51

PEN SYSTEMS AND TOUCHPADS

CHAPTER AT A GLANCE

One of the greatest complaints about personal computers has been their input devices. Keyboards and mice are remarkably effective tools for entering text or making selections (clicking and dragging), but these are not *natural* for humans to use. Keyboards and mice often intimidate many novice PC users, and many veteran PC users suffer from repetitive stress injuries as a result of odd finger and wrist motion. PC designers have responded to these problems by developing new input devices such as pen-based tablets and touchpads. *Pen-based tablets* (Figure 51-1) replace the mouse with a pointing "pen" (or "stylus") that is used against a sensitive electronic tablet in the same way we would use a pen against a sheet of paper. Pen-tablets can work just like a mouse, but they can also be used as very versatile "brushes" in painting and other graphic design/editing software. Pen-based input also provides a means for basic handwriting and signature recognition. The newest generations of personal digital assistants (PDAs) and super-small mobile computers are made possible by the use of pen-tablets integrated into the LCD assembly. By contrast, *touchpads* (Figure 51-2) are small, low-resolution tablets that are used almost exclusively to replace the mouse. By running your finger along the touchpad, you can move the mouse and perform other mouse-type gestures like clicking, double-clicking, and dragging. Touchpads are most popular in new mobile computers, though some high-end keyboards are also incorporating a touchpad instead of a trackball. This chapter explains the basic operation of pen-tablet and touchpad technologies, and examines a series of related symptoms.

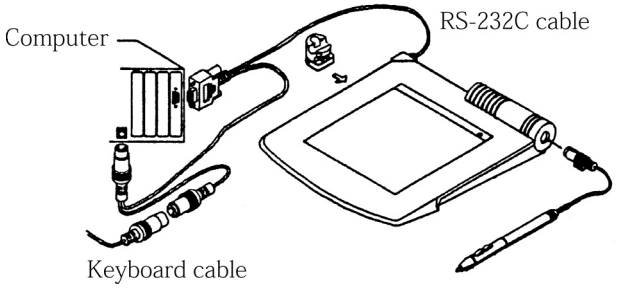

FIGURE 51-1 A popular pen-based tablet

FIGURE 51-2 A popular touchpad assembly

Understanding Pen Digitizers

The key to any pen-tablet or touchpad is the hardware system itself, which is referred to as the *digitizer*. A digitizer converts the analog position of a pen (or finger contact in the case of a touchpad) on the contact surface into a set of horizontal (X) and vertical (Y) coordinate data. In most cases, this position data is passed to the host computer through an ordinary serial (COM) port. The operating system and drivers interpret those coordinates and either activate pixels on the display that echo the pen's position (called the *ink*), or respond to a *gesture* according to the rules of an operating system. To interpret cursive (handwritten) characters or gestures drawn with a pen, the operating system compares the size, direction, and sequence of each stroke against information contained in a database. When a match occurs, the computer responds accordingly. For instance, the pen-computer may interpret a "cross-out" pen motion as a delete

command, or as an upper- or lowercase *x*. This chapter covers three major digitizer technologies: resistive, capacitive, and electromagnetic.

RESISTIVE DIGITIZERS

Resistive digitizers are the simplest and least expensive type of digitizer. They are applied in older low-end pen-computer (or PDA) systems. You may encounter two varieties of resistive digitizer: single-layer digitizers and double-layer digitizers. The diagram for a single-layer resistive digitizer is illustrated in Figure 51-3. A layer of conductive transparent film is applied over a protective glass cover. For a pen-computer, the film and glass are then mounted in position over a liquid crystal display module. Notice how the film's four corners are attached to voltage sources switched by the tablet controller chip. In the idle state, all four corners of the film are held at +5 Vdc (low-voltage systems may use +3.0 or +3.3 Vdc).

X and Y coordinates are read in sequence. The tablet controller chip sets up to measure the Y coordinate by switching controls B and C to the ground position. This configuration keeps the top two corners of the conductive tablet at +V and places the two lower corners at ground. Since the tablet film has a known resistance (per square area), linear voltage gradients are set up from top to bottom. When a pen is applied against the conductive tablet, the pen cable carries a voltage to an analog-to-digital (A/D) converter. As the pen nears the tablet top, its terminal voltage nears +V. As the pen nears the tablet bottom, its terminal voltage approaches 0V (ground). The A/D converter translates the analog pen voltage into an 8-, 12-, or 16-bit data word. An 8-bit A/D converter allows the tablet to resolve 256 (2^8) distinct positions in the vertical (Y) direction, while a 12-bit A/D converter lets the tablet resolve 4096 (2^{12}) Y locations. As you can see, more bits used in a conversion allow the computer to resolve finer pen positions.

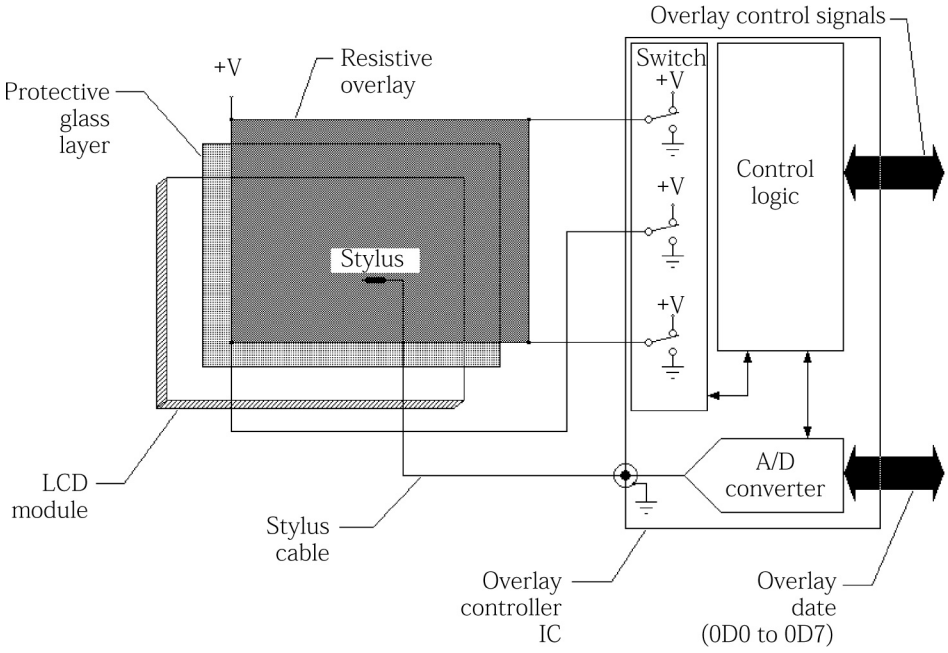

FIGURE 51-3 A single-layer resistive digitizer

Once the Y coordinate is generated, the tablet controller sets up to measure the horizontal (X) coordinate by switching control C to +V and switching controls A and B to ground. This configuration raises the two left corners of the conductive tablet to +V and places the two right corners at 0V (ground). Linear voltage gradients then develop from left to right. Assuming the pen has not been moved since the Y coordinate was just taken, its output voltage now represents the X location. As the pen nears the left of the tablet, its output voltage to the A/D converter approaches +V. As the pen nears the right side of the tablet, its voltage nears 0V.

