GIBSON LABORATORIES

High-Resolution High-Speed

LPS II®

Light Pen System for Apple II™ Computers

Gibson Laboratories, Irvine, CA

PRELIMINARY

SOFTWARE AND DOCUMENTATION

Be sure to return the owner's registration card so that the final software and manual can be sent to you.

FOREWORD

Many years ago the first digital computer was invented. The result was a revolution in the way we think about information and machines. Using these first monstrous machines we learned how to use computers to solve the problems of the government and large corporations. Then, as technology moved forward, the physical size and expense of computer power dropped incredibly. The dawning of the age of the PERSONAL COMPUTER has made this information handling power available to small businesses and the individual.

Just as the first room-filling digital computers revolutionized and streamlined government and big business organization, the PERSONAL COMPUTER promises to revolutionize the way we, as individuals, perform the tasks which make up our day. While small computers have seen application in all forms of financial management and text processing, it is our belief at Gibson Laboratories that GRAPHICS will be one of the next major application areas to be revolutionized by the Personal Computer. It has been said that "a picture is worth ten thousand words." The Personal Computer can be our tool of expression, handling the details of picture design. Soon a complete environment of compatible Personal Computer Graphics applications will exist to aid in the creation of graphic images.

Gibson Laboratories is committed to achieving a leadership position in this new field of Personal Computer Graphics. Our first product, the LPS II Light Pen System for use with Apple II Computers may be the most significant product ever designed for this marketplace ... but this is just the start. As you shall see, a properly designed light pen system with software support is the superior tool for graphic system interaction.

We believe the LPS II Light Pen System provides more value for the dollar than any previous Apple peripheral. We're sure you will agree.

Please be sure to return the enclosed LPS II Owner`S Registration Card. In this way we can keep you informed of future software products which will be used with the LPS II.

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LPS II - Preliminary Owner's Manual

1. Introduction

1.1. What is a Light Pen Anyway?

Seen for the first time, a true operating light pen system appears to command the powers of magic. With a light pen you can actually write on the display screen of a computer using something that looks like an ordinary pen !! If you don't like what you've drawn, you can use the pen to erase all or part of the drawing. If you would like to finish it later, you can have the computer store it on a disk. You can draw the notes of a short musical composition, and have the computer immediately play the composition for you. You can draw a picture freehand, or draw very structured diagrams like those used in mechanical engineering or electronics, and have the computer straighten all of your lines and make your hand-drawn circles perfect. You can even select a symbol to be used from a 'menu' of available symbols. You can use your pen to select from options presented to you in a list, or use the pen to point at text that you wish edited. The power of the light pen is almost magical indeed.

The LPS II Light Pen System makes all this possible with nothing more than a standard Apple II Personal Computer with 48K bytes of memory, Applesoft, Disk II with DOS 3.3 and your imagination.

The LPS II is called a light pen SYSTEM because a useful light pen requires powerful supporting software to be fully useful and easily adapted to the individual needs of the user. This software is provided in the form of the powerful PENTRAK Driver. Included on the DOS 3.3 diskette, the PENTRAK Driver is a machine language program which is loaded into memory automatically along with the Disk Operating System. PENTRAK uses Applesoft's ampersand hook (&) to add an variety of Light Pen System commands to the Applesoft language. These short, powerful, easy to remember commands, reduce the task of generating effective, interactive graphics applications to simple Applesoft programming.

A similar driver, PASTRAK, is currently under development. It will provide Light Pen support to PASCAL, FORTRAN and PILOT programs. In addition, a CPM driver is under consideration for future development. When these new drivers are ready for release, all registered owners of LPS II Systems will be notified by mail.

This manual is intended as an introduction to light pen usage and application. In the remainder of this introduction, we will examine light pens more closely.

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1.2. CRT Display (TV Tube) Operation

Understanding how a CRT displays information is the key to understanding the operation of the light pen.

A CRT display (TV Screen) which appears to us as a sheet of information, is actually formed by a single, rapidly-moving dot of light. It constantly sweeps over the entire screen, turning on and off as it moves. This constant sweeping motion is called Video Refresh, and the on/off pattern determines what image is seen by the viewer. The rapidly-moving dot of light always starts at the upper lefthand corner of the screen and moves in a straight horizontal line to the right. When it gets to the right hand side of the screen, it starts again on the lefthand side, but this time a little lower down. This pattern is repeated until the dot reaches the bottom of the screen, having traced out a RASTER of successive horizontal lines. This sequence of actions is known as a Raster Scan. The computer which is driving the CRT display controls the on/off switching of the dot. This dot intensity information is called the VIDEO signal. In order for this information to be seen clearly, the CRT's dot's position must be synchronized with the on/off video data coming from the computer. The computer tells the CRT when to start at the top of the screen with a signal called VERTICAL SYNC, and also when to start each horizontal line with a signal called HORIZONTAL SYNC. The three signals generated by the computer, Video Data, Vertical Sync, and Horizontal Sync are all combined into one signal called COMPOSITE VIDEO. This Composite Video is available from the connector at the rear of the Apple Computer and may be connected to any CRT monitor equipped to accept a standard Composite Video signal.

1.3. How Light Pens Work

Knowing how a CRT displays information we can readily comprehend the operation of the light pen.

As the name implies, the light pen has the shape of a pen or pencil, and responds to light. It functions by detecting and precisely timing the passage of the CRT's dot of light. The light pen monitors the Horizontal Sync signal generated by the computer to determine when each horizontal line is started. The time from the last Horizontal Sync signal to the instant the dot passes the pen's point determines the pen's horizontal position on the screen, and the number of Horizontal Sync pulses received since the last Vertical Sync signal determines which line the pen is on.

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Since all standard CRT displays are 'refreshed' sixty times each second, a light pen system is able to determine the pen's location sixty times each second. This frequent position readout allows for tremendous freedom in the range of applications suited to light pen solution.

1.4. Light Pen Applications

A light pen is a device which allows a unique form of graphic interaction with a digital computer. It stands alone among graphic input devices. It is extremely small, portable, accurate, inherently interactive, highly reliable, easy to use, AND inexpensive. No other device available today offers this combination of benefits.

Light pens have been used effectively for years with big, expensive computer systems. They can be used anywhere a human operator needs to respond to, or direct, the operation of a computer system. Because of their obvious graphical uses, we find light pens in most Computer Aided Design and Computer Aided Manufacturing systems. Integrated Circuit Design, Printed Circuit Design, Process Control and Monitoring and all forms of graphical computer interaction are greatly enhanced through the use of a light pen ... but so would be the composition of a musical score, or the selection of the correct answer from a menu of choices. Even text processing and typesetting systems can use a light pen as an interactive editing device. Educational applications with young children abound, as do the uses of the light pen in simple interactive non-keyboard applications. A business application package, for example, might ask the operator to select his options or functions with a light pen. This can greatly shorten the learning cycle time for any computer system. Being a very general purpose graphical interaction tool, a light pen's applications are limited only by the imagination of the user.

