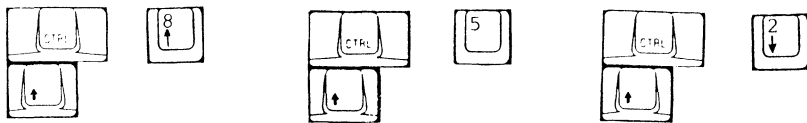
You can also adjust the screen contrast. Press the CTRL, Left Shift
the numeric pad 9keye at the same time to increase the contrast. Pr
the CTRL, Left Shift, and the numeric pad 3keys at the same time to
decrease the contrast. Press the CTRL, Left Shift, and the numeric
6keys at the same time to return to the default (middle) setting.
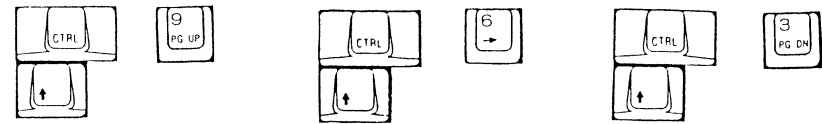
To turn the back-light completely on or off, press the CTRL, Left S
and the numeric pad 0keys at thesame time. Every time you press thi
combination, the back-light will switch from being on to being off
being on again.
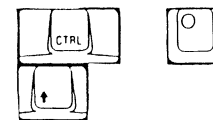
3. Inverse Video

Press the CTRL, Left Shift, and I keys at the same time to switch
dark and light on your screen. This is called inverse video.
Press these same keys again to switch it back.
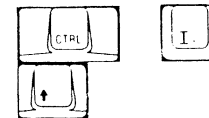
4. Cursor Shape

Press the CTRL, Left Shift, and C keys at the same time to change
the cursor from a blinking line to a blinking block. Press these
keys again to change the cursor back to a line.
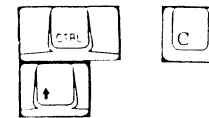
E. World Clock

The World Clock lets you select and display, besides Greenwich
Mean Time (GMT), any 23 cities or locations in the world with
their current date and 24-hour time.

You choose and set your home time zone date and time, and define all locations as a plus or minus difference from GMT. Choose locations which are meaningful for you, such as places you do business, or where friends or relatives live. You must make any adjustments for Daylight Savings time changes. The year is given as four digits to allow for use into the 21st century.
Press the CTRL, Left Shift, and W keys at the same time to display the world clock screen. For example:

```
 _____        _____
|  CTR  |      |   W   |
|_____|      |_____|
 _____
|   ↑   |
|_____|
```

```
 ---------------------------------------------------------------------------
|                                                                           |
|      [GMT]                  DATE:  1-01-1986   TIME:   1:00:00             |
|      LONDON                 DATE:  1-01-1986   TIME:   1:00:00             |
|      PARIS                  DATE:  1-01-1986   TIME:   2:00:00             |
|      CAIRO                  DATE:  1-01-1986   TIME:   3:00:00             |
|      MOSCOW                 DATE:  1-01-1986   TIME:   4:00:00             |
|      MAURITIUS              DATE:  1-01-1986   TIME:   5:00:00             |
|      KARACHI                DATE:  1-01-1986   TIME:   6:00:00             |
|      BOMBAY                 DATE:  1-01-1986   TIME:   6:30:00             |
|      DACCA                  DATE:  1-01-1986   TIME:   7:00:00             |
|      BANGKOK                DATE:  1-01-1986   TIME:   8:00:00             |
|      PEKING                 DATE:  1-01-1986   TIME:   9:00:00             |
|      YOKOHAMA               DATE:  1-01-1986   TIME:  10:00:00             |
|      MELBOURNE              DATE:  1-01-1986   TIME:  11:00:00             |
|      KURIL ISLANDS          DATE:  1-01-1986   TIME:  12:00:00             |
|      AUCKLAND               DATE:  1-01-1986   TIME:  13:00:00             |
|      SAMOA                  DATE: 12-31-1985   TIME:  14:00:00             |
|      HONOLULU               DATE: 12-31-1985   TIME:  15:00:00             |
|      ANCHORAGE              DATE: 12-31-1985   TIME:  16:00:00             |
|      SAN FRANCISCO          DATE: 12-31-1985   TIME:  17:00:00             |
|      DENVER                 DATE: 12-31-1985   TIME:  18:00:00             |
|      CHICAGO                DATE: 12-31-1985   TIME:  19:00:00             |
|      ATLANTA                DATE: 12-31-1985   TIME:  20:00:00             |
|      BERMUDA                DATE: 12-31-1985   TIME:  21:00:00             |
|      RIO DE JANEIRO         DATE: 12-31-1985   TIME:  22:00:00             |
|  PRESS  ESC  TO RETURN,  ↑ OR ↓ TO ALTER THE HOME TIME ZONE,  S TO SET THE CLOCK |
 ---------------------------------------------------------------------------
```

Press ESC to return where you were. Press the Up or Down Arrow keys to change the home location, indicated by the reverse video bar.

To change the time or locations, press S and this screen appears:

```
 ---------------------------------------------------------------------------
|                                                                           |
|   [GMT]           + 0:00         MENU FOR SETTING THE WORLD CLOCK         |
|   LONDON          + 0:00                                                  |
|   PARIS           + 1:00                                                  |
|   CAIRO           + 2:00                                                  |
|   MOSCOW          + 3:00            DATE: 12-31-1985   TIME: 20:00:00     |
|   MAURITIUS       + 4:00                                                  |
|   KARACHI         + 5:00                                                  |
|   BOMBAY          + 5:30                                                  |
|   DACCA           + 6:00    ESC.......RETURNS TO THE WORLD CLOCK          |
|   BANGKOK         + 7:00                                                  |
|   PEKING          + 8:00    F1........MOVES TO THE NEXT SECTION           |
|   YOKOHAMA        + 9:00                                                  |
|   MELBOURNE       +10:00    ← AND →....ALTER VALUES                       |
|   KURIL ISLANDS   +11:00                                                  |
|   AUCKLAND        +12:00    RETURN.....MOVES TO THE NEXT ITEM FOR UPDATING|
|   SAMOA           -11:00                                                  |
|   HONOLULU        -10:00    F10.......RESETS ALL PARAMETERS TO THE DEFAULT VALUES |
|   ANCHORAGE       - 9:00                                                  |
|   SAN FRANCISCO   - 8:00                                                  |
|   DENVER          - 7:00                                                  |
|   CHICAGO         - 6:00                                                  |
|   ATLANTA         - 5:00    RESET HOME TIME ZONE DATE AND TIME            |
|   BERMUDA         - 4:00    REDEFINE CITY NAMES                           |
|   RIO DE JANEIRO  - 3:00    REDEFINE TIME DIFFERENCE FROM GMT [TOP CLOCK POSITION] |
 ---------------------------------------------------------------------------
```
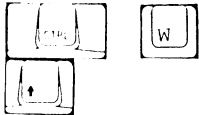
Press F1 to cycle through the three things you can change. These are listed at the bottom right of the screen, and the active one is highlighted:

    Reset home time zone date and time.
    Redefine city names
    Redefine time difference from GMT

As you cycle through this list, the cursor moves to the information to be changed.

Use the Right and Left Arrow keys to change numeric values; type in the location name. Press ENTER to move to the next item to update.

If you want to return all items to the default values, press the F10 key.

Press ESC to return to the World Clock display.

F. Using PHC-16 as a Remote (Dumb) Terminal

The PHC-16 can be used as a remote, or "dumb" terminal, to communicate with:

    *   A data retrieval service, such as the Source.
    *   A mainframe computer.
    *   Another PHC-16 or other microcomputer.

You must add the optional internal modem or an external modem plugged into the serial port. If you communicate with another PHC-16 or compatible computer using a cable and not telephone lines, you don't need a modem.

Press the CTRL, Left Shift, and R keys at the same time to display the Remote Terminal screen:

```
 ----------------------------------------------------------------------------
|                                                                            |
|   COPY TO PRINTER OFF                                                       |
|                                                                            |
|    BAUD      PARITY    STOP     WORD      SERIAL     LF+CR FOR     COPY OUTPUT |
|    RATE                BIT(S)   LENGTH    PORT       RECEIVED DATA  TO SCREEN |
|                                                                            |
|    1200      NONE       1       8 BITS    COM2:         YES           YES   |
|                                                                            |
|          PRESS  ← OR  →  TO CHOOSE PARAMETERS FOR SETTING                   |
|          PRESS THE SPACEBAR TO CHANGE THE PARAMETERS                        |
|          PRESS THE  RETURN KEY TO START COMMUNICATIONS                      |
|          PRESS THE    P   KEY TO TOGGLE COPY TO THE PRINTER ON/OFF          |
|                                                                            |
|          PRESS THE    F1   KEY TO EXIT THIS PROGRAM AND NOT HANG UP         |
|          PRESS THE    F2   KEY TO EXIT THIS PROGRAM AND HANG UP             |
|          PRESS THE   F10   KEY TO SEND A BREAK CODE                         |
|                                                                            |
|               [COMMONLY USED VALUES ARE:]                                   |
|                                                                            |
|    BAUD      PARITY    STOP     WORD      SERIAL     LF+CR FOR     COPY OUTPUT |
|    RATE                BIT(S)   LENGTH    PORT       RECEIVED DATA  TO SCREEN |
|    1200      NONE       1       8 BITS    COM2:         YES           YES   |
 ----------------------------------------------------------------------------
```

Press the Right or Left Arrow keys to choose the parameter you want to change.

Press the Spacebar to cycle through the options available for each parameter:

OPTION	VALUES
Baud Rate	110
	150
	300
	600
	1200
	2400
	4800
	9600
Parity	Odd
	Even
	None
Stop Bit(s)	1
	2
Word Length	7 bits
	8 bits
Serial Port	COM1:
	COM2:
LF+CR for Received Data	Yes
	No
Copy Output to Screen	Yes
	No

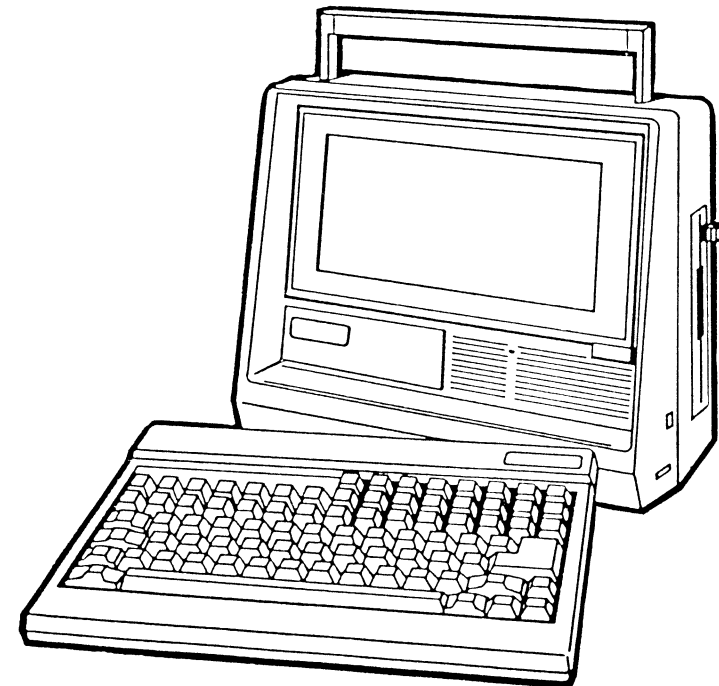Press P at any time to send copy to the printer, or not to.

