

Serial ProTM

User's Manual

AE APPLIED ENGINEERINGTM
A DIVISION OF AE RESEARCH CORPORATION

v.2.0

Contents

<i>Preface</i>	i
About the Serial Pro	i
What to Read?	i
Chapter 1: <i>Getting Started</i>	1
Installing the Serial Pro	1
About Interface Cables	5
Control-Panel Options	9
What's Next	10
Chapter 2: <i>ClockWorks</i>	11
Setting Up Your ProDOS Startup Disks	11
Installing the Clock-Driver File	12
Enhancing AppleWorks	12
Setting the Clock	13
Supporting Catalyst 3.0	14
Supporting Catalyst //e	14
What's Next	14
Chapter 3: <i>Programmer's Reference</i>	15
Printer Command Set	15
Graphics Command Subset	19
Communications Command Set	20
Terminal Mode	24
Accessing the Clock From BASIC	25
Assembly Language Programmer's Information	26
<i>Glossary</i>	29
Appendix A: <i>Accessing the Control Panel</i>	33
Appendix B: <i>The Serial Connection</i>	34
Appendix C: <i>The Hardware Handshaking Switches</i>	36
Appendix D: <i>The Interrupt-Request Switches</i>	39
Appendix E: <i>Serial Pro Clock Chip</i>	41
Appendix F: <i>Serial Pro Battery RAM Allocation</i>	47
Appendix G: <i>Where to Get More Information</i>	51

Preface

About the Serial Pro

The Serial Pro is one of the most versatile multifunction-accessory cards ever designed for the Apple II Plus, IIe, and IIGS computers. It is a true multifunction card, using only one expansion slot to provide both a powerful intelligent serial interface and a clock/calendar feature. A special built-in program, called the control panel, enables you to set the clock and select the interface characteristics right from the computer's keyboard. Serial Pro's battery, which automatically recharges whenever the computer is on, maintains the interface characteristics and keeps the clock running even when the computer is turned off.

Serial Pro is fully hardware compatible with the Apple Super Serial Card and supports virtually all serial devices—printers, plotters, modems, and even the serial ports of other computers! The graphics dump feature enables programmers to print high-resolution graphics screen displays directly from the computer's memory to most dot-matrix printers. Serial Pro can be controlled and configured by software and its built-in terminal mode emulates a simple computer terminal, allowing you to access a serial device or modem without a communications program.

What to Read?

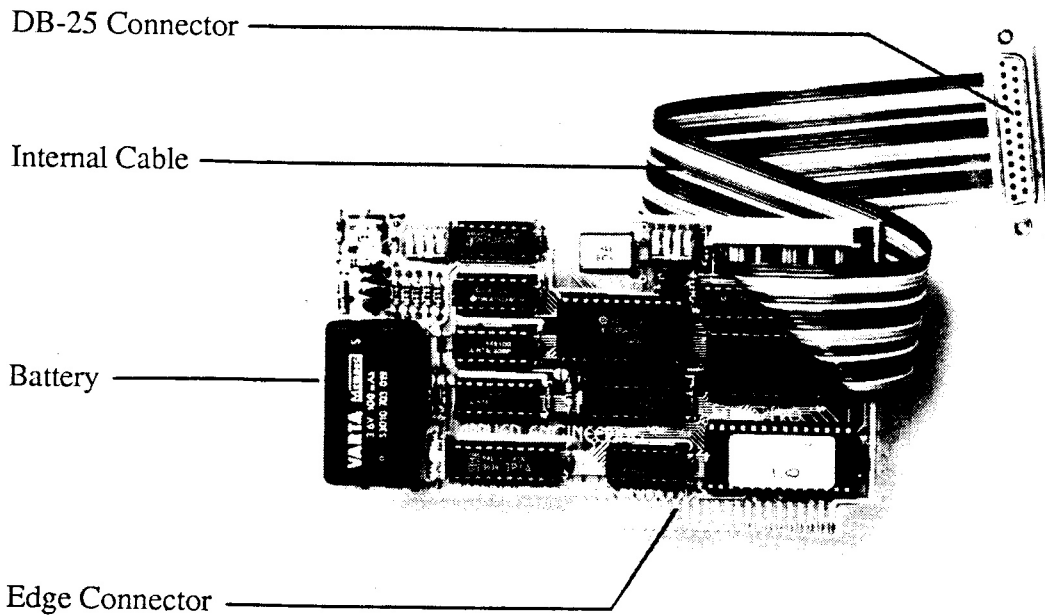
Be sure to read the first two chapters, *Getting Started* and *ClockWorks*. Although they were written for the novice computer user, they also provide experienced users with some very important information about installing and using the Serial Pro.