Double-layer resistive digitizers are a bit more involved, as illustrated in Figure 51-4. The upper conductive layer and controller chip are virtually identical to the components shown already, but the transparent conductive film is laminated to a substrate of clear, flexible polyester. The lower conductive layer is *highly* conductive—virtually zero resistance. The lower layer is bonded to a sheet of protective glass. Upper and lower conductive layers are separated by a series of carefully placed flexible spacers. When a pen pushes the two layers into contact, it is the lower conductive layer (not the pen) that conducts the analog position voltage to the A/D converter. Since no cabled pen is needed, almost any pointing device will suffice. You could even use your finger as the pen. The basic methodology of determining X and Y coordinates is very much the same for two-layer digitizers as for single-layer digitizers.

Resistive digitizers are not without their drawbacks. First, the glass and conductive film(s) placed over the LCD take away from the pen-computer's display visibility. A single-layer digitizer can reduce optical transmission by 15 percent. Two layers can reduce a display's optical transmission by 30 percent or more. Such substantial reductions in visibility can make LCDs unacceptably dark. Additional backlighting can be used to counter the optical reduction, but only at the cost of shorter battery life or heavier systems. Also, resistive digitizers only measure position, not contact pressure. Intuitive pen-based systems should ideally

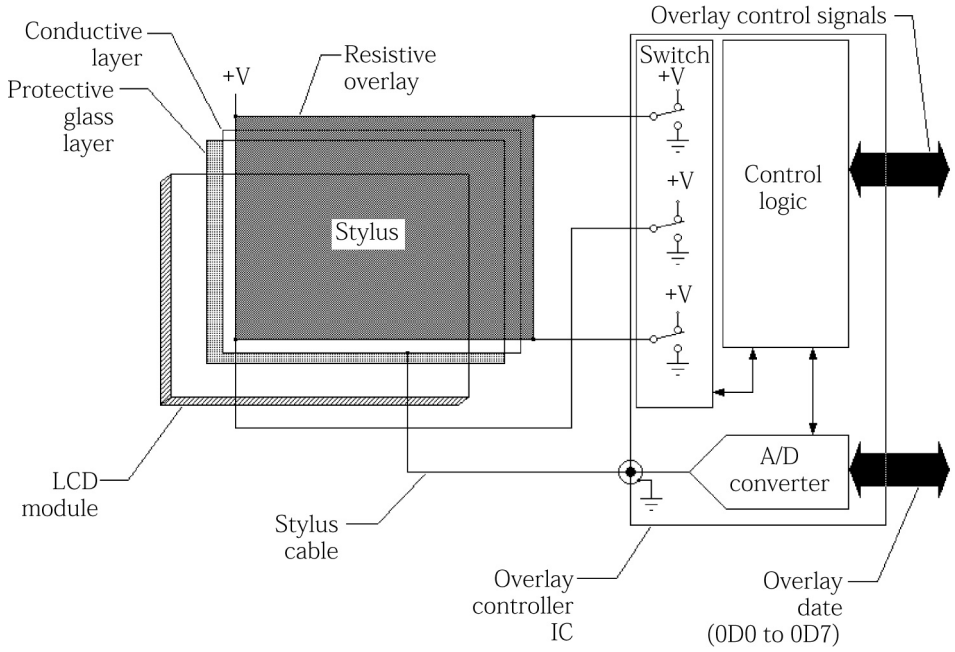

FIGURE 51-4 A dual-layer resistive digitizer

leave darker ink when the pen is under strong pressure and lighter ink when a light touch is used. Since a resistive digitizer simply makes contact (or not), there is little interest in resistive digitizers for *pen-centric* (character recognition–oriented) pen systems. Finally, resistive material tends to drift with temperature, humidity, and wear. Drift can cause inaccuracies that carry over into the digitizer's output.

CAPACITIVE PEN DIGITIZERS

A *capacitive digitizer* (also called an *electrostatic digitizer*) uses a single protective layer of glass with a layer of conductive film bonded underneath, as shown in Figure 51-5. The digitizer controller chip generates a low-power, high-frequency signal that is conducted down the tether wire to the pen tip. As the pen nears the glass, the conductive layer bonded underneath the glass picks up this signal and generates a voltage at that point. This tablet voltage is proportional to pen proximity. The closer the pen is to the glass, the larger the signal will be on the conductive layer, and vice versa. By comparing signal amplitudes from top to bottom and left to right, the digitizer controller chip can extrapolate the pen's X and Y coordinates, as well as its proximity to the glass. Since the pattern of capacitive coupling changes as pen orientation changes, the digitizer controller IC can also detect pen *tilt* and accent the ink feedback to show that tilt.

Capacitive digitizers are an improvement over resistive digitizers because the capacitive approach allows the pen-tablet to sense pen proximity as well as X and Y position. The front glass used in capacitive digitizers makes the tablet virtually immune to wear. On the downside, the tablet must be positioned in front of the LCD, which can reduce the display's visible output by up to 15 percent (for pen-computers only—not for stand-alone pen-tablets). The pen must also be cabled to the system by a wire.

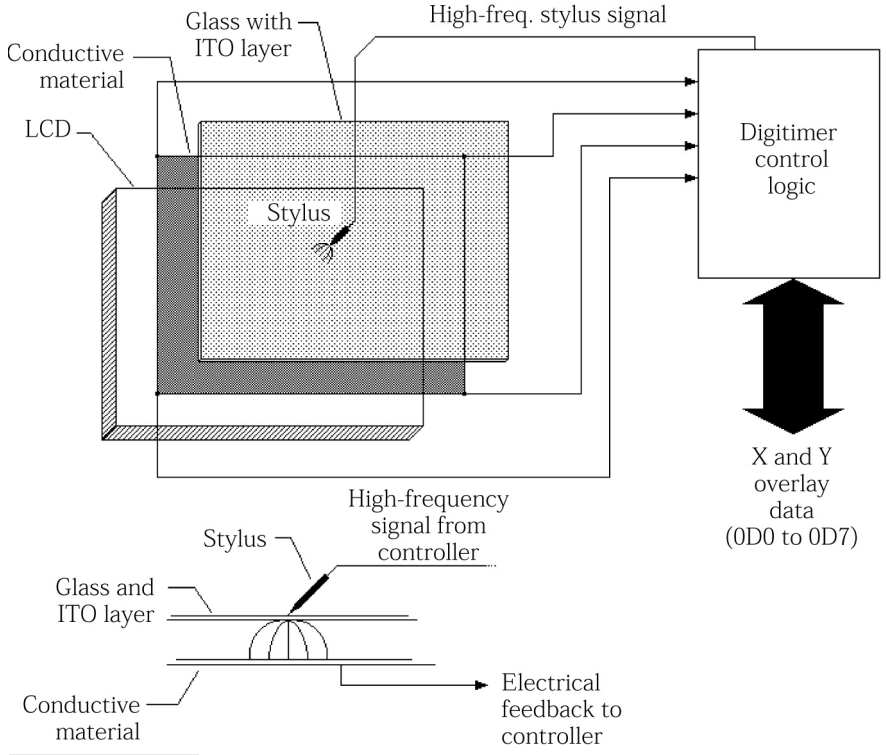

FIGURE 51-5 A capacitive (electrostatic) digitizer

CAPACITIVE TOUCHPAD DIGITIZERS

Many older touchpads use resistive digitizer techniques to detect finger position, but resistive touchpads are often imprecise and suffer from wear. More recent PC touchpads (such as the Cirque "Cat" family) use a variation of capacitive digitizer technology in order to detect finger position. The Cirque touchpad contains a two-layer grid of electrodes that are driven by a custom ASIC mounted on the bottom of the touchpad. The upper layer contains vertical electrode strips, while the lower layer is composed of horizontal electrode strips. The ASIC measures the "mutual capacitance" from each of the horizontal electrodes to each of the vertical electrodes. A human finger near the intersection of two electrodes modifies the mutual capacitance between them (since a finger's dielectric properties are very different from those of air). The position of a finger can then be precisely determined based on these mutual capacitance changes at various locations—and can even be detected before a finger actually touches the pad. This means the wear and tear on a capacitive touchpad is significantly reduced.