Press ENTER to start communications.

To exit the Remote Terminal, press F2 to exit and hang up, or F1 to exit and not hang up. Press F10 to send a break code.

The option you choose for each parameter is stored in the computer for you and remains the same until you change it.

CHAPTER 3

Traveling With PHC-16

PHC-16 is a good traveling companion. With the optional battery power pack installed, it weighs only 14 pounds and is small enough to take almost anywhere.

In addition, the optional built-in modem (see Chapter 6: Options) lets you stay in touch with other computers when you are on the road.

This section gives you a few suggestions and cautions to make traveling with the PHC-16 easy and efficient.

A. Carrying Case

When you´re on the go with PHC-16, the optional carrying case provides protection for the computer and makes it easier for you to carry.

The convenient shoulder strap leaves your hands free. Also, the carrying case is designed with an outside pocket to carry batteries or other equipment securely.

B. The Battery Pack

A battery power pack can be purchased as an option for PHC-16. It is installed exactly the same way as the AC power pack.

Caution: Be sure to recharge the battery as soon as the red LED light flashes. If the battery discharges totally, you will not be able to fully recharge it again.

To recharge the battery power pack, use the charger adapter clip that comes with the battery power pack and the AC power pack that comes standard with PHC-16. The charger adapter clip connects the battery pack to the AC power pack.

You can fully recharge the battery while in the PHC-16 only when the computer is turned off.

To recharge the battery pack while it is in the computer, follow these steps:

> 1.   Put the battery pack in the PHC-16 exactly the same way as the AC power pack.
>
> 2.   Plug one end of the Charger Clip into the computer on the side to the right of the screen. Clip the other end onto the AC power pack.
>
> 3.   Plug the AC power pack into an electrical outlet.

While the battery pack is in the computer, charge it this way.

Charge Clip
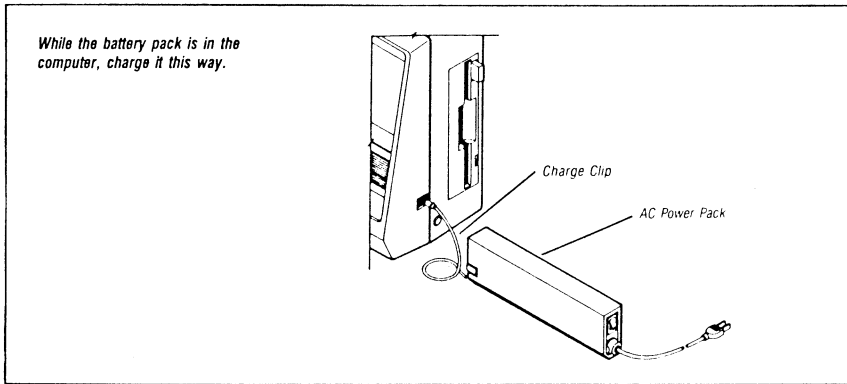
AC Power Pack

When the battery power pack is not in the PHC-16 follow these steps to recharge the battery:

1. Put the clip on the battery and plug the other end of the clip into the AC power pack.
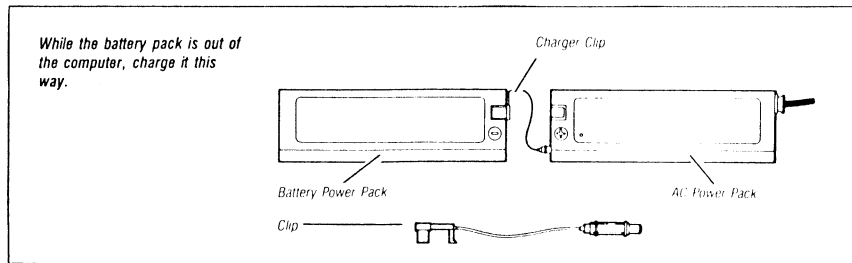
2. Plug the AC Power Pack into an electrical outlet.

While the battery pack is out of the computer, charge it this way.

Charger Clip

Battery Power Pack

AC Power Pack

Clip

It takes about three hours to recharge the battery pack. If you are recharging the battery while it's in the PHC-16, you can charge to only 85% of capacity. It is best to let the battery discharge to 10-15% of power capacity frequently before recharging.

C. Battery Indicator

Immediately under the LCD screen is a small red indicator light. The light begins to blink when the battery is low. Press the CTRL, Left Shift, and B keys at the same time to see the percentage of power capacity remaining.

There are two ways to keep your data safe as power declines:

*   Plug the AC adapter or auto adapter into a power source and the charge clip into the side of the computer. Operate in this manner or exchange the discharged battery for a fully charged battery and disconnect the adapter.

             OR:

*   Save your data, turn the computer off and insert a new battery.

D. Traveling Hints and Suggestions

*   When traveling with PHC-16 or moving it, always insert the white cardboard protector in the physical drive. This protects the physical drive from any damage.

    Or, insert a scratch diskette turned 90 degrees.

*   When you travel by plane, carry PHC-16 with you. NEVER CHECK IT IN BAGGAGE CLAIM!

*   Don't leave PHC-16 in a parked car for long periods if the temperature is either very hot or very cold. The screen display may not work if it has been in extreme temperatures. If this happens, let the computer return to normal room temperature (which might take about an hour) before using it.

*   If you need to ship PHC-16, pack it in the box that it came from the factory in, if possible.

*   Dropping the PHC-16 or hitting it sharply may damage the LCD screen or physical drive alignment. Your warranty will not cover abuse.

CHAPTER 4

Operations
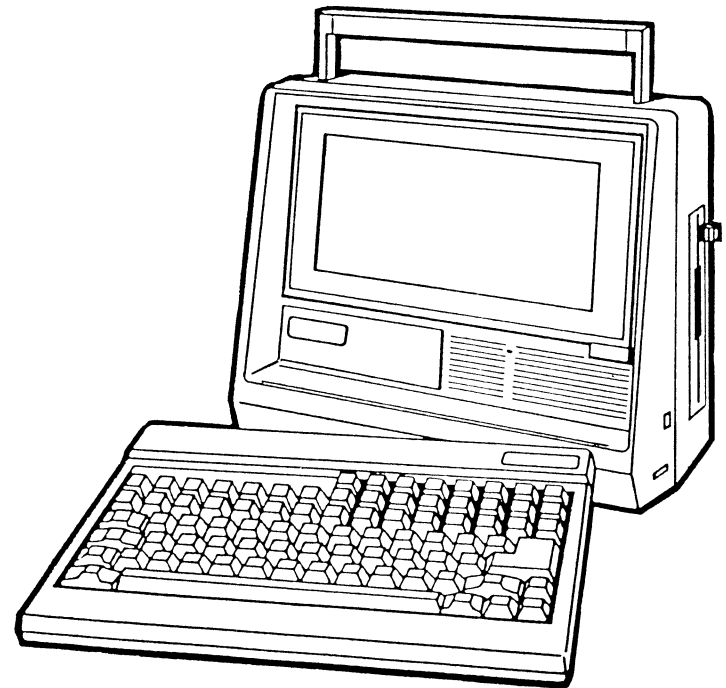
```
========================
CHAPTER 4:  OPERATIONS
========================
```

A. Using DOS

1. What is DOS?

In Chapter 1 you learned about how data is stored in your
PHC-16. From your viewpoint, your data is handled quickly and
efficiently. However, keeping track of hundreds of thousands of
characters is no easy task. The operating system must manage both
data and data transfer in the computer.

Your PHC-16 uses Microsoft Corporation's Disk Operating System,
which is also called MS-DOS, or just DOS, for short. DOS consists
of several programs which allow you to manage your data and to
run software written for the MS-DOS Operating System.

2. Inserting the DOS Diskette

Before you begin to use your PHC-16, you must load DOS into
internal memory. Remove the DOS diskette from your DOS manual,
and insert it in the physical drive with the notch up and the
label facing backward. Notice that the DOS diskette has no write
protect notch. This keeps it from being written over and
destroyed.

Slide the diskette into the disk drive until it clicks. Then press the little square button until it clicks.
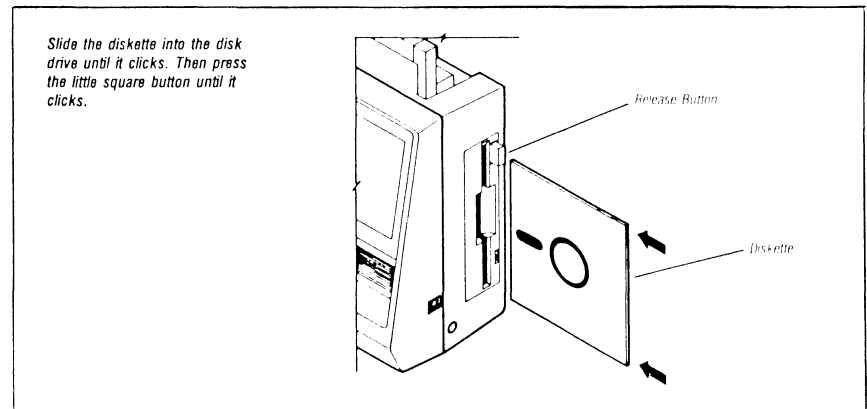
Turn the power on and DOS will load into internal memory. This is
called starting the computer. It is also called booting.
Starting with the computer turned off is called a cold boot.
Pressing the reset button performs a cold boot without having to
turn the on/off switch OFF and ON again. During a cold boot, all
data in RAM, which includes working storage and the RAM drive, is
lost.

You may, at any time, restart with the computer running by

pressing CTRL, ALT and DEL simultaneously. This is called a warm boot. Caution: restart only when necessary because you will loose any data in working storage; you will not, however, loose any data in the RAM drive.

After a few seconds, DOS loads and displays the date and time. DOS takes these from the PHC-16 internal clock. If you want to change the date and time, change them through the World Clock, or using the Clock Tests option from the Diagnostics diskette. You can't change them in DOS.

DOS displays this prompt:

A>

This is called the A prompt. It means that Drive A (your physical drive) is the drive that DOS will read from or write to. This is called the default drive because DOS will work from Drive A unless you tell it otherwise.

The ">" in the prompt means that DOS is waiting for you to enter a command or file name following the >.

You may change the default drive from the physical drive to the RAM drive. At the A>, type B: and press ENTER. DOS will then display the B prompt:

B>

This means that DOS will read from and write to the RAM drive, until instructed otherwise.

You'll learn more about why this is useful later in the chapter under DOS Commands.

CAUTION: Before you continue to work with DOS, make a working, or backup, copy. Then, if you accidently damage your diskette, your DOS master will still be intact. See the section "Making a Backup Copy of Your DOS Diskette" toward the end of this chapter for step-by-step instructions.

B. About the DOS keyboard

Usually you will use the standard keyboard functions for DOS that you learned about in Chapter 1. This includes the keys for letters, numbers and special characters. DOS doesn't differentiate between upper or lower case letters for commands and file names, so you may use either and get the same results.