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1.5. Supplied Software Overview

Included with the Light Pen System hardware is a DOS 3.3 format diskette containing software critical to the operation of the Pen. This software includes:

1.5.1. PENTRAK - Machine Language Driver

Effective use of the LPS II hardware requires a special program known as the PENTRAK Driver. It is so named because Applesoft application programs call to PENTRAK for the execution of light pen functions. PENTRAK in turn translates these higher-level requests into the low-level commands required by the Light Pen hardware. PENTRAK 'drives' the Light Pen electronics. This means that the programmer does not need to worry about the intricacies of light pen operation. In addition to simply controlling the Pen, the PENTRAK Driver has many sophisticated features which significantly ease serious Applesoft graphics programming.

1.5.2. Applesoft Applications

Included on the PENTRAK SOFTWARE diskette are a collection of fully developed Applesoft application programs which demonstrate the various operating modes of the Light Pen System. The application programs are immediately useful for many light pen applications. Additionally, they may be listed, examined, modified, enhanced, and used as starting points for your own applications. Several of these programs have been provided as serious examples of applications of the Light Pen with the Apple computer. Provided are several complete drawing systems: MULTIDRAW, SKETCH and GEOMED II. Each approaches the job of drawing differently, each is useful, and each demonstrates a different style of Light Pen interaction. There is a program called MUSIC with which you can actally draw a rudimentary musical composition on the face of the CRT monitor, hearing the melody as it is composed, and editing it freely. The MENU program allows the user to establish a custom menu-based program selection system by simply LOCKing or UNLOCKing any Applesoft programs on a diskette. LOCKed Applesoft programs are automatically displayed by MENU and are RUN when selected by pointing with the Pen!

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2. Installation & Checkout

2.1. Unpacking the LPS II

Upon opening the LPS II case you will find the following items:

1. The Light Pen System hardware consisting of ...
   a. Light Pen Electronics (the big black block)
   b. The Light Pen itself (looking like an electric pen)
2. The PENTRAK SOFTWARE diskette (DOS 3.3 format)
3. This Owner's Manual (the one you're reading right now)
4. The Owner's Registration Card (please fill out and return)

If any of these are missing you may not have a complete LPS II system and should contact the retail establishment where you purchased your LPS II.

2.2. Installing the LPS II

Installation of the Light Pen System involves nothing more than plugging the Light Pen electronics module into slot seven of your Apple.

Remember!!! Your computer power MUST be off whenever inserting of removing any I/O interfaces or other equipment.

Interactive checkout and calibration of the newly installed Light Pen System is performed with the aid of the supplied program -- CALIBRATE. The LPS II must be calibrated for the specific video display being used. Color monitors and television sets have more internal video delay than monochrome sets. This delay varies between manufacturers and causes variations in the coordinate readout of the LPS II. Once checked-out and calibrated, CALIBRATE re-writes the modified PENTRAK driver onto your disk so that the calibration information will be automatically loaded in the future. If you change monitors frequently, multiple versions of PENTRAK may be generated with the CALIBRATE utility.

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***** LIGHT PEN INSTALLATION *****

To install the LPS II in your computer follow these three steps:

1. DISCONNECT YOUR COMPUTER'S POWER CORD. This assures that the power cannot be accidently turned on during installation.

2. MOVE ANY DEVICE WHICH NOW OCCUPIES SLOT SEVEN INTO ANOTHER SLOT. Refer to your Apple computer reference manual if you are unsure about the numbering of your computer I/O slots. Slot zero is nearest the computer's power supply, slot seven is nearest the Game I/O Connector. The LPS II Light Pen System requires an electronic signal which is available only at I/O slot seven. Most other peripheral devices will function in slots other than seven, so give the LPS II priority and move the other device, if any, to some other slot.

NOTE

Some other I/O devices do require operation in slot seven. If you have one of these and therefore MUST operate the LPS II in a slot other than seven this is possible with the addition of a special wire. See the section titled Non-Slot Seven Installation for details.

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3. INSERT THE LIGHT PEN SYSTEM INTO SLOT SEVEN. Orient the LPS II module so that it's label is facing the game paddle connector. Loop the Light Pen's cord out of the rear of the Apple (through the small opening) and around to the front for use with your monitor.

Thats all there is to it. Your Light Pen System hardware is now installed. If your Light Pen is installed in slot seven, skip the next section (Non-Slot Seven Installation) and proceed with calibration and checkout.

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2.3. Non-Slot Seven Installation

You are reading this section because you have decided NOT to install the LPS II in slot number seven. Once again, be sure the peripheral device now in slot seven MUST be in slot seven to operate. Only a very few products for the Apple require slot seven for operation. If operation of the Light Pen in a slot other than seven can be avoided, avoid it. Here's why....

The Light Pen System must receive video synchronization information from the Apple's video generation circuitry. Apple Computer, Inc. thoughtfully provided this signal at slot seven, and ONLY at slot seven. In order to operate the Pen in any other slot, YOU must provide this signal. Provision has been made for this, although the process requires that you break an electrical connection on the circuit board (jumper) just above the edge connector of the Light Pen electronics module, and connect a wire from a spot on the module to an Integrated Circuit on the main board of the Apple. This requires proficiency in electronic assembly and repair. If you have never done this type of work before, PLEASE FIND SOMEONE WHO CAN DO THIS FOR YOU. Perhaps your local dealer can do this, or knows of someone who will. DO NOT ATTEMPT TO PERFORM THIS MODIFICATION UNLESS YOU FEEL CONFIDENT WITH CIRCUIT BOARD WORK AND SOLDERING. To proceed, you will need the following tools and equipment:

1"	Soldering Iron	- Of a type suitable for electronic work. You will also need a short length of electronic assembly solder.
2"	Sharp X-acto Knife	- Needed for cutting the PC board jumper.
3"	12-inch Wire	- Single conductor, 12-inch minimum length.
4"	IC Removal Tool	- This not a necessity, however one Integrated Circuit on the Apple main board must be removed, and the removal tool makes that easier. If you upgraded to DOS 3.3, a tool came with that kit. The Language Card and the various RAMcards on the market also include this tool.

Below is a step-by-step guide to performing the modification. First you must cut the existing jumper on the PC board. It is EXACTLY under the 'CA' abbreviation of the copyright notice on the PC board. Then you solder your hookup wire into the hole nearest the 'A' of CA. This wire is then connected to pin number 8 of the 74LS51 located at location C13 on the Apple main board.

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NOTE: After the jumper is cut, the special wire will be needed even for standard slot 7 operation.

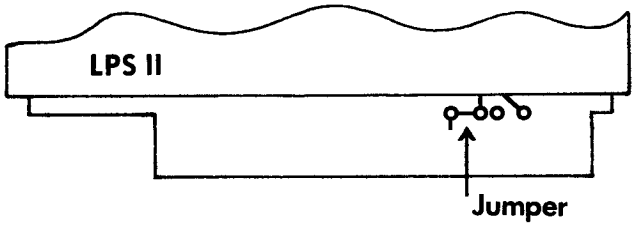
TAKE THE FOLLOWING STEPS TO INSTALL THE LPS II IN A SLOT OTHER THAN SLOT SEVEN.

1" DISCONNECT YOUR COMPUTER'S POWER CORD -

This assures that the power cannot be accidently turned on during installation.