ELECTROMAGNETIC DIGITIZERS

An *electromagnetic digitizer* (or *RF digitizer*) is generally considered to be the top-of-the-line digitizer technique for pen-computers. For a pen-computer, a thin glass sheet is placed over the top of a standard LCD and backlight assembly, as shown in Figure 51-6. The glass provides a wear-resistant writing surface for a pen. Glass is also treated with an antireflective coating on its bottom surface (LCD side), and the upper surface is gently etched with mild acid to provide paperlike friction for writing utensils. An RF pen is designed to produce a very low-power, high-frequency RF signal. The transmitter circuit may be entirely self-contained in a free pen, or contained in the computer and wired to the pen through a tether cable (depending on the designer's particular preference).

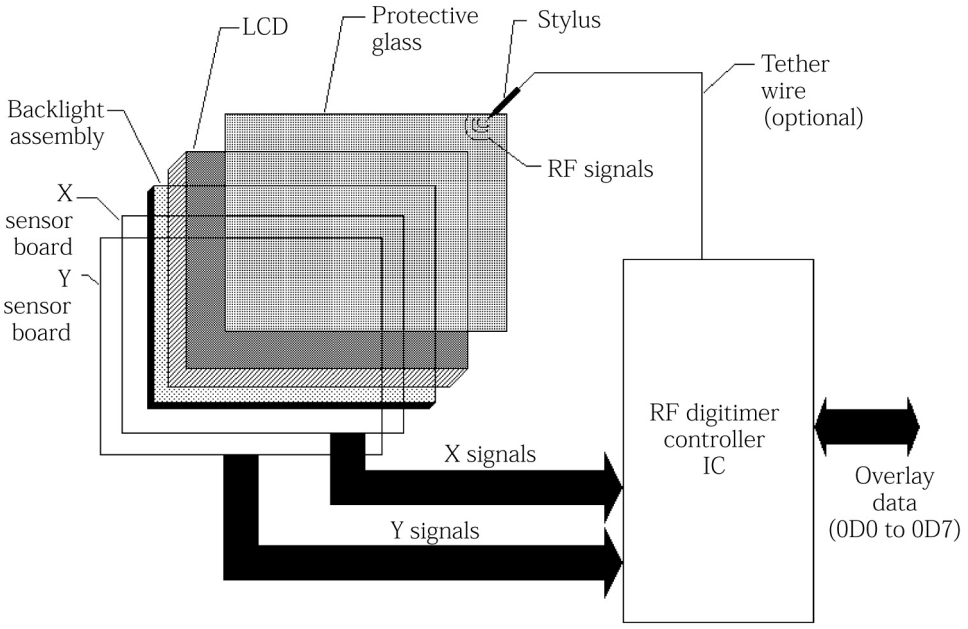

FIGURE 51-6 An electromagnetic (RF) digitizer

The central element in an RF digitizer is the "sensor" PC board. Signals generated by the pen must be detected and converted to X and Y coordinates. The pen transmitter itself is usually powered by one or more batteries, but the very low transmission power allows hundreds of operating hours. Sensor PC boards are five-layer boards fabricated as multilayer PC boards. Four board layers are dedicated to signal detection, and one layer serves as the ground plane. A ground plane is needed to prevent pen signals from causing interference with motherboard circuitry.

Each board layer is etched with sensing coils. Two layers sense in the X direction, and two layers sense in the Y orientation. The actual patterns and physical layout of these copper trace loops are patented since they define the performance characteristics of the digitizer module. Whenever pen transmissions are detected, the digitizer is activated, and it scans across the active digitizing area to determine pen position. The pen also transmits serial pulses that indicate its switch positions and battery level(s). The 3D sensing structure developed in an RF digitizer can also detect pen proximity and tilt (usually up to 45 degrees from perpendicular).

Sensor PC boards must be mounted within 13mm (0.5 inch) below the writing surface. Since the digitizer PC board is the last part of the display section (below the LCD and backlight), you can count on a very dense, precise assembly. It is critically important that you exercise caution when disassembling and reassembling the digitizer. Be certain to maintain all mounting positions and clearances. Erroneous reassembly can easily upset the digitizer's operation. The digitizer can detect the pen transmitter up to 25mm (1.0 inch) above the writing surface.

Electromagnetic shielding and the placement of metals are also important concerns in RF digitizer systems. Make sure to replace any and all ground planes or shields before testing a reassembled digitizer. Not only is it necessary to replace shields around and behind the digitizer, but it is also imperative that no metal is added within the digitizer assembly. Metals between the writing surface and sensor PC board will interfere with the pen signal and cause erroneous operation. Even the step-up transformer used in a CCFT backlight power supply must be shielded to prevent unwanted electromagnetic signals from causing faulty operation.

Now that you have a basic understanding of the major pen digitizer techniques, you should learn a few details about pen/panel interaction.

A Pen Environment

The pen environment is almost entirely software dependent. It is the computer's operating system that provides the driver programs and routines for writing and working with the pen. Experienced Windows or PenPoint programmers can also write application programs that recognize and utilize the pen. Of course, a pen-computer will usually run software that does not use the pen. Such programs are known as *pen-oblivious* applications. To make the program useful, however, input will have to be provided from elsewhere (such as an external keyboard or mouse). The next level of software is capable of checking for and using a pen if one is available, but will run with external input if a pen is not available—much the same way that many DOS programs check for the presence of a mouse and use it if available. These programs are *pen enhanced*. The highest level of pen software supports all pen functions and gestures, as well as the capture and recognition of written input. Such pen-dependent applications are called *pen-centric* programs. As a technician, you should expect to see several different layers of software depending on the ways in which a pen-tablet (or touchpad) is being used:

- If the pen-tablet or touchpad is being used simply as a mouse replacement, chances are that you'll only need a low-level DOS or Windows 95/98 mouse emulation driver. In some cases (depending on the

format of serial data), an ordinary serial mouse driver will work just as well. For a touchpad, this is about all you'll need.

- If your pen-tablet or touchpad unit supports multiple input devices simultaneously, you'll also find a WINTAB driver in the system to support multiple input devices.
- The pen-tablet or touchpad may support signature capture/security software.
- Pen-tablets often include a type of control-panel applet used to adjust the tablet's features and sensitivity settings, as well as low-level diagnostic to test the tablet's output.
- Handwriting recognition requires additional software for the pen-tablet. You'll need handwriting recognition software (drivers) for the operating system, as well as an operating system extension such as Windows for Pen Computing (3.1, 3.11, or 95/98) or CIC PenDOS under MS-DOS or PC-DOS.

Just how a pen's movements are interpreted depends on how the program divides the screen graphically. For example, handwriting can only be entered into certain predefined areas of the display, and gestures can only be interpreted outside of those handwriting areas—how else would the computer be able to tell the difference between the two? To understand why this is important, you should understand a bit more about the two major pen input modes: gestures and glyphs.