- *Getting Started* tells you how to install the Serial Pro in your computer and set it up to work with your serial device.
- *ClockWorks* tells you what you need to do to use the Serial Pro's clock feature.
- *Programmer's Reference* contains heavy-duty information for experienced programmers who wish to take advantage of Serial Pro's features from within their own programs.
- *Glossary* defines some technical terms used in this manual which may be new to you.
- *Appendices* provide quick-reference information for special Serial Pro applications and programs.

Getting Started

This chapter tells you how to install and set up the Serial Pro in your computer. It's easy to install the Serial Pro; just take your time, and read these instructions carefully.

Figure 1 - Serial Pro with internal cable attached



Step 1 Install the internal cable.

Unplug the internal cable from the Serial Pro. Grasp the connector firmly and gently rock it back and forth while pulling it straight out from the card. Don't use the ribbon cable as a handle.

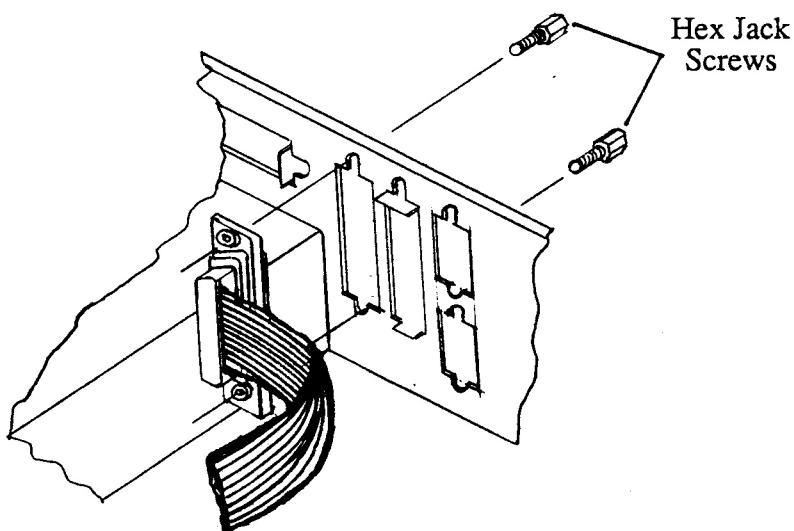
Handle with care! Hold the Serial Pro by its edges only and don't touch the gold-plated contacts on the Serial Pro's edge connector!

Remove the computer's cover and, from inside the computer, hold the internal cable's DB-25 connector up to one of the large openings in the computer's back panel. See Figures 2 and 3. Use the two hex-head jack screws to fasten the connector to the back panel. Be careful not to overtighten the screws!

Cover OFF - Power OFF! When the computer's top cover is off, make sure the power switch is turned OFF. You can do serious damage to the computer and its peripherals by installing or removing peripheral cards with the power on!

Note: It doesn't matter which of the large openings you use, but be sure to install the connector so that the cable won't be pinched or kinked when the card is installed.

Figure 2 - Installing the internal cable



To set a switch to the OPEN position, press in at the bottom of the switch, nearest the word "OPEN" on the switch block. Press in at the top of the switch to CLOSE the switch. Use a small pointed object, like a wooden toothpick or bent-out paperclip to change a switch setting; never use a pencil or pen.