2" CUT THE JUMPER ON THE LPS II PC BOARD -

Place the LPS II electronics module in front of you with the label up , and the light pen cord comming out on the left. You should see the copyright notice that reads: "COPYRIGHT C 1982 BY GIBSON LABORATORIES IRVINE, CA". Looking at the California abbreviation 'CA' you will see that the CA is exactly between two holes in the circuit board. These are called pads. There is a connection between these pads underneath the printing of the CA. This is the jumper connection that must be cut. Using a very sharp knife blade, cut the jumper. To assure that the connection is broken, the circuit board trace should be cut near to each of the two pads, and the trace removed in between. SEE THE DIAGRAM BELOW FOR CLARIFICATION.



3" CONNECT YOUR HOOKUP WIRE TO THE RIGHT PAD -

Prepare your wire by stripping about 1/8th inch of insulation from each end. Using the soldering iron and solder, connect one end of the wire to the circuit board at the pad nearest the A of CA. SEE DIAGRAM ABOVE FOR CLARIFICATION.

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4" PLACE THE LPS II MODULE INTO WHICHEVER SLOT YOU HAVE CHOSEN -

The label should be facing away from the computer's power suppy, facing toward the game paddle connection. Loop the Light Pen cord out the back of the Apple and around to the front where it will be used.

5" REMOVE THE 74LS51 FROM ITS SOCKET ON THE APPLE MAIN BOARD -

Reference the diagram below. On the LEFT edge of the Apple Main Circuit Board you will see alphabetic lettering. These letters label the horizontal rows of chips on the Main Board. The 74LS51 is at location C-13. This can be found by counting from the Left to the 13th chip in the "C" row. Recheck the diagram below to be sure you have located the correct chip. The circuit board will be labeled 74LS51 immediately in front of the chip. Also, the chip should be printed with several groups of letters and numbers. One of the groups should contain the characters "74LS51". BEFORE REMOVING THIS CHIP, NOTE IT'S ORIENTATION !!! You absolutely MUST replace it with the same orientation. Pull the chip straight out of its socket being careful not to bend any of it's fourteen pins.

6" INSERT THE FREE END OF YOUR HOOKUP WIRE INTO PIN 8 OF THE SOCKET -

The diagram below indicates pin 8. Insert the end of the wire into this hole. The 74LS51 Integrated Circuit must be replaced into the socket WITH the wire, so bend the wire to the Left out of the way of the chip.

7" REPLACE THE 74LS51 INTO SOCKET C13 -

Finally, the 74LS51 must be replaced in its original socket with its original orientation. The pin which will occupy hole number 8 must coexist with the special wire. CAREFULLY re-insert the chip being careful to make sure none of the pins become bent, and that they all go into the socket correctly. TAKE YOUR TIME - THIS IS THE FINAL AND MOST CRITICAL STEP.

The Non-Slot 7 installation is now complete. With the LPS II plugged into its appropriate socket, and all of the other boards in place, reconnect the power cord and you are ready to enter the world of High-Speed, High-Resolution Light Pen Graphics made possible by the LPS II.

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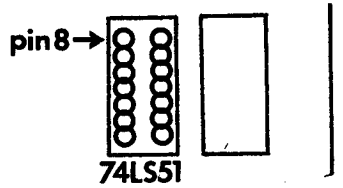

2.4. Getting Started

Turn on your computer and verify that it functions normally, that DOS boots and that programs run. If there is any problem, turn to the section titled "In Case Of Trouble."

2.4.1. Backing Up the PENTRAK Diskette

If you have not already done so, make at least one backup copy of the supplied PENTRAK diskette. Several copies are recommended. As shipped, the PENTRAK MASTER diskette is WRITE PROTECTED. We suggest that you leave it so, and work exclusively from copies.

Turn to page 37 of The DOS Manual provided by Apple Computer with the DOS 3.3 Master Diskette. The sections titled Protecting Yourself Against Disaster and Using The Copy Program will detail all of the steps required for backing up the PENTRAK MASTER diskette.

2.4.2. Booting PENTRAK

Then, with Applesoft active and a copy of the PENTRAK diskette in drive 1, boot the diskette by typing:

```
IN#6
```

HELLO program will be LOADed and RUN.

The HELLO program does several things. First, PENTRAK is BLOADed into memory at location 25000 (decimal). Then control is passed to the PENTRAK configurer with a CALL 25000. The configurer searches through the I/O slots of the Apple looking for the LPS II. When located, it performs a quick diagnostic check of LPS II operation then configures the LPS II for operation in the appropriate slot. When this is finished, PENTRAK is relocated up into high memory just below the Disk Operating System. The Ampersand (&) vectors are then connected allowing PENTRAK to process the additional PENTRAK commands.

NOTE: If another ampersand utility is already connected at the time of the CALL 25000, the configurer recognizes this and arranges to intercept the commands going to the other utility.Then, if PENTRAK is unable to parse the received ampersand command correctly, it resets the text scanner to it's initial point and passes control on to the original ampersand utility. All this means that PENTRAK's use of the ampersand hook does not interfere with other existing ampersand utilities.

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Then, the HELLO program is scanned from the bottom up. The configurer searches for a REMark, and if found, places the balance of the REMark line into the computer's keyboard buffer. This allows another command to be given as if from the keyboard. An example would be:

```
1000 REM RUN INTRO
```

This will cause the INTRO program to be automatically run on the Apple as soon as the PENTRAK installation is complete.

Once PENTRAK is in place, and the Ampersand hooks have been established, the configurer does a DOS ColdStart. This causes DOS to clear out any program in memory (the HELLO program) and to rebuild its Disk I/O Buffers below PENTRAK. PENTRAK has the benefit of sitting between DOS and its buffers. Thus it is completely protected from any of the commands that typically cause the disconnection or loss of other 'hooked-in' systems. There is no command, including FP and INT, which can cause PENTRAK to be lost once connected.

As shipped, the HELLO program runs the short demonstration INTRO. This shows several of the graphics features of PENTRAK, and ends by suggesting subsequent courses of action.

2.4.3. Checkout and Calibration

One suggestion made by INTRO is that the CALIBRATE program be run next. As mentioned previously, video display monitors exhibit varying amounts of internal delay. This is the delay between the time the computer sends a signal meaning Beam-On and when the Beam is actually seen. Although the delays range in the billionths of a second, the result is a horizontal shift in the display of the picture on the screen and would cause incorrect horizontal coordinate readout by the Light Pen if not compensated. The advanced design of the LPS II allows this compensation to be made by the PENTRAK driver automatically. Once calibrated, the PENTRAK driver, carrying this new calibration is re-written to the disk. When Booted again, re-calibration is not required.

The program which performs the calibration is called CALIBRATE. Simply type RUN CALIBRATE to calibrate the LPS II for your system.

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2.4.4. Notes About CALIBRATE

Although the CALIBRATE utility is entirely self-explanatory, several additional comments about its operation may help the user with its application:

* CALIBRATE is the successor to the INSTALL program. Earlier versions of the PENTRAK configurer were not able to locate the I/O slot occupied by the LPS II automatically. These versions required the INSTALL utility. PENTRAK 1.0 (the newest version) obsoletes INSTALL, using CALIBRATE instead.