GESTURES

For anyone who has never worked with pen-computers or pen-tablets before, the change from keyboards to pens requires somewhat of a mental jump backwards. Instead of interacting with the computer by entering text or individual keystrokes, or using a mouse to click and drag items around the screen, pen systems rely on a series of movements (called *gestures*). A gesture is a type of motion, or sequence of subsequent motions, that the computer's operating system recognizes and uses. Gestures can be used for two general purposes: editing and navigation. *Editing* gestures affect information. For example, an "X" motion made through a word can *delete* that word, while drawing a line under a word or sentence can *select* the text for character enhancement (italic, bold, etc.). *Navigation* gestures are used primarily to interact with the pen operating system. As an example, *tapping* on a menu choice may cause a new option bar to be displayed, but tapping and *holding* a screen item can allow you to move an item around the screen—rather like the click and drag of a mouse or trackball. Figure 51-7 illustrates the suite of pen gestures for both the Windows for Pen Computing (Pen Windows) and PenPoint pen-based operating systems.

The variations in gestures between operating systems may prove to be a source of some confusion, so you should always make it a point to be aware of your computer's operating system before beginning a repair. Remember, just because a gesture doesn't work does not indicate a fault in the computer—you may be performing the gesture incorrectly. Even though pen-computers and their operating systems strive to be intuitive, there are definite limits to their tolerance in accepting gestures.

GLYPHS

The process of acquiring a handwritten image, translating the image into individual characters or commands, and sending the translated image to an actual application program (such as a word processor) is an unbelievably involved and complex software process that is well beyond the scope of this book. However, you should have some understanding of the basic steps involved. The algorithms and processing power used to evaluate handwritten input are improving constantly.

The first step is to provide a known, rectangular area of the display where handwriting can be entered. In the Pen Windows environment, this is usually accomplished by opening a small working window. Whenever pen contact is registered within the handwriting window, the master pen device driver software

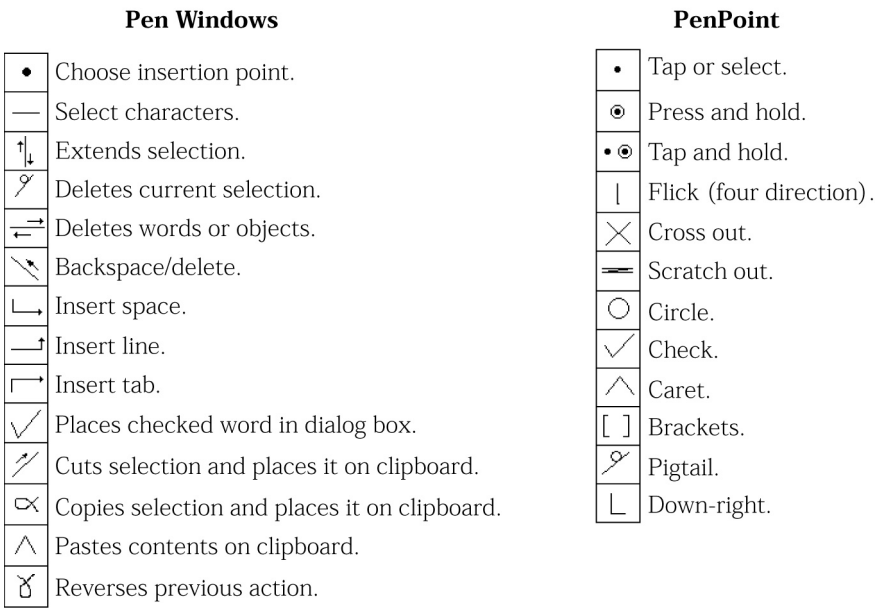

FIGURE 51-7 Comparison of typical pen gestures

tracks the pen's motion. As it tracks, the device driver calls a display driver program that echoes the pen's path—this is the ink that you see on the display. The pen driver then stores the X and Y coordinates at the beginning and end of each pen stroke. Every alphanumeric character is composed of one or more unique strokes.

A recognition program organizes each set of strokes into an item called a *glyph*. Glyphs are then matched against a set of prototype glyphs, and every possible corresponding character for a glyph is recorded as a *symbol graph*. The symbol graph is passed along to another program that adds extra information about the glyph (text in a word processor, numbers in a spread sheet, etc.), and a customized dictionary evaluates the enhanced symbol graph and determines the likeliest translation, which is finally passed to the actual application program (such as the word processor) utilizing the handwriting feature. The processing overhead required to handle handwriting recognition is quite demanding, so it is not yet possible to recognize written characters in real time, and there will be delays between the writing and the result (though improved computer power is speeding this process considerably). This discussion is certainly not comprehensive, but perhaps you will have an appreciation for pen software and how important it is for hardware and software to work together.

Troubleshooting Pen Systems

The great advantage to pen systems is modularity. There are really only four components in a digitizer: the tablet, the pen, the tablet controller, and the bus interface chip. When trouble occurs in the pen system, your problem is almost always located in at least one of these four operating areas. For resistive digitizers, most of the wear and tear in a pen digitizer takes place in the pen and tablet, so you will probably find that most problems occur there. Other digitizer technologies, however, have virtually no wear between the pen

and glass writing surface. Typical problems with electrostatic and RF digitizers involve the pen and its cable (if a cable is used). The following notes and symptoms will give you some additional insights.

CLEANING A PEN-TABLET OR TOUCHPAD

Pen-tablets and touchpads are both solid-state devices, and there are virtually no moving parts (other than a few buttons). Tablet and touchpad surfaces are extremely durable and should require no maintenance, but it is important to keep the working surface clean. In most cases, you can clean a touchpad or pen-tablet by dampening a clean lint-free cloth with demineralized water or isopropyl alcohol, then gently wiping the working surface clean. (Be sure to turn off the PC first.) See that the working surface is completely dry before restoring power to the PC. Under no circumstances should you ever use harsh chemicals or cleansers to clean a pen-tablet or touchpad.

Do not soak the pen-tablet or touchpad surface.

INK AND VIDEO DRIVERS

Pen systems echo the position of a pen by displaying pixels on the screen that mark the pen's travel. This is known as the ink. In some cases, you'll notice that the pen's cursor moves, and handwriting recognition proceeds properly, but there are no "ink trails" left behind as you move the pen. This is almost always due to an issue with the video driver. Make sure your video driver is compatible with pen-tablets. It may be necessary to download and install an updated video driver from the video board manufacturer.

PEN TIPS AND BATTERIES

Pen issues make up a surprising number of pen-tablet problems. Although pen surfaces generate little wear and tear on the tip, wear is a factor in pen maintenance. The constant clicking and double-clicking can also wear the tip shaft within the pen. Wear can make it difficult to click and drag with the pen. Always be sure that the pen contains a fresh tip and is responsive to basic clicking and dragging gestures.

Many capacitive and RF digitizers incorporate active circuitry in the pen and this circuitry is run by batteries in the pen. When these batteries approach exhaustion, the pen's signals weaken, and this can result in all manner of erratic pen-tablet behavior. Always see that the pen contains fresh batteries (or try a new pen).

If the pen is tethered to a tablet via a cable, pen problems can often be traced to cable wear and intermittent contacts. The constant bending and flexing of a cable can eventually result in wiring faults. In this case, try a new pen-tablet to correct the pen problems.