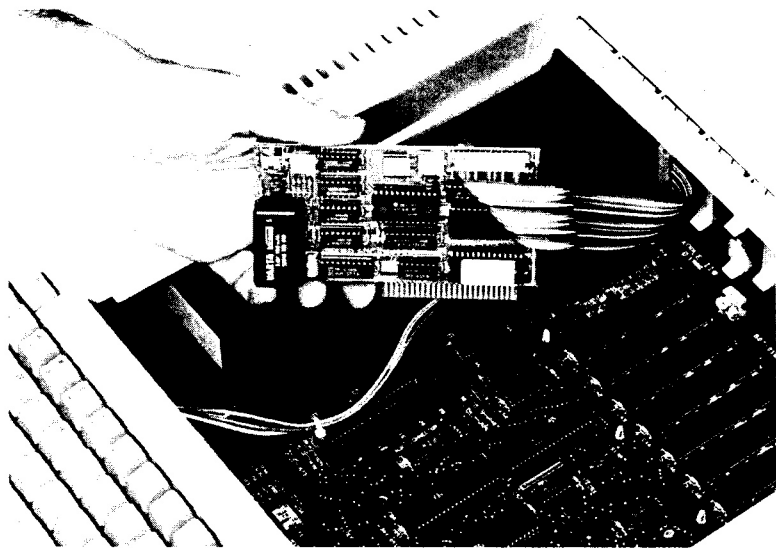
The Handshaking switches allow you to select optional types of hardware handshaking supported by the Serial Pro's PRINTER connector. The Interrupt switches control the use of program interrupts from the clock or the serial port. Most application programs do not require interrupts.

Step 3 Install the Serial Pro

Connect the internal cable connector to the appropriate Serial Pro connector (PRINTER or MODEM). Be sure the ribbon cable is oriented as shown in Figure 5.

Don't ZAP your computer! Before touching any of the cards inside the computer, discharge any static electricity that may be on your body or clothing by touching the power supply. (The power supply is the large metal box inside the computer.)

Figure 5 - Attaching the internal cable

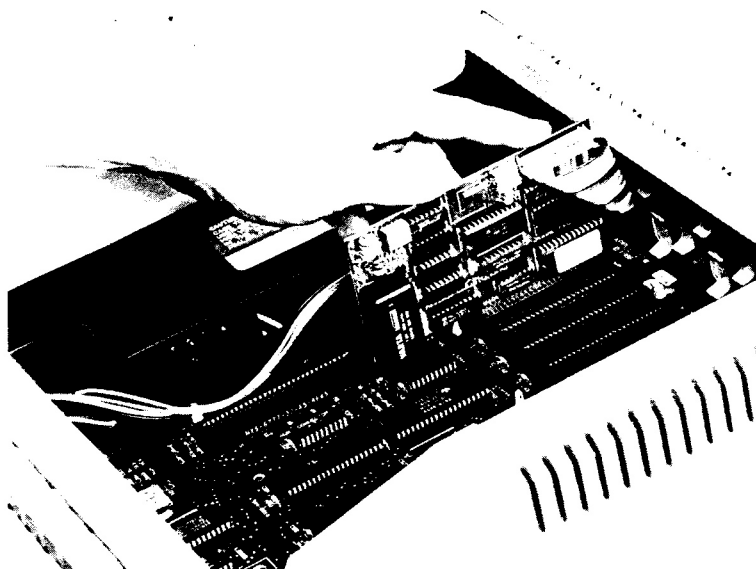


Put the Serial Pro into expansion slot 1 if you will be connecting a printer or slot 2 if you will be connecting a modem. See Figure 6. For the recommended slot for devices other than printers or modems, check the instructions that came with your device.

Put the cover back on the computer and connect the cable from your serial device to the DB-25 connector attached to the computer's back panel.

Apple IIGS users: Remember to use the Apple IIGS control panel to set the Serial Pro's slot to "Your Card."

Figure 6 - Installing the Serial Pro



Step 4 Attach Your Serial Device to the Serial Pro

Connect the cable from your serial device to the DB-25 connector on the back panel of the computer. Make sure the interface cable is securely fastened to both the Serial Pro's DB-25 connector and the connector on your serial device. (Most cable connectors use special clips or screws to hold the connectors firmly in place.)

The "null-modem" cable required by some printers is built into the Serial Pro's printer connector, eliminating the need for a special "rollover" adapter. (If you already have the rollover-type cable, connect the internal cable to the MODEM connector.)

About Interface Cables

Unfortunately, there is no such thing as an interface cable which will work with *all* serial devices. Since *most* serial devices use the standard DB-25 connector (like the Serial Pro's), the choice of either the PRINTER or MODEM connector on the Serial Pro allows you to connect virtually any serial device with a simple "straight-through" interface cable (i.e. pin 1 to 1, 2 to 2, 3 to 3, etc.).