* The first phase of calibration utilizes a device which Gibson Laboratories calls a Tracking Cursor. Since the Light Pen needs to see light in order to know where it is pointing, the Tracking Cursor provides this light. You'll notice that the cursor will follow the Pen's point all over the screen. Adjust the monitor so that the Cursor's motion is smooth and continuous. If the monitor needs to be set to an uncomfortable brightness, the point of the Pen may be removed to provide substantially more sensitivity. This was designed to allow users to set the Pen's sensitivity and in no way diminishes the Pen's resolution, despite the larger opening.

* If several different monitors are being used frequently, separate versions of the PENTRAK driver may be created by CALIBRATE and saved on diskette under different names. The HELLO program (which loads the PENTRAK drivers) may be modified to ask which monitor is being used, and could then load the proper version of PENTRAK.

* If the Tracking Cursor seems to be tracking too high and/or to the left of the Pen, this is normal. The Pen does not use lensing of any kind. This makes pointing to small images, single lines and dots much easier. It also results in the Pen having an expanding conical sensitivity zone. The Pen is able, therefore, to see the first light that enters this sensitive area. As the CRT beam scans from left to right down the screen, this first light occurs in the upper left area of the Pen's point. This is why the Tracking Cursor may appear to be off-center.

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* When using CALIBRATE, the X Coordinate readout fluctuates because of the Pen's extreme sensitivity. Proper fine-tuning has been achieved whenever both X=0 and X=279 can be reached, if only for a moment, at the left and right extremes of the monitor's edges. If this eludes you, increasing the monitor's brightness and/or contrast may help to get the monitor to show these coordinates.

* CALIBRATE forces a BLOAD of PENTRAK. It uses the un-relocated copy of the driver for modification and disk re-write.

* If saving multiple copies of the PENTRAK driver seems needlessly wasteful of your diskette space, there IS an alternative. The variable OFF in CALIBRATE is the user's horizontal OFFset. Following the RUN of CALIBRATE, this variable may be printed. The location where this value is stored in PENTRAK is pointed to by two locations in lower memory. The location may be read by the following expression: LOC = PEEK(24996)+PEEK(24997)*256
This is only valid immediately after running CALIBRATE. Record the value of LOC and OFF, and use these in your program. To set the offset, simply: POKE LOC,OFF . This will poke the offset into PENTRAK at ANY time that PENTRAK is linked in and running. In this way your applications can ask which monitor is being used, and can set PENTRAK accordingly.

2.4.5. A Quick Sample Program

Following the Calibration of the Light Pen System a short PENTRAK program may be written to show some of the basics of the PENTRAK driver, and of Light Pen Graphics:

Remember to type NEW to erase any old program:

Sample program:

```
10  HGR2 : &INIT
20  X = 140 : Y = 96
30  &TRACK(X,Y,KEY,LINES)
```

The syntax and commands of PENTRAK will not be discussed at length in this preliminary Owner's Manual. We simply want to verify that the basic light pen functions are working, and that the Pen has been installed properly. RUN this program. The screen should turn black, with a lit tracking cursor seen in the center and flashing lines running through it's center. Pointing the Pen at the square should

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result in the tracking cursor locking onto the Pen's location and tracking its positon around the screen. If the lines are flashing and the cursor is tracking the Pen's location, the Pen has been installed correctly, is calibrated, and is working properly. The intensity of the computer's monitor may need adjustment for reliable tracking. If the lines do not flash or the cursor will not track the Light Pen's point, backup and recheck everything you have done so far.

If the cursor does respond to the Pen's presence, but jumps violently to one side, it needs calibration. Refer to the section titled: Checkout and Calibration.

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3. The PENTRAK Driver

The Light Pen System is as much a product of software as of hardware. The PENTRAK driver is this software support module for the LPS II. Written entirely in machine language for maximum speed and capability, PENTRAK extends the APPLESOFT language by adding a full set of special high-resolution graphics commands and light pen support functions. The designers of Applesoft provided for this kind of language enhancement through the use of the Ampersand (&) Hook.

The PENTRAK driver is composed of two parts: The Configurer and the Pen Driver. The Configurer is that portion which is actually called by the CALL 25000 following its loading by the BLOAD PENTRAK statement. The Pen Driver is loaded into memory with the Configurer, but is then copied up into high-memory where it becomes operational. Prior to the Pen Driver relocation, the Configurer scans the Apple's I/O slots, locates the LPS II electronics module, copies the Pen Driver up into high-memory just beneath DOS 3.3 and modifies the Pen Driver for operation with the LPS II in the correct slot. Configurer also scans the program in Applesoft's territory at the time of the CALL 25000 and places the contents of the text following the last REM statement into the keyboard input buffer so that any other command can be executed, or other programs executed.

In practice this is all very transparent to the user. It all happened the first time you booted the PENTRAK SOFTWARE diskette, and is really much more straightforward than it sounds. For a perfect example of this BLOAD, CALL 25000 and REM sequence, LOAD and LIST the HELLO program on the PENTRAK SOFTWARE diskette.

The Pen Driver portion of PENTRAK is loaded into the RAM memory area of the Apple, sitting just underneath the Disk Operating System (DOS) and above DOS's file buffers. It is thus tucked in between the two, being both protected from, and ignored by, Applesoft programs.

PENTRAK interfaces to Applesoft application programs through the use of the ampersand (&) hook. Whenever the Applesoft syntax parser runs across an ampersand (&) in an Applesoft program, it immediately jumps to locaton 3F5(hex). This unconditional jump allows user-provided language parsers (like PENTRAK) to take over the task of command interpretation. This in turn allows the use of PENTRAK commands in an Applesoft program in a simple and efficient way.

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To load the PENTRAK driver simply type the DOS command:

```
BLOAD PENTRAK 1.0
```

This can also be typed by your HELLO program with the following statement:

```
PRINT CHR$(4);"BLOAD PENTRAK"
```

The program called HELLO supplied on the included PENTRAK software diskette does just that. The BLOAD loads the Binary Image of the PENTRAK driver into RAM just above the second HI-RES page. It must then be relocated underneath DOS and linked into the Ampersand Hook of Applesoft. This is all performed automatically for you by typing the command:

```
CALL 25000
```

Doing so will move PENTRAK up into the DOS area, and the hooks will be setup. Following the CALL 25000, if the calling program had ANY remark statements, the text following the LAST REMark is used as input to the computer as if it were typed. This allows a follon-on program to be run. For example:

```
50  REM RUN MENU
60  CALL 25000
```

Will run the MENU program automatically after the PENTRAK driver has been relocated and linked.

A simple test of PENTRAK's presence may be made by typing a simple PENTRAK command such as &TP If PENTRAK is loaded and hooked in, nothing will appear to happen since this command requests a switch to the Text Primary page...where you already were. If, however, PENTRAK is not present, Applesoft will complain about the syntax of the statement. One further and more convincing test can be made by giving PENTRAK an unrecognizable and incorrect command such as &TX
Seeing this, PENTRAK will give you a syntax error message of it's own, and you'll know PENTRAK is listening.