Typical Driver Issues

Touchpads and tablets are very sensitive to drivers and driver interactions. When you encounter trouble with a tablet or touchpad, one of the first things to do is check and update the drivers. The following symptoms are typical of driver issues:

- **You set the double-click assist feature in the tablet's control panel and close the control panel, but when you reopen the control panel, the double-click assist is unchecked.**
- **After installing the tablet's driver, your SCSI devices (scanners, hard drives, etc.) are not seen.**
- **When you look at the pen options in the tablet's control panel, the incorrect pen is selected.**

- **The tablet's name shows up at the bottom of the screen when Windows 95/98 starts, but the cursor doesn't move with the stylus.**
- **After installing Windows 98 and the tablet's driver, you no longer have pressure in your applications.**
- **You cannot use the Windows 98 suspend mode with the tablet's driver installed.**
- **You cannot use the tablet on a multimonitor system.**
- **You installed the tablet and it worked, but when you restart the system, the tablet no longer moves the screen cursor.**

SYMPTOMS

SYMPTOM 51-1 **The pen seems to operate intermittently as it moves along the surface** When you slide a pen across the tablet, some portions of the stroke may not be visible as ink feedback on the display. In other cases, entire strokes may be missing while other strokes are fully visible. Fortunately, the ink that does appear shows up in the right places. This problem can be maddening, especially when attempting to write cursive characters. Resistive digitizers are extremely sensitive to pen contact. Be certain to hold the pen gently but firmly in contact. A careless touch may allow bad contact between the tablet and pen.

Such a symptom is almost always the result of a faulty pen cable. Remove your pen from its input jack, open the pen body and jack (if possible), and use your multimeter to check the continuity along each cable wire. Once your multimeter is connected, wiggle the cable to stimulate any intermittent wiring. If your pen cable is hardwired into the tablet, you should remove the tablet's outer housing to expose the cable wiring. Should you encounter a faulty pen, repair or replace the defective wiring, or replace the pen altogether.

If your pen checks out properly (or is not cabled to begin with), check the pen batteries, replace the pen tip, or try a new pen entirely. Next, suspect a fault with your resistive tablet. Both single-layer and double-layer resistive digitizers are extremely prone to wear. As the pen wears out, tablet resistance and surface features may become irregular. Your pen may not make proper contact at all points of a worn surface. Try replacing the resistive tablet. Some small-computer manufacturers sell tablet assemblies as component parts. Use extreme caution when replacing a tablet to avoid accidental damage to the LCD or backlight assemblies. Take careful notes and pay close attention to maintain proper assembly dimensions.

For capacitive or RF digitizers, the sensing assembly is very rarely at fault since writing takes place against a sheet of thin, tempered glass. Intermittent writing performance with a capacitive or RF digitizer is usually the result of a faulty pen transmitter. Check or replace the pen batteries and try the system again. If the problem persists, try a new pen.

SYMPTOM 51-2 **The pen or tablet does not appear to respond at all** Other computer functions seem normal. The external keyboard adapter (if available) appears to work properly. Before you check anything else, make sure the pen or tablet is properly connected to the computer. Also make sure the pen tip is in good contact with the tablet surface. Good contact is critical for resistive digitizers. A careless touch may allow bad contact between a tablet and pen, especially when the tablet surface is worn. For RF digitizers, you should suspect the pen transmitter first. Check the batteries or cabling to your pen. Replace the batteries if necessary and try the system again. Otherwise, try a new pen.

An open pen cable wire can easily disable your pen input (if the pen is tethered). Remove your pen from its input jack, open the pen body and jack (if possible), and use your multimeter to measure continuity along each cable wire. Once your multimeter is connected, wiggle the cable to stimulate any possible intermittent

wiring. Repair or replace any faulty wiring, or replace the defective pen outright. If your pen cable is hardwired into the computer, you should remove the pen-computer's housing to expose the cable wires.

If the digitizer still does not function, you should suspect your tablet or tablet controller chip. For a stand-alone pen-tablet, you can usually replace the entire tablet outright. For a pen-computer, disassemble your pen-computer to expose the motherboard, and check any cabling between the tablet and motherboard. Try replacing the tablet controller chip. If you lack the tools or inclination to perform surface-mount work, try replacing the entire motherboard. If the problem persists, try another tablet assembly.

SYMPTOM 51-3 Ink appears on the LCD as the pen moves, but ink is not exactly under the pen This symptom occurs with older pen-computers and is much more of a nuisance than an actual defect in resistive digitizers. You may assume that the pen is working adequately. The trouble is most likely in the resistive tablet material itself. Resistance is a characteristic that is extremely dependent on temperature and humidity. Variations in a tablet's temperature or humidity can introduce small analog voltage errors when a pen passes over the resistive surface. The net result is a small shift in the visual feedback that appears on the LCD. There is little you can do with temperature or humidity problems except to keep the pen-computer in a stable, consistent environment. If the tablet is damp for any reason, be certain to dry its surface very carefully.

Problems can also occur when the tablet is extremely worn. As resistive material becomes thinner, its resistance at the thinner areas becomes greater. Worn areas can upset the overall resistance of the tablet and result in erroneous voltage signals at the pen. Again, such errors are digitized and appear somewhere in the display. Your best course of action with a worn resistive tablet is simply to replace it entirely. Use extreme caution when replacing a tablet to avoid accidental damage to the LCD or backlight, and to maintain all dimensional tolerances in the assembly.

SYMPTOM 51-4 The pen-computer locks up or suffers other strange problems once the RF digitizer has been repaired or replaced This kind of a follow-up problem is not unusual for pen-computers using RF digitizers. The RF sensor PC board located behind the backlight must be reinstalled exactly as it was removed. No metal objects can be added or removed. Make sure that any and all shielding is installed properly. Missing or damaged shields can allow stray RF signals to reach the motherboard and cause peculiar EMI problems that result in system crashes and intermittent bad data. It only takes one bad bit to crash a computer. Also inspect the way the display and digitizer arrangement has been reassembled. Missing spacers or loose screws can change the physical spacing of the display components and also result in system problems.

It is important that no metal objects be added to the display/digitizer assembly as well. Metal acts as a shield that can interfere with RF signals. The presence of unwanted metal may cause trouble in pen tracking and system operation. Remove any metal that may have been added to the system or digitizer. As a general rule, it is worthwhile to keep thorough notes when working on a display/digitizer system. Notes help to ensure that you reassemble the small computer exactly as it should be.

SYMPTOM 51-5 As you write, no ink appears on the display, but the characters are recognized and translated properly This is almost invariably a problem with the Windows 95/98 video driver. When the pen operating system is installed—especially as an extension such as Microsoft Pen Extensions for Windows (there are versions for 3.1, 3.11, 95, and 98)—the video driver will be required to produce the ink. Unfortunately, not all video drivers interact so smoothly with pen-enhanced or pen-centric applications, and an ink trail is not left under the pen. While hardly damaging, it can be a significant nuisance. Try a video driver designed to deal with pen operations. In actual practice, this may be difficult since many pen-compatible video drivers do not provide extended color depths

or resolutions that many Windows users have come to expect. Check with the pen-tablet vendor and video adapter manufacturer for a "pen-aware" video driver.