Here are some of the special keys you will use with DOS. See your DOS manual for a complete list.

ENTER	Press ENTER when you finish typing a line (such as a command) and want to send it to DOS.
backspace	This key will erase what you have typed, one character at a time, by moving the cursor left over what you typed.
ESC	When you make an error while typing a response, press ESCape to cancel the line and start over. DOS will display a / on the canceled line and go to a new line for your response.
CTRL and NUM LOCK	Use these keys to stop the screen from scrolling the file when using the TYPE command.
Right Shift and PRT SC	Press these keys at the same time to print whatever text is displaying on the screen. Your printer must be connected to your PHC-16, turned on, and on-line. This DOS function will work with many application software programs too.
CTRL and BREAK	Press these keys at the same time to end the current operation and return you to the A>.

C. Summary of DOS Commands

Earlier in this chapter you learned that DOS is a data manager. DOS organizes data into files. You name the file, and DOS assigns storage space in memory or on a diskette.

DOS organizes your data in a way similar to the way you would organize data in a filing cabinet. Each drawer contains file folders that contain your data--sometimes a page or two, and sometimes many pages. You organize the folders in some logical way, and label each file folder and file drawer so you can find your data easily.

DOS puts your data into computer files and stores them in a logical fashion either in memory or on a diskette. DOS maintains a directory on each so it can easily retrieve your data.

Every file must have a name. On a diskette, or in memory, no two files can have the same name. Two files may have the same name, however, if they are on different diskettes, or on one diskette and in memory. In your file cabinet, for example, two files called "miscellaneous" would be OK if one were in the drawer for household expenses, and another was in the drawer for business expenses. If they were in the same drawer, however, you couldn't tell them apart.

The name you give to a file in DOS must follow this format:

        xxxxxxxx.yyy

where xxxxxxxx is the filename from 1-8 characters, and
      yyy   is the extension from 1-3 characters.

The filename and extension may consist of

o the letters of the alphabet
o the numbers 0 through 9
o these special characters: $ & @ ! % ( ) - { } _

The filename and extension may not contain blanks and must be
separated by a period. For example, NEW-MEMO.DOC is valid while
NEW MEMO DOC is not.

1. DOS Commands

Although your DOS manual discusses the DOS commands in detail,
here are some of the common commands that you'll use often:

FORMAT - sets up a diskette so it is ready to receive files.

DIR - list all the files on a diskette or on the RAM disk.

DISKCOPY and COPY - copy a file or files from one location to another.

ERASE - erases a file or files from a diskette or the RAM disk.

TYPE - displays the contents of a file on your screen.

The following pages briefly describe how to use these commands.
Options are shown in brackets. These options are not required,
but provide flexibility in using the commands. Only the most
commonly used options are discussed; see your DOS manual for a
complete description.

Although the names of the commands are printed here in caps so
they stand out on the page, you may type them in either upper or
lower case letters. Options are shown in brackets to indicate
they are not required. When you type the command, do not enclose
the options in brackets! Leave a space between the command and
options, but don't leave spaces between options. Finally, after
you type the command and options, be sure to press ENTER.

When you use a file name with a command, you may specify a
specific file, or you may specify a series of files by
substituting a special character for all or a portion of the
filename and extension. These special characters are called
wildcards. The most commonly used wildcard is the asterisk (*).
You'll see how to use this character in the next few pages.

FORMAT

Before you can use a diskette, DOS must divide it into sectors
and tracks, and set up a directory so it can find the files it
writes on the diskette. The FORMAT command tells DOS to do this.
The FORMAT command must be in this form:

FORMAT [d:][/S][/8][/V][/B]

Everything in brackets is optional, but allows you several
options in formatting. Here's what they mean:

    d: Drive designation of the diskette you want
                formatted. With a one-drive system, this will
                always be A (the RAM drive is formatted
                automatically). Leave this option out if you are
                working from the A>.

    /S   This option will copy the system files (the files
                DOS uses to start your PHC-16) onto the formatted
                diskette. This is very helpful when you are using
                application software, like a word processor. If
                you copy the application programs onto a diskette
                formatted with the system files, the diskette
                becomes self-starting. This means that you don't
                have to start with the DOS diskette and then take
                the DOS diskette out and put the application
                diskette in, because everything you need will be
                on the same diskette.

    /8 or /B   If you don't use these options, DOS will format
                the diskette with 9 sectors, or 360K total
                capacity. However, if you tried to use these disks
                with DOS 1.0 or 1.1, these earlier versions of DOS
                couldn't read the diskette. Using /8 or /B tells
                DOS to format the diskette with only 8 sectors.
                This limits storage capacity to 320K, but allows
                the diskette to be read by any version of DOS.

    /V   This option allows you to enter an 11-character
                volume name for the diskette, providing you format
                the diskette for 9 sectors.

For example, entering, at the A>, FORMAT /S/B will format a
diskette with eight sectors and will contain the system files.

DIR

The DIR or directory command displays the names of all the files
stored on a diskette or on the RAM drive. The DIR command has
several handy options:

DIR [d:][filename[.ext]][/W]

Typing DIR alone lists all the file names on the diskette or on
the RAM drive, in a single column.

     d: specifies a drive other than the default drive.

    filename [.ext] allows you to display specific file names,
                    or, by using a wildcard, specific groups of
                    file names. For example, DIR *.BAS would
                    list all file names with an extension of BAS,
                    and DIR JAN*.* would list all file names
                    starting with JAN.

    /W   lists all file names in five columns across
                    the screen. This lets you display a large
                    directory on a single screen.

DISKCOPY and COPY

These commands copy files from one location to another. With a
PHC-16 with one physical drive, you can copy from a diskette to
a diskette, from a diskette to the RAM drive, or from the RAM
drive to a diskette.

Copying is one of the most frequently performed tasks you will do
with DOS. Backing up your data and your application programs is
critical. Your data is always subject to accidental loss, and
diskettes may be damaged and eventually will wear out.

Copying files also allows you to keep one copy of a data file as
a master file, and use another copy as a work file. And, copying
allows you to organize files on diskettes to meet your own individual
needs.

DISKCOPY copies the contents of one diskette (or the RAM drive) to
another diskette, exactly as they are on the first. Since
DISKCOPY formats as it copies, it erases all data on the diskette
(or RAM drive) you are copying to. Be careful!

Use DISKCOPY to backup your data files at the end of each work
session. When copying to the RAM Drive, you must have
allocated a full 360K to the RAM drive for DISKCOPY to work
properly. Use the format:

DISKCOPY [d:] [d:]

    d: d: The first d: is the drive you are copying from,
               or the source drive. The second d: is the
               drive you are copying to, or the target drive. If
               you are using Drive A for both, omit these options.

COPY copies one file, or using wildcards, a series of files, from
one diskette to another. Although there are many options that can
be used with COPY, the most commonly-used format is:

COPY [d:][filename[.ext]] [d:]

    d: is the drive you are copying from. Omit it if
               you are copying from the default drive.

    filename[.ext] is the name of the file you are copying. You
                    may name a specific file to be copied, such as
                    MEMO.DOC. You may select a series of files to be
                    copied, such as *.BAS (all files with the
                    extension of BAS). Or, you may copy all files by
                    using *.* as the filename and extension.

    d: is the drive you are copying to, or the
               target drive.

Using the COPY command can get complicated and confusing. If you
have any doubts about what you want to do, see your DOS manual
before you try it!

ERASE

ERASE (or DEL) removes files from your disk. The format is:

ERASE [d:][filename[.ext]]

    d: is the drive where the file you want to erase is
               located. Omit it, and DOS will look on the default
               drive.

    filename[.ext] is the name of the file you want to delete.
               As with other commands, you may use a wildcard to
               erase a series of files, but use extreme caution!
               For example, typing MEMO*.* will erase all memo
               files, but there may be a MEMO file you wanted to
               keep, and you may not realize it until it's too late.

TYPE

TYPE is a very useful command, because it displays the contents
of a file. Use the form:

TYPE [d:][filename[.ext]]

     d: is the drive on which the file is located.

     filename[.ext] is the name of the file you want to display.

The file scrolls from beginning to end automatically. Use the
CTRL and NUM LOCK keys together to stop the file from scrolling.
Press any key to continue.

A Final Word About DOS Commands

If you look at the directory of the DOS diskette, you'll see a
list of filenames that match the commands discussed in the
previous pages. These files contain programs that perform the
functions described under the commands.

DOS commands are of two types: resident and non-resident, or
external. When you start the system with the DOS diskette, some
of the commands, or program files, are loaded into memory. These
are called resident commands, because they reside in memory and
will run without having the DOS diskette in the physical drive,
or loaded onto the RAM drive. DIR, COPY, ERASE, and TYPE are all
resident commands.

Other DOS commands are called external because they are not in
memory and will run only if you have the DOS diskette in the
physical drive, or have the program file loaded into the RAM
drive. FORMAT and DISKCOPY are external commands.

D. Making a Backup Copy of DOS

Now that you have read about several DOS commands, you are ready
to use these commands to make a working, or backup, copy of your
DOS diskette. Follow these steps, and besides making a copy of
DOS, you can practice using the commands and see how DOS prompts
you to swap diskettes into and out of the physical drive.

Use the DISKCOPY command to copy your DOS diskette.

1. At the A>, type DISKCOPY.

2. DOS prompts you with this message:

     Insert source diskette in drive A:
     Strike any key when ready

3. The DOS diskette is the source diskette. Place it in the
   physical drive if it is not already there. Press any key.

4. DOS displays this message to let you know it's copying:

     Copying 2 side(s), 9 sectors per track

5. After a few seconds, DOS prompts you again:

     Insert destination diskette in drive A
     Strike any key when ready

6. Remove the DOS diskette from the physical drive, and insert a
   new diskette in the drive. The new diskette is the destination
   diskette. Press any key.

7. DOS displays another status message:

     Formatting target while copying

    Since you are using a new diskette, DOS must format it before
    copying files onto it.

8. After a few seconds, DOS prompts you again:

     Insert source diskette in drive A:
     Strike any key when ready

9. Remove the new diskette from the physical drive and insert
   the DOS diskette. Press any key.

10. After a few seconds, DOS prompts you again:

     Insert destination diskette in drive A
     Strike any key when ready

11. Remove the DOS diskette from the physical drive and insert
    the new diskette. Press any key.

12. After a few seconds, DOS finishes the DISKCOPY and displays this message:

        Copy complete

        Copy another disk (Y/N)?

13. Type n and DOS returns to the A>.

To make sure that the new diskette is good, compare the two diskettes with the DISKCOMP command:

1. At the A>, type DISKCOMP and press ENTER. DOS displays this prompt:

        Insert first diskette in drive A:
        Strike any key when ready

2. Insert the DOS diskette in the physical drive and press any key.

3. DOS displays this message:

        Comparing 2 side(s), 9 sectors per track

4. After a few seconds, DOS prompts you again:

        Insert second diskette in drive A:
        Strike any key when ready

5. Remove the DOS diskette from the physical drive and insert the new diskette. Press any key.

6. After a few seconds, DOS prompts you again:

        Insert first diskette in drive A:
        Strike any key when ready

7. Remove the new diskette from the physical drive and insert the DOS diskette. Press any key.

8. After a few seconds, DOS tells you that it's finished:

        Diskettes compare ok

        Compare another disk (Y/N)?