WARNING * WARNING * WARNING * WARNING

The sequence required to load and link PENTRAK (BLOAD PENTRAK followed by CALL 25000) will result in clearing ANY Applesoft program which might be in memory at that time. For this reason, PENTRAK should always be loaded and linked as soon as you boot DOS and before starting any other programming. The

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best place to do this is in a HELLO program like the one provided on the software diskette.

If you have forgotten to load and link PENTRAK and want to use its features or the Light Pen, save any program currently in memory to the Disk and get PENTRAK up with the standard procedure, then reload your saved program. PENTRAK is so easy to have around, you'll probably find it easier to put a copy of PENTRAK on every DOS diskette and make loading it a standard boot procedure.

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3.1. PENTRAK Command Syntax

This Preliminary Owner's Manual lacks the comprehensive explanation of PENTRAK's complete syntax and command structure which will exist in the final Owner's Manual.

> A copy of the final Owner's Manual will be sent to all purchasers of Light Pen Systems who have received this preliminary manual.

In lieu of the final PENTRAK documentation, the following expanded PENTRAK Reference Guide will provide the Applesoft programmer with the essentials of the PENTRAK driver's operation. Coupled with an analysis of the Applesoft applications which have been included on the PENTRAK SOFTWARE diskette, custom applications may easily be written.

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LPS II - PENTRAK ... Reference Guide

--- --- --- --- --- OVERALL SYNTAX RULES --- --- --- --- ---

1. BEGIN each Pentrak statement with the ampersand (&).
2. END each statement with a carriage return (CR) or colon (:).
3. COMBINE any combination of COMMANDS and OPTIONS.
4. SEPARATE each COMMAND and OPTION with a comma (,).
5. SPELL every COMMAND and OPTION exactly.
6. ABBREVIATE any commands which involve parenthesis.

--- --- --- --- --- --- COMMANDS --- --- --- --- --- ---

INIT

Initialize:
Presets various PENTRAK options to a known initial state as follows:

1" Turns off Click-On-Escape mode
2" Sets Mapping to MAP1
3" Sets NOMIX
4" Sets Vert and Horz Trigger Modes to 0
5" Sets the default LINES on and off times
6" Sets Glitch Filter coefficient to 10
7" Sets Click duration and frequency to 10,20
8" Sets Hi-Res Typeface to 0

It is a good idea to INIT at the beginning of every program. Many of the Options to PENTRAK are 'sticky', that is, once specified, the option keeps its value until changed. This was done so that constant option specification would not be necessary. The INIT option essentially tells PENTRAK that a new program is running, and that all options should be reset to their initial values.

TRACK(h,v,opt,opt,...)

Track Function:
This is the main PENTRAK function. It automatically generates a Hi-Res Tracking Cursor on top of the current-drawing Hi-Res screen. This cursor tracks the Pen's point and allows Pen positioning even on a black screen. The OPTIONS outlined below may all be used with the TRACK mode function, and alter its operation accordingly. The full 60 cycle rate allows complete animation and sketching similar to the functioning

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of the graphics tablet. The first two arguments to the TRACK function, shown as h and v above, are Applesoft variables which deal with the horizontal and vertical position of the Pen. The values of the variables MUST be legal Hi-Res coordinates at the time of the TRACK call (0^=h^=279 and 0^=v^=191). The Tracking Cursor initially appears centered at this Hi-Res location and remains there until the Light Pen sees CRT light. At that time the Cursor immediately moves to the exact position of the PEN HIT. This process repeats and gives the illusion of the Tracking Cursor being locked to the point of the Pen. Tracking must be terminated in some way so that the calling Applesoft program may receive the final coordinate value and proceed with its task. This is accomplished with a technique called ESCAPE MODES. There are many escape modes available with the TRACK and PEN functions. The KEY Escape Mode returns control to Applesoft when any keyboard key is pressed or when either of the paddle buttons are pressed or released. The ZV (Zero Velocity) Escape Mode returns control when the Pen has been relatively motionless for the duration specified by the user. When the TRACK mode ends, the Hi-Res screen is left as it was, and the variables being used for h and v contain the new location of the Pen at the instant of the escape.

The exhaustive array of options can be used together in an almost limitless combinations. Options exist for showing blinking crosshair lines through the center of the Tracking Cursor; for making the Tracking Cursor dim so the image underneath may be seen through and yet still allow tracking; for specifying only horizontal or vertical lines or horizontal or vertical motion only of the Tracking Cursor; for ignoring erratic electrical noise impulses if the Pen must be operated in a noisy environment; for specifying that the resolution of the Hi-Res page should be lowered to allow prescise point placement (as on graph paper); for specifying that the right and/or bottom margins of the screen will be reserved for Light Buttons which may be punched at any time by the Light Pen for program response; for issuing an audible click upon escaping for the function; and even for eliminating the Tracking Cursor if the screen data will be mostly white with black lines. The various options are described separately below. The Word TRACK may be abbreviated T.

An example Track call is: &TRACK(X,Y,KEY,LINES,CLICK)

This will generate a Tracking Cursor at the initial X,Y coordinate, will track the Pen until any keyboard key is depressed, and will show flashing dotted crosshairs passing

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through the center of the Cursor. As soon as a key is depressed, the Tracking Cursor and flashing lines will dissappear from the Hi-Res screen, an audible click will be generated, and the Applesoft variable KEY will contain the ASCII code of the key which was hit to cause the escape from the TRACK function.

PEN(h,v,opt,opt,...)

Pen Function:
The PEN function differs from the TRACK function in that PEN operates in ANY of the Apple screen modes. Unlike TRACK, it assume that something will be on the screen to be seen by the PEN. Pen does not generate any Tracking Cursor, but is a sophisticated method for returning Pen locations to Applesoft. The syntax for the PEN function is similar to that of TRACK, and the Escape modes may all be applied in a similar fashion. Essentially, PEN waits for a PEN HIT and returns with the current location of the Light Pen. Alternatively, PEN may wait for a keypress or zero pen veloctiy before returning to Applesoft (see options KEY and ZVn). PEN may be abbreviated &P(...).

WRITE(h,v,string)

Write Hi-Res Text Function:
Unlike the preceeding two functions, WRITE has nothing to do with Light Pen functions. It has been provided to ease the creation of meaningful graphics applications. WRITE places text onto the Hi-Res page by XORing the text into the existing image. This means that text automatically appears white on a black background and black on a white background. The FACE function/option allows the specification/selection of multiple character sets which may be used interchangeably. The characters are completely compatible with the DOS Tool Kit Hi-Res Text, and occupy seven bits horizontally by eight bits vertically. The h and v variables specify the starting upper lefthand coordinate of the first character typed in the string. The string may be any legal, complex Applesoft string expression. The default typeface is FACE0, is loaded with PENTRAK, and is always available without loading. It is built-in. An additional advantage of the XORing operation, is that anything again XORed removes itself from the screen, thus text may be erased in this fashion ... but there is as better way ... (see the FRAME command below).