SYMPTOM 51-6 **The DOS pen driver(s) will not load as the system initializes** This is typical of external, stand-alone tablets and is often indicated by an error code or message when the PC initializes, usually because the tablet hardware cannot be located. First, make sure that the tablet is turned on (if necessary) and receiving power. Next, check that the tablet is connected properly to its serial port and that the COM number and IRQ number correspond to any command-line settings used to execute the driver. For example, suppose the tablet driver is being started in your CONFIG.SYS file and its command line says that the driver should be installed for COM1 using IRQ3. If the tablet is plugged into COM2, the driver will probably not be able to load.

SYMPTOM 51-7 **The pen buttons do not work correctly in your software** Button assignments for a stand-alone pen-tablet are typically made in the tablet device driver's command line (in CONFIG.SYS or AUTOEXEC.BAT). Check the command line against your pen-tablet's documentation and make sure that any button assignments are correct. Check your particular application as well to see if there are any options that control button functions. If your application allows you to select a pointing device, you can usually keep the Microsoft Mouse selection.

SYMPTOM 51-8 **The pen-tablet does not work in Windows** This problem often surfaces with stand-alone pen-tablets. If the tablet works with DOS applications (or its diagnostic), the problem is likely due to a Windows driver conflict. Check the device driver used in the Windows 95/98 Device Manager and verify that the appropriate driver is selected to support the tablet. Many tablets give you the option of either using the tablet as the sole pointing device, or using *both* the tablet and mouse together. (You may also need a WINTAB driver to support multiple simultaneous input devices.) The driver used with the tablet will depend on whether the tablet is used alone or with a mouse.

SYMPTOM 51-9 **Windows locks up, or the tablet fails to respond** This type of problem may show up intermittently and is generally related to the cursor speed that is set through the Windows Control Panel. When the tablet is set to work in relative mode and the cursor speed is set to Fast, older PCs may not be able to respond to button clicks or pen movement fast enough under some circumstances. This condition almost always results in a fault that can crash Windows or its application. The easiest way to correct this type of problem is to reduce the cursor sensitivity to a low level (50 percent or so) when working in the relative mode. Most pen-tablets designed to work with Windows 95/98 provide a Windows utility (such as a "Tablet Control Panel") that allows you to adjust the tablet parameters.

SYMPTOM 51-10 **The cursor is too sensitive or not sensitive enough to pen movement** When operating a stand-alone tablet in the relative mode, you may need to reduce the cursor sensitivity parameter. When working in the absolute mode, you can adjust sensitivity by altering the size of the cursor's active area. Most stand-alone pen-tablets designed to work in Windows 95/98 provide a Windows adjustment utility (such as a "Tablet Control Panel") that allows you to adjust the tablet parameters, such as sensitivity and active area.

SYMPTOM 51-11 **The cursor seems to "jitter" or leave spikes when drawing** This type of problem is usually related to the serial port (COM port) being used with the stand-alone pen-tablet. Older serial ports using the 8250 or 8250A UARTs have a subtle bug that the Windows 95/98 environments tend to find. The older serial ports do not support current tablets well. Running Windows 3.1x in the standard mode can sometimes improve the situation, but the very best solution is to replace the older

UART (or entire serial port) with a current version. (You can usually install a new multi-I/O board with high-speed serial ports, but remember to disable the older existing serial ports.)

SYMPTOM 51-12 No matter what "stroke width" is chosen in the drawing application, only thin, narrow lines appear when drawing on the pen-tablet This type of issue arises most often with pressure-sensitive applications like PhotoShop 4, and non-pressure-sensitive tablets like AceCAD tablets. In many cases, the drawing application assumes that your tablet/digitizer is pressure sensitive by default, when in fact the pen-tablet is not. If the tablet is not pressure sensitive, be sure to turn off the pressure sensitivity feature in the drawing application. (You'll need to select line widths manually.) If the tablet is supposed to be pressure sensitive, verify that the tablet and its drivers are configured properly for pressure-sensitive operation, and also check the pen for proper operation.

SYMPTOM 51-13 After installing the latest pen-tablet drivers for Windows 95, you get an "Invalid Dynamic Link call to a .DLL file" error once the PC restarts In many cases, this kind of error message is generated as the result of a conflict between the WINTAB driver for your pen-tablet and the "video capture" driver for your video board (for example, these problems often crop up with Diamond Stealth 64 PCI video cards). You must remove the offending video capture driver. For the example of a Diamond video capture driver, follow these steps:

1. Open your Control Panel, and then select Multimedia.
2. Under Multimedia, select Advanced, and then click the plus sign just to the left of Video Capture Devices.
3. Highlight the Diamond Video Capture entry (or the capture device for your particular video board), and then click Properties.
4. Under Properties, click Remove in order to remove the driver.

If you get the error message again, simply go back through the process one more time. (The second time around you should be able to remove the driver without incident.) Restart Windows 95/98, and the problem should be gone.

SYMPTOM 51-14 Installing the pen-tablet on a Packard Bell PC results in various errors Error messages often start out like "While initializing device PBCIR..." and the system winds up starting in Safe Mode. Such problems are almost always the result of Packard Bell's "Remote Media Card." The work-around below will often get the pen-tablet up and running, but it will disable the IrDA ("infrared") functionality of this card. You can restore the card by just reversing this process.

1. Shut down the computer and turn it off.
2. Restart the computer. When you see the message "Starting Windows," press F8.
3. When you see the Windows 95/98 Startup menu, select Command Prompt Only, and press ENTER.
4. At the C:\> prompt, type **cd windows** and press ENTER.
5. At the C:\WINDOWS> prompt, type **edit system.ini** and press ENTER.
6. You will now be looking at the [boot] section of your Windows 95/98 SYSTEM.INI file. Find the section entitled [386Enh].
7. Look for a line in the [386Enh] section that reads DEVICE=PBEWD01S.VXD. When you find this line, type a semicolon (;) in front of the line. The line should then read ;DEVICE=PBEWD01S.VXD.

8. Save the changes to the SYSTEM.INI file and exit.
9. You should now be back at the C:\WINDOWS> prompt. Type **edit win.ini** and press ENTER.
10. You will now be looking at the [windows] section of your Windows 95/98 WIN.INI file.
11. Look for a line in the [Windows] section that reads RUN=C:\FMEDIA\FMEDIA.EXE. When you find this line, type a semicolon (;) in front of the line. The line should then read ;RUN=C:\FMEDIA\FMEDIA.EXE. (It may be necessary to delete this line entirely.)
12. Save the changes to the WIN.INI file and exit.
13. You should now be back at the C:\WINDOWS> prompt. Type **win** and press ENTER to return to Windows.

At this point your pen-tablet should be working. However, it may be necessary to reinstall the pen-tablet drivers. (Be sure to use the most recent pen-tablet drivers.)

Always create backup copies of your INI files before attempting to edit them.

SYMPTOM 51-15 **The pen cursor moves, but everything is reversed** For example, when the pen moves up, the cursor moves down. The tablet also "thinks" it's the wrong size (for example, 12×12 instead of 5×5). This is usually because you're running a tablet sizing utility when you shouldn't be. For example, AceCAD tablets can suffer this problem when mistakenly running the ACE12 utility. Open your AUTOEXEC.BAT file and verify that the proper command-line switches are in place. For the AceCAD example, copy ACE12.COM from the ACE12 subdirectory on your Drivers/Utilities disk to your C:\WINDOWS\COMMAND directory, and then add/modify the following line in your AUTOEXEC.BAT file:

```
C:\WINDOWS\COMMAND\ACE12.COM U (if your tablet is on COM1)
C:\WINDOWS\COMMAND\ACE12.COM U2  (if your tablet is on COM2)
```

Reboot your computer. The problem should be gone.