9. Type n and DOS returns to the A>.

This new diskette now becomes your Working Copy DOS diskette. Put the master DOS diskette back in the DOS manual and keep it in a safe place.

The DISKCOMP may find errors in certain tracks and sectors on your new diskette. If this happens, use the FORMAT command to reformat the new diskette. If DOS finds bad sectors, throw the diskette away and FORMAT a new diskette until you find one that formats without bad sectors. Then repeat the DISKCOPY and DISKCOMP steps above.

Making a Working Copy DOS diskette - Alternate Method

Another way to make a working copy of your DOS diskette is to use the RAM drive (full 360K) as an intermediate repository. This means you must first copy the DOS diskette to the RAM drive and then copy to the new diskette, but it reduces the diskette swapping required by only using the physical drive. Here's how it works:

1. At the A>, type DISKCOPY A: B: and press ENTER.

2. DOS prompts you with this message:

        Insert source diskette in drive A:
        Insert destination diskette in drive B:
        Strike any key when ready

3. Insert the DOS diskette in the physical drive and press any key.

4. DOS displays this message to let you know it's copying:

        Copying 2 side(s), 9 sectors per track

    When DOS finishes copying, it will display this message:

        Copy complete

        Copy another disk (Y/N)?

5. Type N and DOS returns to the A>.

6. Type B: and press ENTER to change the default drive to B.

7. At the B>, type DISKCOPY B: A: and press ENTER.

8. DOS prompts you with this message:

        Insert source diskette in drive B:
        Insert destination diskette in drive A:
        Strike any key when ready

9. Remove the DOS diskette from the physical drive, insert a new diskette, and press any key.

10. DOS displays this message to let you know it's copying:

    Copying 2 side(s), 9 sectors per track

    When DOS finishes, it displays this message:

    Copy complete

    Copy another disk (Y/N)?

11. Type N and DOS will return to the B>.

12. Type A: and press ENTER to change the default drive to A.

This completes the copying phase. Follow the DISKCOMP
instructions above to make sure your new working copy of DOS is
ok.

E. Using the RAM Drive

PHC-16 RAM drive works like a second physical drive, so you
have the versatility of a two-drive system. We suggest that, when
you run normal application programs, you follow these steps:

1. Load DOS into the PHC-16.
2. Remove the DOS diskette.
3. Put the application diskette in the physical drive.
4. Copy the programs into the RAM drive using COPY or DISKCOPY.
5. Remove the application diskette from the physical drive.
6. Put the data diskette in the physical drive.
7. Change the default drive designation to B, the RAM drive.
8. You are now ready to start.

This puts your application programs on the RAM drive where they
will run faster and allows the PHC-16 to read and write your
data to the diskette.

When you are asked for file names by the application program, be
sure to include the drive designation as part of the filename.
For example, suppose your word processor is in Drive B (the RAM
drive) and your data diskette is in Drive A (the physical drive.)
Your word processor asks you what file you want to edit. The file
you want is called MEMO.DOC and is on your data diskette. Type
A:MEMO.DOC.

Caution: Your application program may be copy-protected to
prevent piracy. This will usually prevent you from using the RAM
drive as we have just described. Always follow the installation
instructions that come with your application program.

F. Using BASIC (Not Included with PHC-16)

BASIC is a programming language that lets you write your own
programs. If you want to use BASIC to write programs, skip this
section and go directly to the optional Microsoft BASIC manual.

BASIC for the IBM and COMPAQ computers will not run on the
PHC-16. You must buy GWBASIC, Better BASIC, or some other
generic BASIC that does not depend on BIOS ROM code for
identification or support routines.

There will be times, however, when you may want to run BASIC
programs that are already written. This section introduces you to
BASIC and shows you how to load and run BASIC programs.

Caution: Before you begin using BASIC, be sure to make a back-up
or working copy of your BASIC diskette.

To use BASIC, start the PHC-16 with DOS. Remove the DOS diskette
from the physical drive and insert your working copy of the
BASIC diskette. At the A> prompt type BASICA and press ENTER. This
screen appears:

GW-BASIC 2.02
(C) Copyright Microsoft 1983, 1984
xxxxx Bytes free
OK

1LIST 2RUN< 3LOAD" 4SAVE" 5CONT<   6,"LPT1 7TRON< 8TROFF< 9KEY
0SCREEN

Notice that the DOS A> prompt no longer appears. BASIC has it's own
prompt to tell you it's ready for your response. The BASIC prompt
is OK with the cursor on the line below it. Make sure you begin
typing at the BASIC prompt.

Look at the numbers at the bottom of the screen. These numbers
correspond to the function keys, and show the BASIC commands that
are programmed for each function key. The only function keys you
need to load and run BASIC programs are F2 and F3, RUN and LOAD.

Remove the BASIC diskette from the physical drive and insert your
data diskette containing the BASIC program you want to run.
Suppose it's a game with the file name FUN.BAS. Before you can
run the program you must load it. At the BASIC prompt, type
LOAD"FUN and press ENTER. BASIC will load the program and
return to the BASIC prompt. Or, if you want to use the function
keys, at the BASIC prompt, press F3. BASIC will reply with
LOAD" and the cursor will be after the ". Type FUN and press
ENTER.

To run the program, type RUN and press ENTER or press F2.
BASIC will run your program. When you exit your program, BASIC
returns to the BASIC prompt.

When you are through using BASIC, put the BASIC diskette back in
the physical drive. Type SYSTEM at the BASIC prompt and press
ENTER. BASIC returns to the DOS A> prompt.

Some programs, especially games, use 40-column displays rather
than 80-column. When you exit the BASIC program and return to the
BASIC prompt, you may see a large OK and no function key commands
listed at the bottom of the screen. This means you are still in
the 40-column display mode. But you can continue to use BASIC
commands and function keys as with the BASIC screen, even though
the function key identifiers do not appear at the bottom of the
screen. If this happens, and you want to return to the BASIC
screen, insert the BASIC diskette in the physical drive, if it is
not already there, type SYSTEM and press ENTER to return to the
A> prompt, and type BASICA and press ENTER to reload BASIC.

For more information on BASIC, see your BASIC manual.

CHAPTER 5

Problem Solving

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Chapter 5 Problem Solving
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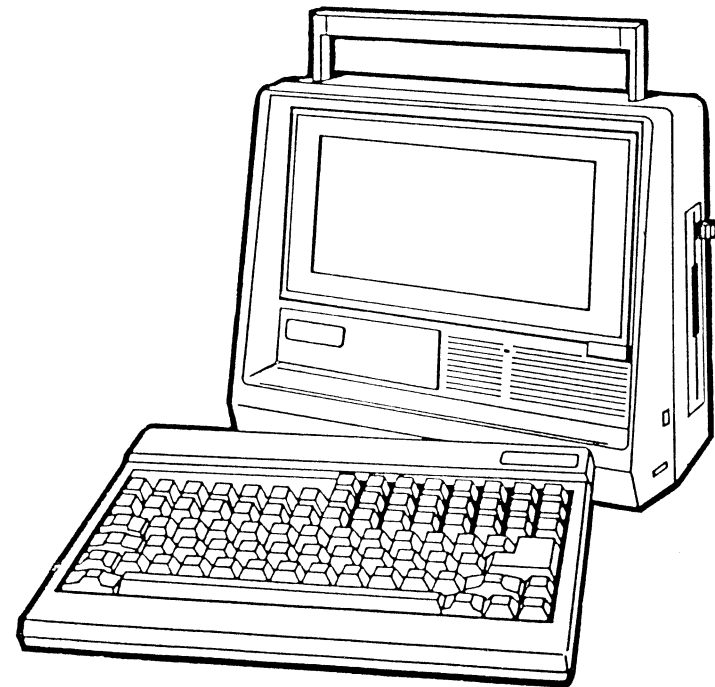
PHC-16 is a solidly constructed and thoroughly tested computer
that should give you years of trouble free operation. However,
as with any equipment, things can go wrong. If your PHC-16 is
not operating properly, you can check a number of functions
yourself.

A. Check These Things First

If your PHC-16 fails to turn on, check these things first:

 *   Is your computer plugged into an electrical outlet?

 *   Are both the on/off switch on the back of the   PHC-16
        and the switch on the power pack turned ON?

 *   Is the memory board plugged securely into the connection?
        The black part of the plug must completely cover the
        gold-colored prongs. Sometimes you have to press hard.

 *   Is the screen adjusted so you can see the memory
        partition screen?

 *   Is the palette being used visible? Press the CTRL,
        Left Shift, and S keys at the same time to cycle
        through the palettes and choose the best one.

 *   Is the PHC-16 in the external monitor mode? Press the
        CTRL, Left Shift, and M keys at the same time to turn
        the external monitor mode on or off.

If your PHC-16 has been operating and suddenly stops, check
these things first:

 *   Is the keyboard infrared beam still pointed directly at
        the computer?

 *   If you are using a battery power pack, has the battery
        run down? The light on your computer just under the
        screen comes on to warn you that the battery is low.

 *   If the red light on the keyboard does not come on when
        you press a key, the keyboard batteries need to be
        replaced. Follow the instructions and diagrams in
        Chapter 1 for installing batteries.

 *   Sometimes application software will "lock up." Press
        CTRL and BREAK keys at the same time. This should
        return you to the A> prompt.

        If this doesn't work, restart by pressing the CTRL, ALT,
        and DEL keys at the same time. Make sure you have a

DOS diskette or self-starting application diskette in the physical drive before you restart. This erases everything in working storage but keeps all data on the RAM drive. Return to your application and continue.

If this doesn't work either, press the reset button. This returns you to the memory allocation screen, but erases everything in both working storage and the RAM drive.