While the Serial Pro does use the recommended-standard DB-25 connector, some serial devices do not. They may use an opposite-gender DB-25 or even a special non-standard connector. Apple Computer, for example, is notorious for using connectors like the Mini DIN-8, DIN-5, or DB-9 on some of their serial products.

If an interface cable is not provided with your serial device, remember that the Serial Pro is fully hardware compatible with the Apple Super Serial Card, which also uses the DB-25 connector.

All you need is an interface cable designed to connect your serial device to a Super Serial Card.

Most computer dealers and computer-accessory stores will have a variety of serial cables and gender adapters in stock. Or you can call:

CABLES TO-GO (800) 826-7904; in Ohio (800) 826-0958.

Step 5 Set the Serial Pro control-panel options

The control panel menu is used set the Serial Pro's clock and to configure the card's serial port to match the settings on your serial device. Remember that many application programs can temporarily override some of the control panel settings, but *your* settings will still be retained in the Serial Pro's memory.

Have the owner's manual that came with your serial device handy! You'll need it to find out what the settings on your device are before you can select matching control-panel options.

To access the control panel menu, switch the computer ON. No disk is required. Press Control-Reset. At the BASIC prompt (]), enter IN#*s*, where *s* is the number of the expansion slot containing the Serial Pro. For example: if your Serial Pro is in slot 2, type IN#2 and press Return. At the next BASIC prompt, type a Control-I followed by a question (?) mark.

If "Control-I ?" doesn't work, try "Control-A ?". If you are still not able to access the control panel, refer to Appendix A: Accessing the Control Panel at the end of this manual.

Use these keys to change menu selections and to change options within a menu selection:

- Return, ↓ , or M** DOWN to next menu selection
- ↑ or I UP to previous menu selection
- ← or J Change options for current menu selection
- or K
- Escape** Exit the control panel and save configuration

Figures 6 and 7 give example control-panel settings for a printer and a modem. If these do not work with your device, refer to the instructions that came with your serial device and set the Serial Pro accordingly. A brief description of each of the control-panel options is given on pages 9 and 10.

By the way, you can't break anything by choosing the wrong settings!

Warning: DO NOT select P8 or P8A emulation from the DEVICE TYPE menu option unless your software is designed to use the old Apple Serial Interface Card firmware. (Do not confuse Serial Interface Card with Super Serial Card.) P8 and P8A emulation modes do not allow direct access to the control panel. If you do get trapped in one of these modes, refer to Appendix A: *Accessing the Control Panel*.

Setting the Clock

The clock is also set with the select keys. To synchronize the Serial Pro clock with your watch or wall clock, move the highlight cursor to the SECONDS position and set the seconds to the desired time using the left or right arrow keys. The clock will stop for as long as the highlight cursor remains on the SECONDS menu selection. Moving the highlight cursor or exiting the control panel will start the clock.

Exiting the Control Panel

Press the Escape key to exit the control panel. The Serial Pro's battery will maintain the selected options and keep the clock running, even when the computer's power is off. Just having the computer on for eight hours each month will keep the battery adequately charged. Under normal conditions, the battery should last for 20 years or more.

Figure 6 - Serial Pro Control Panel menu ...Printer example

APPLIED ENGINEERING SERIAL PRO...SLOT 1

DEVICE TYPE: PRINTER
BAUD RATE: 9600
DATA BITS: 8
STOP BITS: 1
PARITY: NONE
CR DELAY: NO DELAY
GENERATE LF: NO
LINE LENGTH: 80
PRINTER GRAPHICS: IMAGewriter

YEAR: 87
MONTH: 01
DAY: 23
WEEKDAY: FRIDAY
HOUR: 09
MINUTE: 54
SECOND: 32

USE ARROWS OR <RETURN> TO SELECT/MODIFY
USE <ESCAPE> TO EXIT CONFIGURATION MENU

Figure 7 - Serial Pro Control Panel menu...Modem example

APPLIED ENGINEERING SERIAL PRO...SLOT 2

DEVICE TYPE: COMMUNICATION
BAUD RATE: 1200
DATA BITS: 8
STOP BITS: 1
PARITY: NONE
CR DELAY: 32 MSEC
GENERATE LF: YES
XON/OFF HANDSHAKE: ENABLED
LOCAL ECHO: ENABLED