SYMPTOM 51-16 **The pen is not "selecting" or "inking"** In virtually all cases, there is a fault with the pen. If the pen is tethered to the tablet, check the pen wiring. If the pen is "free," try replacing the pen batteries. Also check the pen tip, and make sure the pen tip is not sticking out or loose inside the pen. Carefully unscrew the pen cap and inspect the battery casing for cracks. If the problem persists, try another pen.

SYMPTOM 51-17 **The cursor flickers in Windows 95/98; handwriting recognition works, but the ink often gets cut off** This problem sometimes occurs when 16-bit applications (written for Windows 3.1x) are running under Windows 95/98. The cause is a minor incompatibility between the 16-bit application and Microsoft's Pen Services 2.0 for Windows 95/98. Turn off any 16-bit applications. If possible, upgrade the application from the 16-bit version to the 32-bit equivalent.

SYMPTOM 51-18 **The cursor is moving, selecting items, or otherwise behaving strangely, even though the pen is not touching the tablet** Chances are that the tablet and pen operate at a frequency that may be shared by some monitors. This can cause the tablet to become "confused" if it is placed too close to the monitor. Make sure the tablet is not physically located too close to the monitor. (Keep it at least 12 inches away.) Another possible cause for odd cursor behavior is weak pen batteries. Try replacing the batteries.

SYMPTOM 51-19 There is no inking, and handwriting recognition doesn't work If you cannot see ink on the screen, or if you cannot get handwriting recognition to work, check the following points:

- In Windows 95/98, click on Start, then Run. Point to the Open edit box. If you do not see a pen pointer, you need to install the operating system pen extensions (such as Microsoft Pen Extensions for Windows 95).
- Try writing in the Open edit box. If you do not see ink, try writing in Notepad or WordPad. If you still do not get inking in these applications, reinstall the operating system pen extensions.
- If you see a pen pointer, try selecting text in the edit box. If the pen pointer does not change to an inverted arrow pointer, reinstall the operating system pen extensions.
- Check your video driver and note the driver you are using. (Some drivers do not support pen environments well.) Set your video to VGA, 16 colors. Try inking and/or handwriting recognition again. If it works, update your video driver with a version that will support ink.
- If you are still not getting handwriting recognition and/or inking, try uninstalling the pen-tablet's low-level software. Disable all TSRs (virus checkers, etc.), and reinstall the pen-tablet's low-level software again.

SYMPTOM 51-20 You can't get proper pen operation in Microsoft Word using Windows 95 Pen Computing There are a number of known issues with Windows 95 for Pen Computing and MS Word for Windows 95 (v 7.0a) and MS Word 97. Check with Microsoft (**www.microsoft.com**) for updates to either Word or the operating system, which may overcome these problems. The following gestures do not work:

- Edit text (check mark circled).
- Insert text (caret circled).
- Context menu (M circled), or can't right-click for context menus. (To work around this problem, press SHIFT+F10 with the pen at the point you want a context menu.)
- Select (lasso tap).

In addition, the following symptoms and problems may occur:

- The Pen Windows display does not refresh correctly when the pen is near the digitizer pad. To work around this problem, keep the pen away from the digitizer pad when not in use.
- When the pen is near the digitizer pad and the pen barrel button is depressed, the insertion point changes to an I-beam.
- The pen "drag handle" is not shown. This is a small button that floats along with the insertion point, allowing access to a context menu and easier access with a pen.

SYMPTOM 51-21 You see an "Invalid VxD dynamic link call…" error when trying to install pen-tablet software under Windows 95/98 For example, such problems may cause an error like "Invalid VxD dynamic link call from CICPEN(01) + 0000431D to device 'VCD', service 4" while trying to install CIC Handwriter software under Windows 95/98. Normally, an Invalid Dynamic Link Call error message is the result of an incompatibility between driver versions, or a damaged or miss-

ing driver. Try uninstalling and then reinstalling any programs or components that you installed recently. You may also work around this problem by bypassing the VCD (creating an additional Binary entry in your registry):

- Run the RegEdit utility.
- Select HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\VPEND\CICpen\
- Create a new BINARY entry.
- Enter **PORTPROTECTION**.
- Assign a value of 0.
- Save the changes and reboot.

Always make a backup copy of your registry files before attempting to edit them.

SYMPTOM 51-22 **You see the error "VxD not present—either Windows is running in Safe Mode, or xxx.VxD is not installed correctly"** This VxD file is not loaded if you are running Windows 95/98 in Safe Mode. If you are not in Safe Mode, make sure the named driver (for example, CICPenC.VxD) is present in your \Windows\System\VMM32 directory. Try reinstalling the pen-tablet software.

SYMPTOM 51-23 **The pen-tablet works intermittently on a laptop** If your particular pen-tablet (such as the CIC Handwriter Manta) has been designed to draw power from the serial port (RS232), there could be a power draw limitation with the port. (Desktop PCs do not suffer this problem.) For example, CIC has encountered some laptops that have power draw problems with their Manta. To conserve power, the laptop's current draw is reduced to the load, so the tablet stops working after a certain time. The following lists the laptops CIC has identified as having this power draw issue:

- IBM 750cs
- Gateway 2000 SOLO (REV 3)
- Samsung Sens Pro
- Winbook Fx
- Hitachi Mx
- Dell Latitude

Check with the pen-tablet maker to see if there is a supplemental power supply or other patch that may alleviate this problem.

SYMPTOM 51-24 **After installing a pen-tablet driver, the cursor moves very slowly** This is a known issue with some Wacom drivers and is almost always due to problems with the video driver. Many of the current video drivers have cursor problems in high-resolution modes due to the amount of data that is being produced by the pen-tablet. For example, a Wacom tablet produces approximately four times more data than a standard mouse, and the video drivers cannot keep up with the amount of data being transmitted. You should try and update your video driver to a version that is more compatible with high-resolution pen-tablets. In the meantime, do not run with an enlarged or animated cursor. If cursor performance is still slow, reduce the color palette to 256 colors or less until the video driver can be updated.

SYMPTOM 51-25 **After installing a pen-tablet driver, SCSI devices are no longer present** This is almost always a pen-tablet driver problem and is a known problem with Wacom pen-tablet drivers prior to version 2.44. Try installing the latest version of the pen-tablet driver. (Check with the pen-tablet manufacturer for the latest version.) For the Wacom pen-tablets, install the v.2.44 driver, and then restart to MS-DOS mode. From the Wacom 2.44 driver disk, copy the SCSI.FIX file to Windows\System\Wacom.vxd, such as,

```
c:\XXXXX\win\3195\>copy scsi.fix c:\windows\system\wacom.vxd
```

where XXXXX is the directory where the Wacom driver was extracted. You should be prompted to replace the WACOM.VXD file. Select "yes" to replace the file. Restart Windows and try the SCSI devices again. If you expanded the patch file to a floppy disk, restart to MS-DOS mode, place the floppy in the floppy drive, and from the c:\windows> prompt type

```
c:\windows>copy a:\win\3195\scsi.fix c:\windows\system\wacom.vxd
```

You should be prompted to replace the WACOM.VXD file. Select "yes" to replace the file.