B. Memory Test

This is a special test that allows you to see if any of the ROM or RAM memory chips in your PHC-16 are not working properly. Turn switch SW2-3 ON and the tests will be run during start up. This screen shows the condition of your memory chips:

```
* * * * * BIOS ROM USERSION BPII * * * * *

* * * * * ROM TEST PASSED  RAM TEST IS NEXT * * * * *

* * SET DIP SWITCH SW2-3 OFF TO SKIP THESE TESTS * *

* * * * * * PRESS THE 'ESC' KEY IF YOU WANT TO RESET

                    ALL SYSTEM PARAMETERS * * * * * *

* * * * * * * PRESS ANY KEY TO CONTINUE * * * * * * *
```

```
SELECT THE RAM CONFIGURAION PRESENTLY INSTALLED

                    0 → 256K

                    1 → 512K

                    2 → 768K

                    3 → 1024K

                    4 → 1280K
```

256K OF RAM ON THE MAIN BOARD

RAM MUST BE EXACTLY AS CHOWN!!
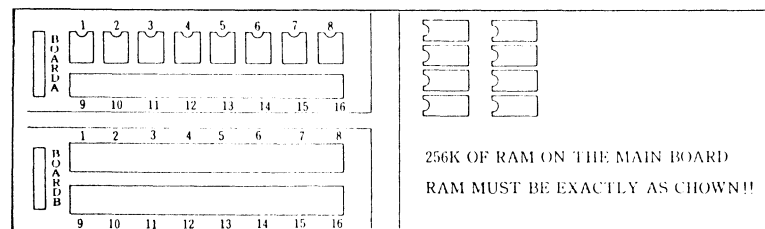
Since this test takes considerable time, you may want to use it only when you suspect your memory may be malfunctioning. Keep switch SW2-3 OFF for normal use.
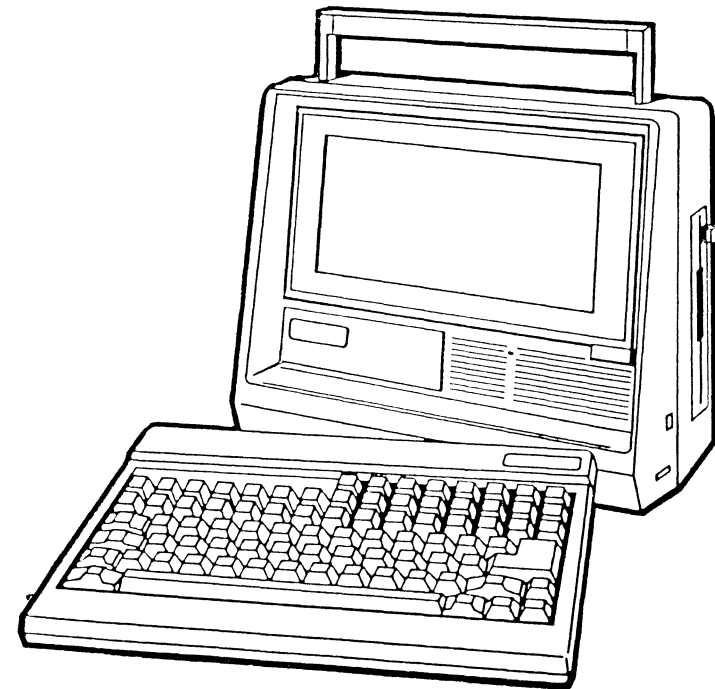
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==================
Chapter 6 Options
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A number of options are designed specifically for use with the
PHC-16. These are described briefly here, but specific
instructions for installing and operating them come with
the individual options.

Also, PHC-16 is completely compatible with the IBM PC. Printers
or "mice" designed for use with the IBM PC can also be used with
the PHC-16.

A. Add-On Physical (Diskette) Drive

PHC-16 has an optional second 360K byte physical drive that
attaches directly to the back of PHC-16. With the add-on drive
your system becomes a two physical drive system.

Attach the second disk drive like this. Don't forget to change switch SW2-6 to ON.
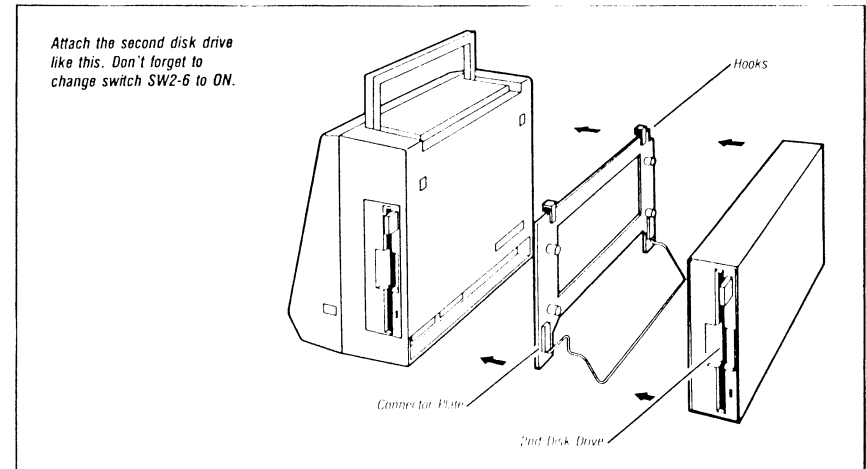
1. How it Works

To attach the add-on physical drive, follow these steps:

    1.   Attach the connector plate to the back of the PHC-16 by
          putting the hooks on the plate into the slots on the
          back of the PHC-16 case.

    2.   Attach the add-on physical drive to the plate with the
          knobs on the plate and the slots on the back of the
          add-on.

3. Take the connector that is attached to the add-on
    physical drive and insert it into the expansion port on
    the back of the PHC-16.

4. Change these switch settings:

    Switch SW1-7 must be OFF
    Switch SW1-8 must be ON
    Switch SW3-3 must be OFF

Now when you use any software, the add-on physical drive can be
used and identified as the C drive. For example, if you put a
word processing program in the A drive, you could put another
diskette in the add-on physical drive and instruct PHC-16 to
create your text files on the diskette in the add-on physical
drive. Identify the add-on as the C drive.

B. Modem

PHC-16 offers an optional internal modem that is Bell 212A
Standard. It can communicate at either 300 or 1200 baud. It
features auto-dial, auto-answer and re-dial. It accepts Hayes-
type commands and is bundled with the communications software
Crosstalk XVI.

The PHC-16 built-in modem is easy to use. Install it in the
modem compartment on the left side of your computer (just below
the memory slot). It adds little weight to the PHC-16.

C. Expansion Unit

The optional expansion unit allows you to use up to three IBM PC
compatible expansion boards, and can be purchased with or without
a 10 megabyte hard drive.

If you use the expansion unit to run a monitor, be sure to turn
switch SW2-4 ON.

If you use the expansion unit to add memory, be sure to turn
switch SW3-7 or SW3-8 (or both) OFF.

Caution: When the I/O box is used to supply power to the PHC-16, make
sure the power adaptor has been disconnected. Failure to do so is
dangerous and may cause damage to the power adaptor. If the adaptor is
dameged bue to this negligence, the maker is not responsible for
replacement, even if the damage occurs during the warranty period.

D. Expanding Memory

PHC-16 comes with 256K bytes of memory already installed, but
this can be expanded to 1280K. You can buy your PHC-16 with an
additional 768K or 1024K.

If you buy additional memory, it will be located on an expansion
memory board in the memory compartment on the left side of the
PHC-16. If you buy the full 1024K expansion (for a fully-loaded
PHC-16 of 1280K, or 1.25 MEG, total) you will probably never
need to remove the memory board.

However, if you buy the 512K expansion (768K total), you may want
to add memory at some time. You must use 256K chips, and must
add memory in banks of 256K at a time.

Open the cover to the memory board compartment on the left side
of the computer:
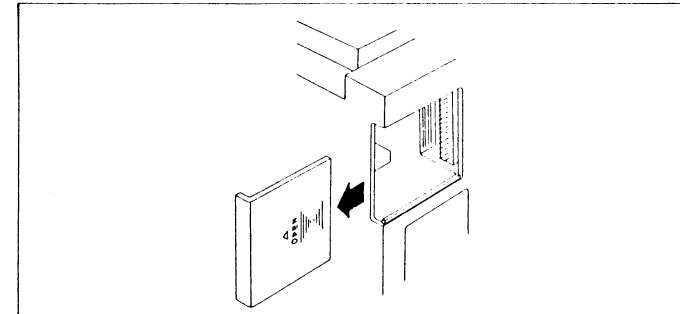
To remove the memory board and install more memory chips, follow
these steps:

1. Turn OFF all power to the PHC-16.

2. After opening the cover, disconnect the board
    by pulling the white plastic tab a little to your left.
    You'll be able to tell when the board plug is
    disconnected.

3. Now, slide the whole memory board out.
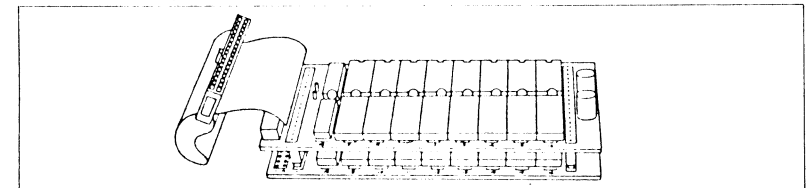
The memory board really contains two individual boards bolted together. If you bought 512K of additional memory, the lower board will be filled with chips and the upper board will be empty. The empty chip sockets are in two rows and are numbered 1-8 and 9-16.

Memory can only be increased in 256K increments by filling up a whole row of eight sockets at a time. Be sure to use only 256K chips. Install the first row of chips in sockets 1-8. If you also install a second set, use sockets 9-16.

To install new chips, follow these steps:

1. The pins on your new chips are usually spread apart a little too much. Before inserting, press the pins in slightly.

2. Now, insert the chip on the board in the correct slot as shown in this illustration.

Press the chip on the board in the desired slot. Make sure that the chips are all inserted facing the same direction. The tops (end with notch) are all to be facing upwards, as are the standard RAM chips already inserted into the board.

3. Make sure that all the chips are inserted facing the same direction. The tops (the end with the notch) should all be facing up, as are the chips that were installed in your PHC-16 at the factory.

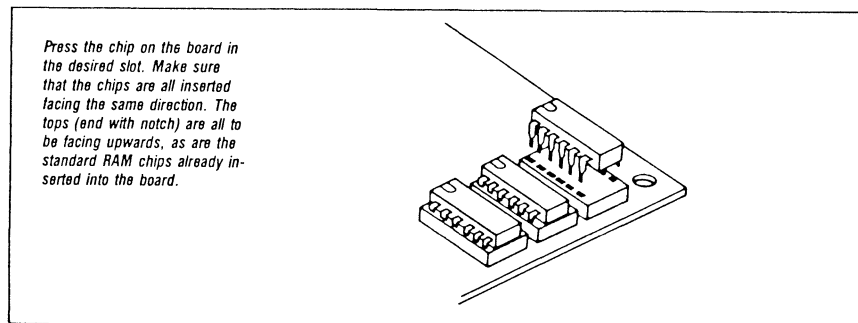4. After you have installed the extra memory chips, insert the board back into the slot. Notice the tracks that the upper board should slide into.

5. Plug in the connector.

If you bought the PHC-16 with the 512K memory upgrade installed, the switches should be set correctly, and are the same for all total memory over 640K.

Here's a summary of possible memory combinations and appropriate switch settings:

System Board	256K				
Lower board sockets 1-8	Empty	256K			
Lower board sockets 9-16	Empty	Empty	256K		
Upper board sockets 1-8	Empty	Empty	Empty	256K	
Upper board sockets 9-16	Empty	Empty	Empty	Empty	256K
TOTAL MEMORY	256K	512K	768K	1024K	1280K

SWITCHES:			
SW1-1		OFF	ON
SW1-2		ON	ON
Sw1-3		ON	OFF

E. Color or Composite Monitor

PHC-16 contains all the circuitry necessary to use a color or composite monitor. Plug a color monitor into the RGB jack or a composite monitor into the composite (RCA type) jack. Both jacks are on the back of the PHC-16.

Make sure you set switches SW1-5 and SW1-6 for your monitor. These settings will be different for different monitors.

You can switch back and forth between the monitor and the PHC-16 LCD by pressing the CTRL, Left Shift, and M keys at the same time.

F. Carrying Case

A carrying case designed specifically for the PHC-16 is available in a sturdy, canvas-like cloth.