YEAR: 87
MONTH: 01
DAY: 23
WEEKDAY: FRIDAY
HOUR: 09
MINUTE: 54
SECOND: 32

USE ARROWS OR <RETURN> TO SELECT/MODIFY
USE <ESCAPE> TO EXIT CONFIGURATION MENU

Control-Panel Options

Here's a brief description of each of the control-panel options:

Device Type: See the warning message on page 7 about P8/P8A emulation. This option allows you to select which of the four specialized command sets is to be used to support the device connected to the Serial Pro. If you are connecting a modem, use the Communication option.

Baud Rate: The data-transmission speed, in bits-per-second. For example, 9,600 bits-per-second is expressed as 9600 Baud. The Baud rate settings of the Serial Pro and your serial device must be the same, unless your application software can override the Serial Pro setting.

Data Bits: Each character, number, and symbol is coded into a group of bits called a data word. This option allows you to select a data-word length of 5, 6, 7, or 8 bits. The data-bit settings of the Serial Pro and your serial device must match, unless your application software can override the Serial Pro setting.

Stop Bits: Either 1 or 2 bits at the end of a data word which signify the end of the word. The stop-bit settings of the Serial Pro and your serial device must be the same, unless your application software can override the Serial Pro setting.

Parity: An error-checking feature in which one bit is added to a data word to make the sum of the bits always even or always odd. The parity settings of the Serial Pro and your serial device must be the same, unless your application software can override the Serial Pro setting.

CR Delay: The time delay following the transmission of a carriage return character, which usually marks the end of a line. Some serial devices do not support handshaking and require the CR delay to allow one line to be transmitted before beginning another.

Generate LF: If this feature is enabled (YES), a line-feed character will be inserted after each carriage return character sent. Line-feed-after-carriage-returns can also be generated by application software and serial devices, resulting in double- or even triple-spacing between lines.

Line Length: (Printer device type only) The number of characters to be sent to the serial device before a carriage return character is automatically inserted.

Printer Graphics: (Printer device type only) Provides graphics-printing support for most popular serial dot-matrix printers capable of printing graphics. (Some printers do not support graphics.) This option has no effect on text output.

XON/XOFF Handshake: (Communication device type only) An abbreviation of Transmit ON/Transmit OFF. With this option enabled, a control-S (XOFF) received from the serial device will cause the Serial Pro to stop transmitting data until it receives a control-Q (XON) from the device.

Local Echo: (Communication device type only) If enabled, characters entered from the keyboard will be displayed on the screen as they are transmitted. If disabled, the characters transmitted will not be displayed. Some remote devices can echo the characters (remote echo or echoplex) back to the sender, resulting in double characters being displayed if local echo is enabled.

What's Next

The next chapter, ClockWorks, tells you how to use the ClockWorks Utilities Disk to enhance AppleWorks and how to modify your ProDOS program disks to recognize the Serial Pro clock.

ClockWorks

This chapter tells you how to use the programs on the ClockWorks Time Utilities disk to take advantage of the Serial Pro's clock/calendar feature. With these programs you can:

- Set up your ProDOS-based startup disks to use the clock
- Enhance AppleWorks with the ClockWorks time options
- Set the clock
- Patch your Catalyst™ startup disk to support the Serial Pro clock

Setting Up Your ProDOS Startup Disks

When ProDOS is booted, it looks for a ProDOS-compatible clock card installed in one of the computer's expansion slots. Since the Serial Pro's clock circuitry is built into a card that ProDOS does not recognize as a clock card, the clock is not automatically ProDOS compatible.

To make the Serial Pro's clock compatible with ProDOS, you must first use the ClockWorks Time Utility disk to install a special clock-driver file on each of your ProDOS-based startup disks. Then, each time the ProDOS startup disk is booted, the clock driver file will tell ProDOS to read the date and time from the Serial Pro's clock, making the clock fully ProDOS compatible.

The Serial Pro clock won't be ProDOS compatible without the clock-driver file installed on your ProDOS startup disk.