SYMPTOM 51-26 **When you place a pen against the tablet surface, the cursor jumps to the upper-left corner of the screen** You also may see an error such as "unable to implement function." In most cases, this occurs after upgrading pen-tablet hardware and is due to leftover pen-tablet drivers from other manufacturers. You'll need to remove the leftover driver(s):

- *Removing ACECAT drivers* Edit your SYSTEM.INI file, go to the drivers= line in the [boot] section, and remove awintab. Then go to the [drivers] section and remove the line that reads awintab= awintab.drv. Also look for any reference to "Virtual Tablet" and remove it. Save the changes to SYSTEM.INI and restart Windows 95/98.
- *Removing KURTA drivers* Edit your SYSTEM.INI, look for references to wtkurta, and remove them. Save your changes to SYSTEM.INI and restart Windows 95/98.

SYMPTOM 51-27 **After installing a pen-tablet driver, you cannot open AVI files** This sometimes occurs with Wacom drivers and is caused by a module in DirectX v.2.0. You should remove this module and install a newer version of DirectX. To remove the module, open the Multimedia control panel, select Advanced, and then open the Video Compression Codecs folder. Highlight the DirectVideo Driver [Draw] entry, and click on the Properties button. Select the Remove button, close the control panel, and restart Windows 95/98.

SYMPTOM 51-28 **You notice that the system slows after installing touchpad drivers in Windows 95/98** In almost all cases, this is due to a conflict between touchpad drivers and older (preexisting) mouse drivers. You'll need to isolate and remove the older mouse drivers:

1. Shut down the PC. (You may need to turn the PC off if you can't exit normally.)
2. Reboot the PC and press F8 when you see "Starting Windows."
3. You should now see the Windows 95/98 Startup menu.
4. Start the PC in the Safe Mode.

5. Open the Windows 95/98 Control Panel.
6. With the Control Panel open, double-click on the Add /Remove Programs icon.
7. In the list of programs available for removal, find the reference to the old mouse software (for example, "Mouseware" or "Logitech Mouseware"), and highlight it by clicking on it once.
8. Click on the Add/Remove button.
9. The old software should uninstall (for example, "Mouseware Setup" will initialize and prompt you to confirm removal).
10. Windows should uninstall the software and prompt you that the computer needs to be restarted. Click the Restart button.
11. The computer will restart and begin loading Windows 95/98. (You may see added information about the software's removal—this is normal.)
12. The system will boot into normal mode and should be functioning normally.

SYMPTOM 51-29 The touchpad cursor freezes in the center of the screen after installing the driver(s) You may also see this as a "Windows Protection Error" after installing the driver(s) under Windows 95/98. This is usually due to an improper mouse driver reference in SYSTEM.INI. You'll need to edit SYSTEM.INI manually without the benefit of the mouse:

1. Press CTRL and ESC together to bring up your Windows 95/98 Start menu.
2. Use your arrow keys to move the highlight to Run, and then press ENTER.
3. In the text box next to Open, type **sysedit** and press ENTER.
4. The "sysedit" window will appear, displaying your system files.
5. Press ALT and W together to display a menu listing your system files.
6. Use your arrow keys to move the highlight down to the line that has "system.ini" in it, and then press ENTER.
7. Use your arrow keys to scroll down through the SYSTEM.INI file until you find a line reading [386enh].
8. Find the line that reads mouse=c:\glide\xmvmd.386.
9. Change this line to read mouse=*vmd.
10. After you have made this change to the SYSTEM.INI file, press the ALT and F keys together. This will bring down the File menu.
11. Use your arrow keys to move the highlight down to Exit, and then press ENTER.
12. Windows will display a dialog box stating that the SYSTEM.INI file has been changed, and will ask if you want to save these changes. Select "yes."
13. After the "sysedit" window has closed, press CTRL and ESC together to bring up the Windows 95/98 Start menu.
14. Use your arrow keys to move the highlight up to Shut Down, and then press ENTER.
15. Use your arrow keys to select Restart the Computer from the Shut Down dialog, and then press ENTER.
16. Windows will restart the system, and the cursor should now move with the touchpad.

SYMPTOM 51-30 The touchpad and software were installed, but it refuses to operate—the mouse continues to operate Most touchpad drivers (such as for the Cirque GlidePoint) accommodate only one pointing device. If you still have an external mouse connected, unplug it and reboot your computer. If your computer has a built-in pointing device, you should consult your computer manual for instructions on disabling the device.

If you have no way to disable the existing mouse, you may also be able to edit the touchpad's INI file to specify how the touchpad is connected. For example, a Cirque touchpad uses the GLIDE.INI (or MOUSE.INI) file in the Cirque GlidePoint directory. The line that reads MOUSETYPE= should be changed to indicate the port in which the touchpad is installed. If the touchpad is on a serial port, the line should read MOUSETYPE=SERIAL1 or MOUSETYPE=SERIAL2. If the touchpad is on a PS/2 port, the line would read MOUSETYPE=PS2.

SYMPTOM 51-31 While installing touchpad software, you see an error indicating that previous software was found For example, when installing Cirque GlidePad software, there is an error indicating that Microsoft Intellipoint or Logitech Mouseware was found. Although Windows supports two pointing devices, it will not support two device drivers. Both software items cannot be loaded on the machine at the same time, so you'll need to remove the older software:

1. Click on Start, and highlight Settings.
2. Click on Control Panel, and double-click on the Add/Remove Programs icon.
3. Scroll down the list until you find the offending software.
4. Double-click on the item to begin removing the software.

This process will remove the software and allow the touchpad software to load properly.

SYMPTOM 51-32 The pen-tablet driver is causing a conflict with the SoundBlaster Live card This is a known issue with the Sound Blaster Live card and Cirque drivers (version 1.05). Both conflict with the standard Windows API call. To correct this problem, Cirque has released an updated driver (version 1.06) that eliminates the use of this API and thus eliminates the conflict. Creative Labs has also released an update to their SoundBlaster Live software that corrects this issue.

SYMPTOM 51-33 You notice intermittent pressure in your drawing application(s) For example, you may find intermittent pressure in MetaCreations Painter. This occurs because versions of Painter older than V5.0.3 (running on Windows 95/98) may have intermittent problems with pressure not functioning. Upgrade to Painter V5.0.3 or greater (available on the MetaCreations Web site at **http://www.metacreations.com**). This can also occur with MetaCreations Expression and is caused because versions of Expression older than V1.0.5 (running on Windows 95/98) may have intermittent problems with pressure. Upgrade to Expression V1.0.5 or greater (available on the MetaCreations Web site at **http://www.metacreations.com**).

SYMPTOM 51-34 After installing the tablet driver, the cursor moves very slowly This problem is most commonly caused by older video drivers that have problems in high-resolution modes. This is due to the amount of data that's being produced by the tablet. For example, the Wacom tablet produces about four times as much data as the standard mouse, and the video drivers cannot keep up with the amount of data that the tablet is putting out. A couple of things may help. First, don't run with an animated cursor, or enlarged cursors. If you can, run at (or under) 256 colors. Finally, try upgrading the Windows 95/98 video driver.

Further Study

AceCAD: **http://www.acecad.com**

CCI: **http://www.cic.com**

Cirque: **http://www.cirque.com**

Glidepoint: **http://www.glidepoint.com**

Kurta/Mutoh: **http://www.mutoh.com**

Pen Computing Magazine: **http://www.pencomputing.com/**

Wacom: **http://www.wacom.com/productinfo/**