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An example of the WRITE function is:

```
M$ = "NOW IS THE TIME FOR ALL GOOD"
&WRITE(140-3.5*LEN(M$),92,M$)
```

This will place the message set in M$ in the exact center of the Hi-Res screen.

FRAME(x1 TO x2 AT y1 FOR n,memloc)
FRAME(memloc,x1 TO x2 AT y1 FOR n)
FRAME(B,x1 TO x2 AT y1 FOR n)
FRAME(B,x1 TO x2 AT y1 FOR n,memloc)

Frame Function:
The frame function, like the WRITE function above, does not have any direct connection to Light Pen function, but greatly eases the creation of significant Applesoft Hi-Res graphics programs. Essentially, FRAME allows rectangular windows to be created in the Hi-Res screens of the Apples. Into these windows or frames can be placed text or other graphics. When finished, the window can be 'closed' thus removing the text and restoring the image to its initial condition. The concept is simple: A Frame is specified by four parameters. (See the instances above) x1 is the leftmost horizontal coordinate of the frame. x2 is the rightmost horizontal. y1 is the starting vertical point at the top of the frame, and n is the vertical line count of the frame. Once specified, the data contained within this frame may be moved to any other location in memory. While this is happening, the Hi-Res screen can be prepared for the typing of text by setting the frame domain to solid black or white. In the first example, the frame described is transferred to the linear memory area starting at location memloc. The frame is not changed, it is merely saved. In the second example, a linear memory area is transferred into the specified frame. The third instance above shows the frame being made completely black (the B or W) without its data being saved anywhere for resurrection later. Finally, the fourth example shows the frame being made black while the data overwritten is being saved starting at location memloc. This would allow text or any other image to be drawn in, and later erased with the original frame data restored by using the second example above. As can be seen by examination, the "B" and "W" are triggers which specify the frame to be filled with black or white respectively. If a non B or W argument precedes the frame domain specification (as in the second example) the Apple's memory is read out starting at location memloc into the frame and onto the image

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plane (Hi-Res page). If an argument follows the frame specification, the contents of the frame are stored starting at location memloc. They are stored before being optionally made black or white.

The power and flexibility of this simple command will be fully utilized in forthcoming application software.

XLINES(h,v,opt,opt,...)

Xor Lines Function:
Draws horizontal and vertical dotted lines crossing at any Hi-Res location specified. Lines are drawn by Exclusive-Oring and are erased by a second XLines at the same location. Abbreviate &X(...).

ZOOM(h,v)

Zoom Function:
Very quickly zooms any 40h by 24v area of either Hi-Res screen onto the primary text page. Abbreviate &Z(...).

CLEANUP

Cleanup:
Removes any 'debris' which the TRACK function of PENTRAK may have left on the Hi-Res screens if RESET was hit by mistake while TRACKing. If the Tracking Cursor or the blinking Lines were on the Hi-Res screen at the time, they may be removable. CLEANUP cannot guarantee to remove Tracking debris, because there is no telling where the program was when the RESET is hit. However, if an image is damaged in this way, CLEANUP represents a ray of hope. In general, always use applications which exit from TRACK mode gracefully, as with KEY or ZV.

START

Start Pen:
Conditions the Light Pen to begin looking for a Pen Hit.
The START command must be given prior to a PEN command, since PEN merely returns when first light is seen. START may also be used for clearing the PEN HIT status of the Pen at any time so that any erroneous Pen Hits may be ignored.

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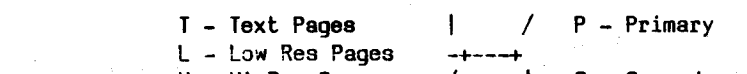
CLICK!(dur,freq)

Click Mode Function:
Frequently, polite audible feedback helps coordinate complex tasks. CLICK requests that PENTRAK functions TRACK and PEN give an audible Click sound upon exiting (escaping). The default duration and frequency are set for an audible but pleasing response. If the exclamation point is present as shown above, then the Click-on-exit mode is not engaged, but rather an immediate click sound is generated. This can be used for producing an array of special sound effects from Applesoft programs. The Click call may be abbreviated "C" when a duration and frequency are being specified, otherwise it must be spelled out in full.

TP
TS
LP
LS
HP
HS

Screen Mode Selection:



These six, two-character commands have two functions: When used outside of the TRACK function parenthesis, they cause an immediate switch to that screen display mode. When used within a TRACK function, they activate the Screen-Lift Function and specify which screen is to be viewed behind the main screen.

CHP / CHS

Clear Hi-Res Primary / Secondary:
Immediately clears the entire Hi-Res page to black.

DHP / DHS

Draw Hi-Res Primary / Secondary:
Specifies which Hi-Res page the Applesoft Hi-Res and PENTRAK functions will be working with.

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Throughout the discussion of PENTRAK functions and options we refer to the "current Hi-Res page". This has NOTHING to do with which page of memory is currently being displayed and hence seen, but rather refers to which area of screen memory is being DRAWN upon by the various commands. This a VERY important concept, which may be a bit difficult for Applesoft programmers because Applesoft never makes a distinction. With Applesoft, the page you see is the page drawn upon by HPLOT and DRAW. PENTRAK changes this by allowing specification of the VIEWED PAGE (via TP,HP,HS,etc.) separate from specification of the "current Hi-Res page".

The Applesoft commands HGR and HGR2 could be used for this function, and they can be, however HGR and HGR2 also force a clear of the respective Hi-Res page and switch that page into view. For this reason DHP and CHP exist. They do nothing other than specify which screen will receive the attention of the computer's drawing functions whether they be HPLOTs, DRAWs or the PENTRAK functions: TRACK, XLINES, FRAME, WRITE, ZOOM, CLEANUP, and NEG.

NEG

Negate:
Immediately negates the entire current Hi-Res Page.

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--- --- --- --- --- PENTRAK FUNCTION OPTIONS --- --- --- --- ---

KEY

Key Escape Mode:
As discussed in the description of the TRACK function above, the optional specification of Escape Modes provides the "triggers" which terminate the PENTRAK function in process and return control to Applesoft. Escape modes are absolutely essential in TRACK. Without an escape mode specified TRACK will NEVER quit. Hitting RESET would be the only out, and this aborts Applesoft's execution as well.

KEY is the most used and useful escape mode.

WHEN USED IN THE PEN OR TRACK FUNCTIONS, KEY MUST BE THE THIRD PARAMETER SPECIFIED. IT MUST APPEAR IMMEDIATELY AFTER THE HORZ. AND VERT. VARIABLES. THIS IS THE ONLY RESTRICTION ON THE PLACEMENT OF OPTIONS TO THE FUNCTION CALLS.

The use of the KEY argument as the third argument to the TRACK or PEN functions instructs them to return to the calling Applesoft program as soon as a key is hit, or the paddle buttons change state from the state they were in when the function was started. When control is returned to Applesoft, the variable KEY will have been created, and will have a value which uniquely specifies the reason for the escape.

If KEY is less than 128, a key hit caused the return to Applesoft, and the value of KEY is the ASCII code for the key which was hit.