The clock-driver file is only required on ProDOS startup disks, not data disks or program-only disks. The file works with all versions of ProDOS and only requires 4 blocks (about 2K) of disk space. *By the way*—the clock-driver file is the same one used by Applied Engineering's Z-Ram Ultra clock and //c System Clock.

If you're curious, the ClockWorks installation program copies the clock-driver file, AECLK.SYSTEM, to your ProDOS startup disk, inserting it in the disk directory ahead of the first system program (a SYS-type file with a ".SYSTEM" filename suffix). Then, when the disk is booted, ProDOS executes AECLK.SYSTEM first, before any other system program. AECLK.SYSTEM will check for a ProDOS-compatible clock first; if one is not found and a Serial Pro clock is, AECLK.SYSTEM patches ProDOS (the ProDOS image in memory) and executes the next system program.

Installing the Clock-Driver File

Here's how to install the clock-driver file on your ProDOS startup disks:

- Make a backup copy of the ProDOS-based startup disk you wish to modify. Never modify an original disk!

- Boot the ClockWorks Time Utility disk.

- Insert the startup disk (write-enabled) to be modified in any drive when the ClockWorks options menu appears. (On a one-drive system, it's OK to remove the ClockWorks disk.)

- Select the **Install Clock driver file** option.

- Choose the volume to be modified from the list of volumes (disks) displayed. (Press the ESCape key if you want to return to the ClockWorks option menu.)

Some disk copy-protection schemes may prevent the AECLK.SYSTEM file from being copied to your disk. If your startup disk is copy protected, contact the publisher or author of the program for information about possible unprotected updates.

Enhancing AppleWorks

STOP RIGHT HERE if you have the *Super AppleWorks Desktop Expander* or the *AppleWorks 2 Expander* program! The ClockWorks enhancements are already provided in these expander programs. (The *Super AppleWorks Desktop Expander* and the *AppleWorks 2 Expander* are included with Applied Engineering's memory-expansion products.)

The ClockWorks time enhancements replace the AppleWorks screen message, "⌘-? for Help," with a display of the current date and time. (⌘-? will still access the Help screen.) You will also be able to enter the current date or time into a Data Base category by typing the @ symbol as the only character in the category. The category name *must* contain either the word DATE or TIME, but not both.

*You **must** install the ProDOS clock-driver file to the AppleWorks startup disk before any of the ClockWorks time enhancements will work.*

Installing the Enhancements

The ClockWorks enhancements work with all versions of AppleWorks up to and including the latest release, version 2.0. Just follow these instructions:

- Make BACKUP copies of your *original* AppleWorks disks. Any patches or modifications to AppleWorks required by other programs (e.g. Pinpoint, Macroworks) should be installed *after* installing the ClockWorks enhancements.
- Boot the ClockWorks Time Utility disk.
- Select the option, **Patch AppleWorks for time/date**
- After reading the on-screen instructions, remove the ClockWorks disk and insert your AppleWorks startup disk. Press the spacebar to continue.
- Once your startup disk has been patched, replace it with your AppleWorks program disk. Press the spacebar to continue.
- When the patch is complete, remove the program disk and boot your AppleWorks startup disk in the normal manner.

Setting the Clock

The Serial Pro clock can be set with Serial Pro's built-in control panel or with the ClockWorks Time Utility disk. *Getting Started* explains how to use the control panel; this section tells you how to use the ClockWorks disk:

- Boot the ClockWorks Time Utilities disk. The time and date currently set on the clock will be displayed on the top line of the screen.
- Select the **Set time and date** option from the ClockWorks-options menu.
- You will be prompted to enter:

```
Day of Week (0 through 6) : -  
Year (0 through 99): -  
Month (1 through 12): -  
Day (1 through 31): -  
Hour (0 through 23): -  
Minute (0 through 59): -
```

Second (0 through 59): _

- The Day of the Week is represented by numbers between 0 and 6. Sunday = 0, Monday = 1, Tuesday = 2, and so on.
- The Hour is shown in 24-hour (military) format. To enter a PM time, add 12 hours to the corresponding AM time.
- If the Return key is pressed without entering a value, the program assumes a value of zero for that entry.
- Press the ESCape key at any time to return to the Clock Utilities menu without changing the previous setting.