The carrying case features an outside pocket for storing extra batteries, the PHC-16 Guide to Operations, or other supplies.

G. Car Adapter

This option is the same design as the AC power pack that comes
standard with the PHC-16. But instead of plugging into an
electrical outlet, it plugs into an automobile cigarette lighter.

H. Keyboard Cable

An optional keyboard cable is available for use with the PHC-16.
The available cable is coiled and can be extended up to ten feet.

I. High Performance Components

You can add these components to greatly increase the performance
of your PHC-16. All are installed on the system board by
removing the case and plugging them into the appropriate socket.
See the Appendix, Technical Information, for more details.

1. 8087 Coprocessor

Adding an 8087 coprocessor can greatly increase the processing
speed of your PHC-16. The most significant increase will come
when performing complicated mathematical calculations.

Be sure to turn switch SW1-4 OFF.

2. ROM

You can add a pre-programmed 16K or 32K ROM chip. The PHC-16
will read this ROM on startup. Although programming ROM is a
complicated process and must be performed by experts, this gives
you the capability of making your own programs permanently
available on the PHC-16, independent of other storage devices.
This is called "firmware".

3. CMOS

CMOS (Complementary Metal Oxide Semiconductor) is RAM powered by
a battery to retain the data stored in it. PHC-16 comes with 2K
of CMOS, which is used to store settings for the world clock,
audio feedback, monitor, and remote terminal. You can add up to
8K to permanently store your own data. For example, you may want
to store a telephone number list for your modem.

G L O S S A R Y
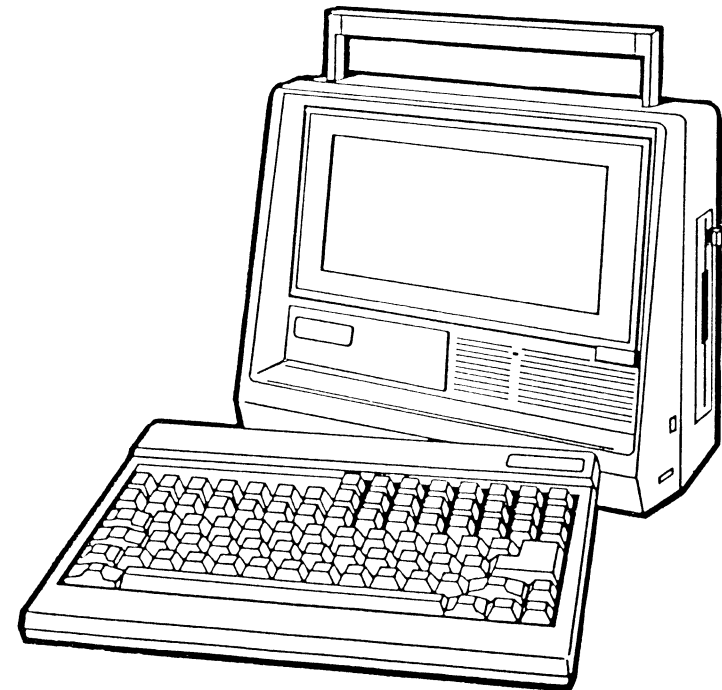
```
========
GLOSSARY
========
```

ASCII -   Acronym for American Standard Code for Information
            Interchange, the standard set of characters used by
            your computer and printer. This includes letters,
            numbers, punctuation, and a few special characters
            such as a carriage return.

BASIC -   Abbreviation for Beginner's All-purpose Symbolic
            Instruction Code.   BASIC is a popular, easy-to-learn
            programming language.

Bit -   The smallest unit of storage in a computer's memory.
            Eight bits equal one byte. A bit is an electrical
            pulse in a microcomputer's chip that represents the
            one or zero of computer binary language.

Byte -   A single character or number (see Bit).

Chip -   A small slice of silicon crystal etched with
            electrical circuits. The chip has allowed computers
            to become smaller in size while they have increased
            in storage capacity. The two most common types of
            chips are the microprocessor, or the computer's
            "brain", and the memory chip.

Circuit Board - See Expansion Unit.

Cursor -   A flashing bar or block that moves around on the
            screen and shows you where to enter information.

Default -   A value, option, or disk drive that is assumed by
            the computer when none is specified.

Disk -   See Diskette or Hard Drive.

Disk Drive - See Physical Drive or Hard Drive.

Diskette -A circular sheet of flexible plastic treated to store
            electomagnetic charges and used by a computer to
            permanently store data. The PHC-16 uses double-sided,
            double-density 5-1/4 inch diskettes which hold 360K of
            data.

Diskette Drive - See Physical Drive

DOS -   see MS-DOS.

Expansion Board - A board containing circuits and electronic
        components which expand the features of a computer.
        Expansion boards can be installed in PHC-16 optional
        expansion unit. The most common expansion boards add
        memory or produce graphics. See Expansion Unit.

Expansion Slot - See Expansion Unit.

Expansion Unit - PHC-16 optional chassis which plugs into the
        expansion bus on the back of the PHC-16 and which has
        expansion slots for adding IBM PC compatible expansion
        boards.

Fixed Disk - See Hard Drive.

Floppy Disk - See Diskette.

Function Keys - Keys on the keyboard that allow the computer to
        perform specific tasks and functions, such as moving
        the cursor or deleting characters.

Hardware - The computer system itself, made up of the CPU, the
        physical drive, keyboard, and screen.

Hard Disk - See Hard Drive.

Hard Drive - A mechanical unit containing a rigid disk (hard
        disk) treated to store electromagnetic charges and
        used by a computer to permanently store data. Hard
        drives for the PHC-16 must be mounted in the expansion
        unit or externally mounted in their own case and
        attached to the expansion unit. Unlike diskettes,
        hard disks are usually not removable. Because of
        their construction, hard disks hold much more data
        (usually 10 or 20 megabytes) and are much faster than
        diskettes.

K - Abbreviation of Kilobyte.

Keyboard - The collection of keys and controls used for typing
        information into a computer.

Kilobyte - Roughly 1000 bytes, abbreviated as K; actually 1,024
        bytes. The PHC-16 standard 256K of memory equals
        262,144 bytes.

Megabyte - Roughly one million bytes, abbreviated as MB.
        Actually 1,024,000 bytes.

Memory - The area in which programs and information are stored
        in the computer.

Menu - Like a menu in a restaurant, a list of choices you can
        select from to perform desired functions, such as
        edit, delete, or print.

Microcomputer - A computer that uses a microprocessor as its
        central processor. The term microcomputer includes
        personal, desktop, home, and portable computers.

Microprocessor - See Chip.

Modem - A device allowing a computer to send and receive
        information to and from another computer over
        telephone lines.

MS-DOS - The most widely used operating system for
        microcomputers, and included with the PHC-16.

Operating System - A software program that allows the computer
        and its peripherals to function as a system.
        MS-DOS is an operating system.

Palette - A combination of shades of gray on your LCD. Six
        palettes are available on the PHC-16 to compensate for
        the different ways application software displays on
        the screen.

Peripherals - Computer components that are not part of the
        computer itself, such as physical drives and printers,
        but that the computer controls. Peripherals help the
        computer process information.

Physical Drive - the mechanical unit that reads, writes, and
        stores data on a diskette.

Port - A computer or peripheral device's input/output
        connections.

Printer - A machine that prints output on paper. Dot matrix
        printers form characters, numbers or graphics with a
        collection of dots. The characters on letter-quality
        printers resemble typewriter characters.

Program - The computer instructions recorded on disks that make
        the computer "intelligent" and able to perform
        different functions such as accounting and word
        processing.

Programming - The process of writing instructions for a
        computer.

RAM Drive - An electronic "drive" that reads, writes, and stores
        data like a physical drive, but is temporary, and loses
        data when power is shut off. Data is stored in
        a portion of RAM and is controlled by software built
        into the PHC-16. The PHC-16 RAM drive can be from 0
        to 360K.

Random Access Memory (RAM) - A computer's read and write memory,
          which allows the CPU to receive, record and store
          information when the machine is on.

Read Only Memory (ROM) - This permanent memory stores the
          information necessary for the machine's daily
          operations. The computer can only read information
          from ROM. ROM memory is never lost, whereas RAM memory
          can be if the information is not stored on diskette and
          the computer is turned off.

Scratch Diskette - A diskette containing data you don't want or
          need anymore.

Software - Programs that tell the computer to store and process.
          It is the software that makes the computer capable of
          doing the tasks you want it to perform.

APPENDICES
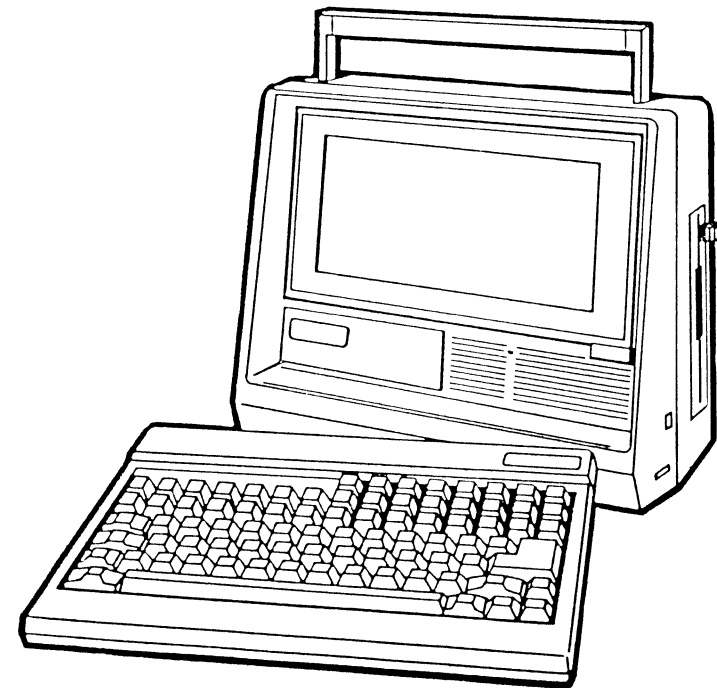
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APPENDIX
========

A. Technical Information

1. Memory Map

							For Option 2 all data in that area is read as FFH
FFFFF F0000	S T A N D R A D	ROM 1 32KBytes (27256)	O P T I O N 1	ROM 1 32KBytes (27256)	O P T I O N 2	ROM 1 32KBytes (27256)	
FBFFF F8000							
F7FFF F4000		BLANK		ROM 2 32KBytes (27256)		ROM 2 16KBytes	
F3FFF F0000							
EFFFF E0000	Bank switched RAM Up to 640K can be addressed in this 64K area (Optional) See below for switching info.						
DFFFF D0000	Reserved						
CFFFF CC000	Reserved						
CBFFF C8000	Hard Disk ROM						
C7FFF BC000	Reserved						
BBFFF B8000	16KBytes for color graphics video Internal standard (external option)						
B7FFF B4000	Reserved						
B3FFF B0000	16KBytes for monochrome Video adapter (external option)						
AFFFF A0000	Reserved						
9FFFF 80000	128KBytes Expansion RAM (Option)						
7FFFF 40000	256KBytes Expansion RAM (Option)						
3FFFF 00000	256KBytes Main Board RAM (Standard)						

2. ROM

You can put programs into a 27128 or 27256 ROM and have these programs always present for use.