IF KEY is 128, 129, 130 or 131 then a paddle button change caused the return. The value of KEY can be interpreted as follows:

KEY	BUTN0	BUTN1
128	0	0
129	1	0
130	0	1
131	1	1

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The button combinations shown are the new combination as of the exit time from PENTRAK.

IF KEY equals 255, a key hit did not trigger the escape from PENTRAK, but rather one of the other escape modes did.

ZVn

Zero Velocity Escape Mode:
The Zero Velocity Escape Mode is the second of the two escape modes currently implemented in PENTRAK. It frees the user from the need to hit ANY keys or buttons to escape back to Applesoft, but rather merely requires that a succession of screen coordinates be received at substantially the same location. In other words, the Pen's velocity must be zero for some set time interval to trigger an escape from the function.

For example, since the coordinates are always being received at the rate of sixty per second, if we require that thirty be received at one location, then the Pen would have to be held stationary for 1/2 second to qualify for return.

This mode of return finds great use in menu selection ... you would not want the computer to pickup the first thing it sees, but want the pen to come to rest before triggering a menu selection.

Specification of the ZV option takes the following form:

```
&TRACK(X,Y,ZV30)  ...or...  &PEN(X,Y,ZV30)
```

... where the number immediately following the ZV option is the number of screens (at 60 per second) required for escape mode qualification. The general syntax of the specification would be:

```
&^TRACK or PEN" (h,v,ZVn)   :   0 ^= n ^= 255
```

... where "n" can be any legal expression which evaluates to between 0 and 255. For example, the following call allows the specification of ZV delay in seconds. The number of seconds, or fractions of seconds is in the variable T:

```
&PEN(X,Y,ZVT*60)
```

PENTRAK will see the ZV, and will then interpret the following formula not matter how complex.

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"n" = 0 is a VERY special case. The PEN function returns to Applesoft immediately following the receipt of a peh hit if neither KEY nor ZVn have been specified. The operation of TRACK is not similar. IF the programmer wishes to have TRACK return as soon as the first pen hit is received, this action can be achieved by specifying a ZV of 0 ... or ZV0. This is the method by which freehand sketching is accomplished.

LINES
LINES(on,off)

Lines Option Mode:
Frequently, the Light Pen needs to be aligned with some other point on the screen of the Apple. By providing exactly horizontal and vertical dotted flashing lines running through the center of the Pen, the alignment task is made much easier. Merely specifying LINES to PENTRAK's TRACK function does all this for you:

&TRACK(X,Y,KEY,LINES)

This will generate the lines, flashing at the default rate of 4 screens ON and 2 screens OFF. The cycle time is then 6 screen times, which at 60 screens per second would be 10 flashes per second. This too may be altered by the programmer. Whenever the LINES option is followed by parentheses, the ON time and OFF time is set. This allows the flashing rate or the relative ON to OFF time to serve as a visual que to the user. Both these formats are acceptable:

&LINES(10,10) ...or... &TRACK(X,Y,ZV30,LINES(1,1))

There is a special case for the LINES option which allows the lines to remain ON until they must move to another location. If the OFF time is set to zero, the Lines will not flash, but will stay visible continuously.

Once the flashing rate has been specified, it remains until explicitly changed. Thus, once the command &LINES(1,0) has been given, the non-spec usage &TRACK(X,Y,KEY,LINES) will have non-flashing Lines. This is an example of a good reason to issue the &INIT command at the start of every program. &INIT resets all of the 'sticky' options to their initial default values and conditions.

LINES generates very sharp looking, professional displays. (It wasn't easy to do either !!!)

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RT

Rough Terrain Track Mode:
One of the problems with using the Tracking Cursor on a substantially black screen is that it covers up so much of the picture underneath it. The Tracking Cursor HAD to be that size to allow a reasonable tracking rate across the surface of the CRT. To prove this to yourself, while on the Apple's text page, hit a series of ^RETURN"s until the screen is scrolling up and you are at the bottom, then type the following PENTRAK command line:

&INIT,HP,MIXED,CHP,DHP,T(140,96,KEY)

This will INIT PENTRAK, switch to the Hi-Res primary screen, specify mixed Hi-Res and text, clear the primary page, and specify that drawing (tracking) is to occur on the primary page. Next, TRACK's Tracking Cursor will appear in the center of the screen and will track the Pen until you hit any key. Don't hit a key yet, just watch the position of the cursor as you track across the screen at increasing speeds. You will notice that the cursor begins to lag behind the Pen's point. Remember, the cursor's position is being updated at the full screen rate 60 times per second. Even so, if you move the Pen too fast, you'll LOSE the Tracking Cursor. We conducted many tests with cursor size before arriving at this size. You would not want the cursor to require any slower tracking than it does currently, but any decrease in size would result in the Pen losing the Tracking Cursor at a much lower velocity.

However, we found an answer!!!!!

ROUGH TERRAIN TRACKING

The real problem is not the size of the cursor, but the amount of screen covered. If the terrain over which the Pen is being drawn is rough, that is, if there is a lot of information there, it becomes necessary to see underneath the cursor WHILE you point at some detailed location. TRACK's Rough Terrain tracking option solves this problem.

If the Pen is being pointed at some detail on the screen, it is not being tracked at anywhere near full velocity. This means that the cursor does not really need to be present all of the time. If it went away for a short time, then came back to see if the Pen had moved, the user could see the picture most of the time, and the Pen could see the cursor only when

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it really needs to. But, if the Pen started moving fast, the cursor would need to be on more, and maybe even on steadily. But, when the Pen slowed down, and if it seemed that it was slowed down to stay, the cursor could again begin flickering. Believe it or not, we did all that!!! It's called Rough Terrain Tracking, and it is triggered by an "RT" in the TRACK command:

&TRACK(X,Y,KEY,RT)

If you hit a key now to exit that last tracking experiment, you'll notice that the computer is unhappy about something you typed. We specified the h and v to TRACK with numbers rather than with the variables TRACK requires. We did that so we would not have to say: X = 140 : Y = 96 first to setup the starting position for the Tracking Cursor. When PENTRAK tried to store the final coordinates of the Pen into the NUMBERS 140 and 96 it naturally had a problem. You can try out the RT option in a similar manner as above.

We like setting up the screen as above, because you can see what you're typing and its effect on the Hi-Res screen at the same time.

The resultant effect achieved with the RT option is all that anyone could desire given the constraints and tradeoffs.

HLO / VLO

Horizontal / Vertical Lines Only:
Specifies that only one of the normal two lines (either the horizontal or the vertical) is to be drawn. This option is useful in both TRACK and XLINES functions.

HMO / VMO

Horizontal / Vertical Motion Only:
Occasionally, tracking in only one direction, horizontal or vertical, can be useful. The two options HMO and VMO restrict the allowable motion of the Tracking Cursor in either the horizontal or vertical direction. In use, the Tracking Cursor will appear at it's initially specified location, and will not move in one of the dimensions.

The HMO and VMO options are useable with the PEN function. With these options, the range of qualifying pen hits is restricted to a specifiable horizontal or vertical band across the screen. For details on this, see the Glitch Filter

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discussion below.

HTM / VTM

Horizontal / Vertical Trigger Margin:
A frequent technique for achieving effective interaction with light pens involves the use of on-screen menus in the form of "Light Buttons". These are ever present visible blocks containing text. They sit out of the way in the margin areas of the graphics screen but can be "punched" with the Light Pen as one would punch a button on the panel. The advantages of Light Buttons are clear.

1" They are in the main vision area of the operator, and do not require that attention be diverted away from the screen to search for a switch.

2" They are software definable/redefinable. Rather than being assaulted by a confusing array of hardware buttons, the application can display only those choices immediately relevant to the task. They are thus mode dependent, and can guide the operator through the proper sequences.

3" Being defined in software, the button selections can change as the application's evolution dictates.

With Light Buttons being as useful as they are, PENTRAK should hardly be without a provision to facilitate light button interaction. The HTM / VTM options provide this facility.

The HTM option provides a horizontal zone along the bottom of the display screen wherein the Zero-Velocity Escape Mode can function. The HEIGHT of the trigger zone is specified by the value of the argument following the HTM. For example:

&TRACK(X,Y,KEY,ZV15,HTM8)

This command will activate the TRACK function with KEY Escape Mode active for the majority of the screen area. A Zero Velocity Escape zone will also be created along the bottom of the screen, one character high. Normal drawing can proceed over the surface of the screen, but if the Pen enters the ZV zone, and is motionless for the ZV time (1/4 second) the TRACK function will terminate with KEY set equal to 255. The value for X can be used to determine where along the bottom of the screen the Pen was pointed.

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PENTRAK's built-in Hi-Res text capabilities via the WRITE and FRAME functions provide a complete facility for the operation and generation of Light Buttons.

The VTM (Vertical Trigger Margin) functions in an identical fashion to the HTM but the margin is along the right side of the display screen.

The HTM / VTM margins are 'sticky'. INIT sets them to zero, but nothing else will if Applesoft does not. To turn the Light Button / Trigger Margins off, simply issue the command: &HTM0,VTM0

Additionally, the Vertical Trigger Margin also sets the LIFT MARGIN WIDTH for the Screen Lifter option. If the Screen Lifter option is specified, vertical margin zero velocity triggering will not occur. Rather, the VTM option controls the width of the Screen Lifter trigger margin. Therefore:

```
&TRACK(X,Y,KEY,VTM12,TP)
```

will activate the Screen Lifter (due to the TP inside of the TRACK parenthesis) with a lift margin width of 12 Hi-Res points. Specification of any screen switch command (TP, TS, LP, LS, HP, HS) within the bounds of the TRACK function parentheses activates the Screen Lifter. The instant the Pen point is seen, the screen mode is changed to that which was specified.

GFn

Glitch Filter:
There is no other Light Pen System for the Apple on the market because Light Pen Systems are not very easy to design. One of the problems to be solved involves the handling of completely erroneous data points. Any real-world system picks up a certain amount of extraneous noise. In the Light Pen System we call these "Glitches". Handled correctly, the user need never be aware of the existence of these glitches. The Glitch Filter is the technique which shields the user from the glitch. This filtering system is so effective and inoffensive that it is active by default all of the time. The degree of filtering is continuously variable over the range 0 to 255. The default setting made by INIT is 10. Bigger numbers are cause filtering.

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The only negative effect that might ever be seen with very small glitch filter settings (less than 5) is slowed recognition of the Pen's motion. This would affect tracking on both black and even on an all white screen. The glitch filter will refuse to keep up with the Pen, confusing the rapid motion with noise due to its extreme sensitivity at such a low GF setting.

In general there is probably no reason ever to bother the glitch filter. There is only one exception to this rule:

If the HM0 or VM0 options are being used, the target area of the glitch filter is artificially locked in the dimension specified. Pen hits outside of this target region will be completely ignored. The center of the target area is the location initially specified in the function call. For example:

```
X=20 : Y=0 : &GF4,PEN(X,Y,ZV5,VM0)
```

will create a vertical sensitive bar running down the screen. The bar will begin at X=16 and stop at X=24 and will extend from the top to the bottom. If the Pen is within the bar, and with zero velocity for only 1/12th of a second, the PEN function will terminate. This feature could be used to good advantage for menu option selection on the text page with a vertical line of light buttons centered at X=20.

MAPn

Mapping Option:
Many real-world graphics applications are much more structured than simple freehand sketching. One the the first things seen is the need to reduce artificially the input resolution of the Light Pen. This is the equivalent of drawing on graph paper. The graph line intersections are used as registration points, and as endpoints for all images drawn. This has the effect of cleaning-up the freehand drawing, since only aligned points are returned from PENTRAK. Imagine drawing as with a T-square ... without one.

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The MAP option takes an argument which is a power of 2. Acceptable arguments are then 1,2,4,8,16,32,64, and128. With a MAP setting of n, the points returned by PENTRAK all fall on exactly even multiples of n. No matter where the pen is pointed on the screen, PENTRAK returns the coordinate of the grid intersection NEAREST to the Pen's point. The resolution of the grid is n.

The MAP function is very 'sticky'. INIT sets it to MAP1.

MIXED

Mixed Mode:
Specifies that mixed text and graphics will be shown whenever the primary Hi-Res page is selected.

NOMIX

No Mixed Mode:
Specifies that the primary Hi-Res page will be viewed without four lines of text at the bottom.

FACEn

Typeface Select:
This command simply tells the WRITE function which typeface to write. The default is FACE0. FACE is sticky and is set to 0 (the default built-in face) by INIT. The alternate typefaces may be loaded by the TYPEFACE LOADER program.

NC

No Cursor:
When tracking on a white screen, there is no need for a white tracking cursor. When NC is included in the a TRACK function the white Tracking Cursor is eliminated.

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Warranty and Service Policy

LPS II WARRANTY

Gibson Laboratories ("LABS") warrants to the original purchaser of the LPS II Light Pen System that it shall be free from defects resulting from faulty manufacture, faulty components or faulty software for a period of ninety (90) days from the date of sale of the LPS II. LABS shall correct any such defects covered under the terms of this warranty, and may elect to repair or replace the LPS II or any of its component parts. In the event replacement is elected by LABS, any replacement unit shall be warranted under the terms of this warranty for the remainder, if any, of the original ninety (90) day period.

LABS' entire obligation under the terms of this warranty shall be the repair or replacement of any defective LPS II hardware or software, and LABS shall in no event be liable for any incidental or consequential damages arising from the use or possession of the LPS II.

For any warranty claims, return the defective LPS II and all supplied software in its original packaging, postage prepaid to Gibson Laboratories, 406 Orange Blossom, Irvine, California, 92714. All warranty claims will be handled promptly by Gibson Laboratories.

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Some states do not allow either limitations on the length of an implied warranty, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

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

SERVICE POLICY

For service requirements during the warranty period, promptly return the LPS II and all supplied documentation and software with proof of purchase, to Gibson Laboratories, at the address above. Should the LPS II require repair after the warranty period has expired, it will be repaired of replaced for a flat fee of $55.00, prepaid. This does not cover damage due to negligence or misuse. Return the LPS II post paid, with full payment to Gibson Laboratories at the address above.

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5. Subject Index

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