When the BIOS is booting, it checks from C8000H to F7FFFH at 2K increments (C8000H, C8800H,...) looking for AA55H. This is the data code that tells the system that a program is present in ROM. The third byte is the number of 512-byte blocks contained in the routine. Checksums are not calculated. The system then does a far call to the fourth byte on that boundary (for example, C8003H). This allows the ROM code to do its own initialization, if needed, or to take over the system and run its own software.

This allows some interesting possibilities. Word processors, communications software, dedicated industrial controllers, etc. can be implemented without the need for disk-based software.

As viewed from the modem door, ROM 1 is the upper ROM, ROM 2 is the lower ROM. Be sure to turn off the computer and pay close attention to the direction of the notch on the ROM when inserting ROM chips.

Most of the routines that can be called using the CTRL Left Shift XXX keyboard sequence can also be called from within a program by using a far call to 0F000:0FEA8H with AL=ROUTINE to call.

```
AL=0   Show battery level
AL=1   Show date and time (cursor is moved to home position)
AL=2   Invert black/white on the LCD
AL=3   Toggle between LCD and RGB or composite monitor
AL=4   Cycle through the 6 palette choices
AL=5   Toggle between block and underline cursor
AL=6   Enter the dumb terminal program
AL=7   Enter the help screen program
AL=8   Enter the world clock program
```

Writing to and reading from CMOS RAM is done through an I/O port and is rather complicated. To make the use of CMOS RAM easier, the following BIOS calls are available:

Set the address you want to read from or write to into the DX register.

Write: Set the data you want to write into the AL or AX register. Do a far call to the desired routine.

Read: Do a far call to the desired routine. The data read is returned in the AL or AX register.

```
F000:FF60   READ BYTE    [AL HAS THE BYTE READ]
F000:FF64   WRITE BYTE   [AL HAS THE BYTE TO WRITE]
F000:FF68   READ WORD    [AX HAS THE WORD READ]
F000:FF6C   WRITE WORD   [AX HAS THE WORD TO WRITE]
```

3. RAM

Memory can be increased from 256K (standard) to 1280K (1.25 megabytes) in 256K increments.

The maximum system RAM is 640K. Sections of this can be enabled internally or externally to allow the use of memory cards or other devices in the expansion interface box.

For the 768K configuration, the 128K portion that exceeds the 640K limit can be used as a RAM drive. This 128K resides in the 64K area from E0000H to EFFFFH. This is done by bank switching in 64K blocks of RAM.

For a 1024K (1 megabyte) configuration, the system memory is 640K and 360K of the 384K over that can be used as a RAM drive.

The remaining 24K can be used by the system for CTRL-Left Shift functions to store the screen image and as a buffer:

* 16K of the high RAM is used to store the current screen when any of the CTRL-Left Shift functions are called.

* 8K is used as a data buffer for the dumb terminal program.

For a 1280K (1.25 megabyte) system, the upper 256K is free for use.

Bank switching of the RAM is done through control port 77H (write only). The data pattern written to this port controls RAM as follows:

D7	D6	D5	D4	D3	D2	D1	D0	
X	X	X	X	0	0	0	0	Bank #0 Open RAM Window
X	X	X	X	0	0	0	1	Bank #1 Open RAM Window
X	X	X	X	0	0	1	0	Bank #2 Open RAM Window
X	X	X	X	0	0	1	1	Bank #3 Open RAM Window
X	X	X	X	0	1	0	0	Bank #4 Open RAM Window
X	X	X	X	0	1	0	1	Bank #5 Open RAM Window
X	X	X	X	0	1	1	0	Bank #6 Open RAM Window
X	X	X	X	0	1	1	1	Bank #7 Open RAM Window
X	X	X	X	1	0	0	0	Bank #8 Open RAM Window
X	X	X	X	1	0	0	1	Bank #9 Open RAM Window
X	X	X	X	1	0	1	0	Close RAM Window
X	X	X	X	1	0	1	1	Close RAM Window
X	X	X	X	1	1	0	0	Close RAM Window
X	X	X	X	1	1	0	1	Close RAM Window
X	X	X	X	1	1	1	0	Close RAM Window
X	X	X	X	1	1	1	1	Close RAM Window

X = Don't care

With the RAM window closed, any external drive wishing to use the area from E0000H to EFFFFH can do so.

4. Battery Backup CMOS RAM

2K bytes are standard and 8K bytes are optional.

To upgrade from 2K to 8K, turn the power off, remove the 6 screws that hold the front and back of the case together, and remove the socketed RAM chip (M5M5117P or equivalent) on the I/O board and replace it with an 8K RAM chip (M5M5165P or equivalent).

When installing a 2K memory chip (24 pins) in the CMOS RAM socket (28 pins), be sure that the end that is not notched is even with the end of the socket:

Lower RAM locations (1K) are used by the system to store setup parameters. This allows the system to power up in the same mode as when it powered down.

RAM locations 0400H to 07FFH are free for the programmer (2K standard). RAM locations 0400H to 3FFFH are free for the programmer when the optional 8K is installed.

This memory is addressed through I/O port addresses 27BH, 37FH, and 370H - 377H.

The procedure is to first set address lines A11, A12 via the port 27BH. The data on the LSB D1, D0 lines are latched (D0->A11, D1->A12).

Then set address lines A3 to A10 through port 37FH. (D0->A3, ... D7->A10).

8 bytes of data can now be read/written directly from/to the CMOS RAM by reading/writing any of ports 370H to 377H.

Example: Write the number 55 to location 37 in the RAM.
37 DECIMAL = 25 HEX = 100101

This corresponds to putting the following pattern on the address bus:

```
A12  A11  A10  A9  A8  A7  A6  A5  A4  A3  A2  A1  A0
 0    0    0    0   0   0   0   1   0   0   1   0   1
```

```
    MOV  DX,27BH
    MOV  AL,0
    OUT  DX,AL              ;SET A12, A11
    MOV  DX,37FH
    MOV  AL,00000100B
    OUT  DX,AL              ;SET A10 TO A3
    MOV  DX,375H            ;A2, A1, A0 PATTERN IS 101B = 5
    MOV  AL,55              ;370H+5 = 375H
    OUT  DX,AL
```

To make it easier, there are two routines in the system BIOS ROM that when called will do a read/write to the CMOS RAM area.

How to use:

> Set the address you want to read from or write to into the DX register.
>
> > Write: Set the data you want to write into the AL or AX register. Do a far call to the desired routine.
> >
> > Read: Do a far call to the desired routine. The data read is returned in the AL or AX register.

```
F000:FF60   READ BYTE     (AL HAS THE BYTE READ)
F000:FF64   WRITE BYTE    (AL HAS THE BYTE TO WRITE)
F000:FF68   READ WORD     (AX HAS THE WORD READ)
F000:FF6C   WRITE WORD    (AX HAS THE WORD TO WRITE)
```

The backup battery may run down if the computer is not used for 45 days or more (NICAD type). If this happens, it may be necessary to set switch 2-3 ON to force the computer to boot up using the LCD display when no RGB is attached.

5. DIP Switches

See Chapter 2: Customizing Your PHC-16 for the location and use of the dip switches. This section provides technical information about the switches.

Switch 1 is read through an 8255 chip having ports 60H, 61H, 62H, and 63H:

* Port 60H is used as a read only port.

* Port 61H is used as a control port and can be written to or read from.

* Port 62H is used as a read only port.

* Port 63H is the 8255 chip control port and is used to set up ports 60H - 62H.

The relationship between ports 60H, 61H, 62H, the SW1-1 to SW1-8 settings, and the data that is read at ports 60H and 62H are as follows:

PORT 60H DATA BIT	PORT 61H D7=0	PORT 61H D7=1
D0	KEYBOARD D0	1
D1	KEYBOARD D1	SW1-4
D2	KEYBOARD D2	1
D3	KEYBOARD D3	1
D4	KEYBOARD D4	SW1-5
D5	KEYBOARD D5	SW1-6
D6	KEYBOARD D6	SW1-7
D7	KEYBOARD D7	SW1-8

PORT 62H	PORT 61H D2=0	PORT 61H D2=1
D0	SW1-3	0
D1	1	1
D2	1	SW1-1
D3	1	SW1-2

CAUTION: Some software does direct read/write without using the system BIOS routines. This software may not work correctly unless SW3-2 is ON.

A 5.25 inch floppy disk drive can be attached to the back of the case. In this configuration, it is necessary to distinguish between Drive B being internal or external. After power on, the internal/external Drive B selections can be made by setting D2 of port 73H to 1 or 0.

SW3-5 and SW3-6 can be used to select different fonts. Type 3 and 4 fonts are currently undefined.

Port 73H (write only) is a control port used to enable or disable the functions selected by dip switch SW3-2 to SW3-8. The following are the data bit settings:

D0=0 Used to turn power to the backlit LCD (when installed) ON or OFF.
D1=0 Always supply power to the floppy disk drives (OFF saves battery power).
D2=0 The 2nd floppy disk drive is internal.
D3=0 Internal video RAM is being used (B8000-BFFFF).
D4=0 Selects   D4=1 Selects   D4=0 Selects   D4=1 Selects
D5=0 USA font D5=0 Type 2 font D5=1 Type 3 font D5=1 Type 4 font
D6=0 Internal RAM is being used (40000-7FFFF), OFF for external cards.
D7=0 Internal RAM is being used (80000-BFFFF), OFF for external cards.

This allows a programmer to select these options from a program if desired.

6. CRT Video and LCD Video

The PHC-16 has RBG and composite video connectors out the back. The RBG pinout is the same as the "industry standard".

The CRT video and LCD video are controlled by a V6355 controller chip. The selection of a CRT monitor or the LCD screen is done by reprogramming the chip and by writing to port 72H (write only).

Port 72H also controls the reverse video and contrast on the LCD screen.

D0=1 Lower the contrast.
D1=1 Raise the contrast.
D2=1 Set the contrast to a mid-range value.
D3=1 Select a CRT monitor (D3=0 selects the LCD).
D4=1 Reverse the black and white on the LCD screen.
D5   Not used.
D6   Not used.
D7   Not used.

The V6355 chip has 16 palettes. Each one can be reprogrammed to give any of an 8 level gray scale on the screen. All "colors" can be made the same, or they can be set as desired.

The CTRL-Left Shift-S command rotates through six different palette settings to make the LCD screen readable for a variety of color combinations. The first five settings are fixed. The sixth setting is user selectable; however, the desired values must be written to CMOS RAM.

PALETTE
----
0   General use.
1   Enables the intensity bit for Wordstar type programs.
2   Reverses the use of the intensity bit.
3   Gives an 8-level gray scale in text mode.
4   For composite video output.
5   User definable. The default values give the same effect as inverse video on the LCD screen (the values are the reverse of palette 3).

RBG output will not be affected by the palette selection.

Default Palette 5 values are:

    00H,70H,00H,60H,00H,50H,00H,40H
    00H,30H,00H,20H,00H,10H,00H,00H
    00H,70H,00H,60H,00H,50H,00H,40H
    00H,30H,00H,20H,00H,10H,00H,00H

7. 8087 Coprocessor

When SW1-4 is OFF, an 8087 coprocessor can be used.

8. CTRL-Left Shift Functions

The CTRL-Left Shift functions are explained in Chapter 2:
Customizing Your PHC-16.

In addition:

*   Only one function can be active at a time

*   The remote (dumb) terminal program is used for communication
        purposes. It can go through either COM1 or COM2. It is menu
        driven for ease of use. At present, there is no checking of
        the clear to send or data set ready.

*   Data is received through an interrupt driven routine. If
        24K of RAM is saved for the the CTRL-Left Shift functions,
        then the last 8K is used as a data buffer. If not, the last
        8K of video RAM is used as a buffer. If the buffer is
        overrun, an error message occurs and the system prompts the
        user. Further data is lost, however.

9. Technical Notes

1.   To conserve power, the PHC-16 uses CMOS parts wherever
        possible including the printer port. If the computer is
        turned off before the printer, garbage may be printed as the
        printer circuit loses power. Turn the printer off first.

2.   Some software continually refreshes the screen during certain
        displays. The video chip for LCD, RGB, and composite video
        is built such that it is never necessary to disable video to
        refresh the screen. Certain software assumes a CRT and
        waits for VSYNC, turns off video, then updates the data.
        When done, it enables video again. For a CRT, the first few
        raster scans are not shown and the picture is OK. For an
        LCD, all rasters are shown. This and timing differences
        cause about five raster lines at the top and the middle to
        be missing from the LCD.

Paralle Port Pin Chart
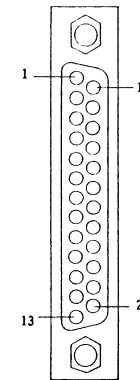
Pin NO.

# 1	Strobe
# 2	Data 0
# 3	Data 1
# 4	Data 2
# 5	Data 3
# 6	Data 4
# 7	Data 5
# 8	Data 6
# 9	Data 7
#10	ACK
#11	Busy
#12	PE
#13	SLCT
#14	N/C (no connect)
#15	N/C
#16	init
#17	N/C
#18	ground GND
#19	ground GND
#20	ground GND
#21	ground GND
#22	ground GND
#23	ground GND
#24	ground GND
#25	ground GND

Sirial Port Pin Chart
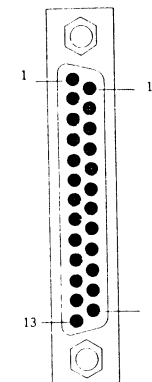
Pin NO.

# 1	FG (frame ground)
# 2	TKD Transmit Data
# 3	RXD Receive Data
# 4	RST Request to send
# 5	CTS Clear to send
# 6	DSR Data set ready
# 7	signal ground
# 8	CD (carrier detect)
#16	+5
#20	DTR (data terminal ready)
#21	RI (ring indicator)

RGBI Pin Chart
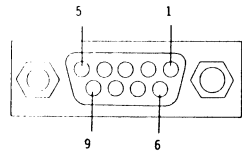
Pin NO.

# 1	ground GND
# 2	ground GND
# 3	R
# 4	G
# 5	B
# 6	I
# 7	non connect
# 8	HSYNC
# 9	VSYNC

Composite Pin Chart
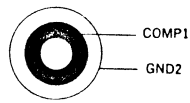
Pin NO.

# 1	VIDEO OUT
# 2	ground GND

Modem Bus Port Pin Chart
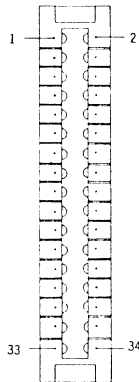
Pin NO.   Pin NO.

# 1	+5v	#18	IBA4
# 2	IRQ4	#19	-15V
# 3	IBD7	#20	IBA3
# 4	IBRESET	#21	-15V
# 5	IBD6	#22	IBA2
# 6	MODEMCS-N	#23	IBAENRD
# 7	IBD5	#24	IBA1
# 8	NC	#25	+5V
# 9	IBD4	#26	IBA0
#10	IBA7	#27	GND
#11	IBD3	#28	IBIOW-N
#12	IBA6	#29	GND
#13	IBD2	#30	IBIOR-N
#14	IBA5	#31	GND
#15	IBD1	#32	IRQ3
#16	MODEMOPN-N	#33	GND
#17	IBD0	#34	GND

External Bus Port Pin Chart
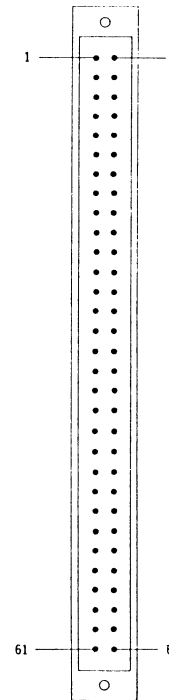
Pin NO.   Pin NO.

# 1	+5V	# 2	I/OCHCK-N
# 3	D7	# 4	EXREST
# 5	D6	# 6	+5V
# 7	D5	# 8	IRQ2
# 9	D4	#10	NC
#11	D3	#12	DRQ
#13	D2	#14	-15V
#15	D1	#16	DIR
#17	D0	#18	+12V
#19	I/OCHRDY	#20	GND
#21	IBAENBRD	#22	IBMEMW-N
#23	IBA18	#24	IBMEMR-N
#25	IBA19	#26	IBIOW-N
#27	IBA17	#28	IBIOR-N
#29	IBA16	#30	IBDACK3-N
#31	IBA15	#32	DRQ3
#33	IBA14	#34	IBDACK1-N
#35	IBA13	#36	DRQ1
#37	IBA12	#38	IBDACKO-N
#39	IBA11	#40	EXCRK
#41	IBA10	#42	IRQ7
#43	IBA9	#44	IRQ6
#45	IBA8	#46	IRQ5
#47	IBA7	#48	IRQ4
#49	IBA6	#50	IRQ3
#51	IBA5	#52	IBDACK2-N
#53	IBA4	#54	IBTIC
#55	IBA3	#56	IBAENBRD
#57	IBA2	#58	+5V
#59	IBA1	#60	OSC
#61	IBA0	#62	GND

ASCII value	Character	Control character	ASCII value	Character
000	(null)	NUL	032	(space)
001	☺	SOH	033	!
002	☻	STX	034	''
003	♥	ETX	035	#
004	♦	EOT	036	$
005	♣	ENQ	037	%
006	♠	ACK	038	&
007	(beep)	BEL	039	'
008	▫	BS	040	(
009	(tab)	HT	041	)
010	(line feed)	LF	042	*
011	(home)	VT	043	+
012	(form feed)	FF	044	,
013	(carriage return)	CR	045	-
014	♫	SO	046	.
015	☼	SI	047	/
016	►	DLE	048	0
017	◄	DC1	049	1
018	↕	DC2	050	2
019	!!	DC3	051	3
020	¶	DC4	052	4
021	§	NAK	053	5
022	▬	SYN	054	6
023	↨	ETB	055	7
024	↑	CAN	056	8
025	↓	EM	057	9
026	→	SUB	058	:
027	←	ESC	059	;
028	(cursor right)	FS	060	<
029	(cursor left)	GS	061	=
030	(cursor up)	RS	062	>
031	(cursor down)	US	063	?

ASCII value	Character	ASCII value	Character
064	@	096	`
065	A	097	a
066	B	098	b
067	C	099	c
068	D	100	d
069	E	101	e
070	F	102	f
071	G	103	g
072	H	104	h
073	I	105	i
074	J	106	j
075	K	107	k
076	L	108	l
077	M	109	m
078	N	110	n
079	O	111	o
080	P	112	p
081	Q	113	q
082	R	114	r
083	S	115	s
084	T	116	t
085	U	117	u
086	V	118	v
087	W	119	w
088	X	120	x
089	Y	121	y
090	Z	122	z
091	[	123	{
092	\	124	¦
093	]	125	}
094	∧	126	~
095	—	127	⌂

ASCII value	Character	ASCII value	Character
128	Ç	160	á
129	ü	161	í
130	é	162	ó
131	â	163	ú
132	ä	164	ñ
133	à	165	Ñ
134	å	166	ª
135	ç	167	º
136	ê	168	¿
137	ë	169	⌐
138	è	170	¬
139	ï	171	½
140	î	172	¼
141	ì	173	¡
142	Ä	174	«
143	Å	175	»
144	É	176	░
145	æ	177	▒
146	Æ	178	▓
147	ô	179	│
148	ö	180	┤
149	ò	181	╡
150	û	182	╢
151	ù	183	╖
152	ÿ	184	╕
153	Ö	185	╣
154	Ü	186	║
155	¢	187	╗
156	£	188	╝
157	¥	189	╜
158	Pt	190	╛
159	ƒ	191	┐

ASCII value	Character	ASCII value	Character
192	└	224	α
193	┴	225	β
194	┬	226	Γ
195	├	227	π
196	─	228	Σ
197	┼	229	σ
198	╞	230	μ
199	╟	231	τ
200	╚	232	Φ
201	╔	233	Θ
202	╩	234	Ω
203	╦	235	δ
204	╠	236	∞
205	═	237	$\emptyset$
206	╬	238	ϵ
207	╧	239	$\cap$
208	╨	240	$\equiv$
209	╤	241	$\pm$
210	╥	242	$\geq$
211	╙	243	$\leq$
212	╘	244	$\lceil$
213	╒	245	$\rfloor$
214	╓	246	$\div$
215	╫	247	$\approx$
216	╪	248	°
217	┘	249	•
218	┌	250	·
219	█	251	$\sqrt{}$
220	▄	252	ⁿ
221	▌	253	²
222	▐	254	■
223	▀	255	(blank 'FF')

WARRANTY

A. Warranty Provisions

The Kohjinsha Co., Ltd. warrants this product to be in good working
order for a period of one hundred eighty (180) days from the date of
purchase as a new product. Should this product fail to perform properly
any time within that one hundred eighty (180) day period, Kohjinsha Co.,
Ltd. will, at its option, repair or replace this product at no cost
except as set forth in this warranty. Replacement parts or products
will be furnished on an exchange basis only. Replaced parts and/or
products become the property of Kohjinsha Co., Ltd. No warranty is
expressed or implied for products damaged by accident, abuse, misuse,
natural or personal disaster, or unauthorized modification.

Warranty service described herein may be obtained by delivering this
product, during the one hundred eighty (180) day warranty period, to
Kohjinsha Co., Ltd. located at 2-7-21 Matsukage-cho, Naka-ku, Yokohama
231 Japan. When delivering to the factory, product must be accompanied
by proof of purchase date. If shipped by mail or any common carrier,
owner agrees to insure and accept all liability for loss or damage to
this product, to prepay all shipping charges, and to use shipping
container equivalent to original packaging.

B. Warranty Limitations

All warranties for this product expressed or implied, including
merchantability and fitness for a purpose, are limited to 180 days
duration from date of purchase, and no warranties, expressed or implied
will apply after that period.

If this product does not perform as warranted herein, owner's sole
remedy shall be repair or replacement as provided above. In no event
will Kohjinsha Co., Ltd. be liable to any purchaser for damages, lost
revenue, lost wages, lost savings, or any other incidental or
consequential damages arising from purchase, use or inability to use
this product, even if PHC-16 has been advised of the possibility of such
damages.