– After all entries have been made, press the Spacebar (or any key) to set and start the clock.

Supporting Catalyst™ 3.0

Catalyst, version 3.0, is a program-selector and desk-accessory program for large-capacity disk drives. Once the clock-driver file is installed on the Catalyst 3.0 program disk, the Catalyst clock desk-accessory will display the time in hours and minutes, but the program does not display the seconds properly. This can be easily fixed by running the "CAT.3.0.MOD" program included on the ClockWorks Time Utilities disk.

Boot the ClockWorks disk and select the **Exit to BASIC** menu option. At the Applesoft BASIC prompt (`)`, enter the command: **RUN CAT.3.0.MOD**. Follow the instructions displayed on the screen.

Supporting Catalyst™ //e

The file, CAT.CLOCK, on the ClockWorks Time Utilities disk installs the clock driver required by Catalyst //e to support the Serial Pro clock. This driver file is required only by Catalyst versions 2.1 and earlier. The instructions for installing the CAT.CLOCK driver file are provided in your Catalyst //e User's Manual.

The AECLK.SYSTEM clock-driver file must also be installed on the Catalyst startup disk.

What's Next

Unless you're a programmer, stop right here.

Programmer's Reference

*For programmers only...*The information provided in this chapter is intended for programmers who wish to access and control the Serial Pro from within their own programs. The topics covered are:

- The printer device-type command set
- The communications device-type command set
- Accessing the Serial Pro clock from BASIC
- Accessing the Serial Pro firmware from assembly language

Serial Pro Command Sets Serial Pro's two command sets (selectable from the control panel's DEVICE TYPE option) enable programmers to temporarily control the interface characteristics of the Serial Pro from the keyboard or from within a BASIC or Pascal program. Although similar, the printer set and the communications set provide specialized commands for use with either a printer or communication (modem) device. The commands can be used to override the Serial Pro's control-panel settings and change its interface characteristics. The commands will remain in effect until the default settings are restored by a Reset command.

Printer Command Set Whether issued from the keyboard (immediate mode) or from within a program (deferred mode), each printer command must be preceded by a command character. The default printer command character is a Control-I (the TAB character), indicated by ^I in the following examples. Spaces shown in the following command descriptions are part of the command expression.

^I? **Enter Serial Pro Control Panel**

If the printer command set has been previously selected from the DEVICE TYPE option of the control panel, this command will access the control panel. The current command-default states and the PR# and IN# pointers will be reset upon exiting the control panel.

^I^t **Change Command Character**

Changes the printer command character from Control-I to the control character indicated by *t*. To change back to ^I, issue a ^t^I command. Serial Pro default: ^I

^I^I

Output the Command Character

The printer command code and entire printer command string are stripped from the output string. To include the command character in the output string, enter the current command character twice.

^InD

Set Data Format

Sets the number of data bits and stop bits per character. Valid values for *n* are:

<u><i>n</i></u>		<u><i>n</i></u>	
0	8 Data, 1 Stop	4	8 Data, 2 Stop
1	7 Data, 1 Stop	5	7 Data, 2 Stop
2	6 Data, 1 Stop	6	6 Data, 2 Stop
3	5 Data, 1 Stop	7	5 Data, 2 Stop

^InB

Set Baud Rate

Overrides the control-panel Baud rate option. Valid values for *n* are:

<u><i>n</i></u>	
0	Restore control panel setting
1	50 Baud
2	75 Baud
3	110 Baud
4	135 Baud
5	150 Baud
6	300 Baud
7	600 Baud
8	1200 Baud
9	1800 Baud
10	2400 Baud
11	3600 Baud
12	4800 Baud
13	7200 Baud
14	9600 Baud
15	19200 Baud

^InC

Set Delay after Return

Sets amount of time delay after each carriage return (^M) character sent. Default is the control-panel setting. Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^InF

Set Delay after Form Feed

Sets amount of time delay after each form feed (^L) character sent. Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^InL

Set Delay after Line Feed

Sets amount of time delay after each line feed (^J) character sent. Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^InP

Set Parity

Selects the type of parity supported by the Serial Pro. Valid values for *n* are:

<u><i>n</i></u>		<u><i>n</i></u>	
0	No Parity (Default)	4	No Parity
1	Odd Parity	5	Mark (Parity always=1)
2	No Parity	6	No Parity
3	Even Parity	7	Space(Parity always=0)

^InT

Translate LowerCase Characters (Apple II and Apple II Plus)

Translates all incoming lowercase characters in accordance with the translation option specified by *n*. Valid values for *n*:

<u><i>n</i></u>	
0	Translate lowercase to uppercase (Default)
1	Pass lowercase characters without change
2	Translate lowercase to inverse uppercase
3	Translate uppercase to uppercase inverse; lowercase to uppercase normal

- ^InnN Set Line Length**
- Sets line length to the value specified by *nn* and turns the video display off. Default line length on Reset is 40 (40 columns).
 Note: You must also use the Column Overflow (^IC) command to set automatic insertion of carriage returns. *nn* can be any value between 0 and 255.
- ^IC Insert Carriage Return on Column Overflow**
- Automatically inserts carriage return (^M) after the number of characters specified in LINE LENGTH menu option or specified by the ^InnN command. Once the ^IC command is issued, it remains in effect until a Reset command is sent.
- ^IR Reset Serial Pro**
- Resets the Serial Pro to its control-panel settings and printer-command default states. Also resets the PR# and IN# pointers.
- ^IZ Ignore Control Characters**
- All subsequent control characters sent through the Serial Pro will be ignored by the firmware. This command can only be cleared by a system Reset.
- ^IK E Keyboard Enable/Disable**
^IK D
- Subsequent input from the keyboard can be disabled with the ^IK D command. A system Reset or a ^IK E command from within a program will enable keyboard input. The default is keyboard-enabled.
- ^IL E Line Feed Enable/Disable**
^IL D
- Enabled, this feature inserts a line-feed character (^J) after each carriage return. Default is control-panel setting.
- ^IM E Suppress Line Feed Enable/Disable**
^IM D
- Enabled, this feature strips incoming line-feed characters which are immediately preceded by a carriage return. Default state is disabled.
- ^IT E BASIC Tab Character Enable/Disable**
^IT D
- Enabled, the BASIC horizontal position counter is left equal to the column count. All tabs work, including back-tabs. BASIC tabs work differently on different computers. Refer to the owners guide for your

computer and your BASIC programmer's reference manual. This command is normally disabled and it is not supported by Pascal.

^IX E
^IX D

XON/XOFF Enable/Disable

Enabled, the firmware stops sending characters whenever a ^S (XOFF) is received from the serial device. Transmission resumes when the serial device sends a ^Q (XON) character. Default state is enabled.

Graphics Command Subset

All graphics output require a graphics-capable dot-matrix printer and the GRAPHICS option of the Serial Pro control-panel must be set to the compatible printer type.

^IG

Print High Resolution Graphics Page 1

This is the basic command to output the contents of page 1 of the high-resolution graphics screen.

^IG2

Print High Resolution Graphics Page 2

This is the basic command to output the contents of page 2 of the high-resolution graphics screen.

^IGS

Print High Resolution Graphics Pages 1 and 2

Outputs the contents of both high-resolution graphics screen pages, side-by-side.

^IGR

Print High Resolution Graphics Page 1 Rotated 90°

Outputs the contents of high-resolution graphics page 1 rotated clockwise 90°. (^IG2R will output the contents of page 2.)

^IGI

Print Inverted High Resolution Graphics Page 1

Outputs the contents of high-resolution graphics page 1 inverted (dark background). Default (normal) is light background.

^IGISR

Example Graphics Combination

This example graphics commands will print the contents of both high-resolution pages side-by-side, rotated 90° and inverted.

**Communications
Command Set**

Whether issued from the keyboard (immediate mode) or the from within a program (deferred mode), each communications command must be preceded by a command character. The default communications command character is a Control-A, indicated by ^A in the following examples. Spaces shown in the following command descriptions are part of the command expression.

^A?

Enter Serial Pro Control Panel

If the communications command set has been previously selected from the DEVICE TYPE option of the control panel, this command will access the control panel. The current command-default states and the PR# and IN# pointers will be reset upon exiting the control panel.

^A^t

Change Command Character

Changes the communications command character from Control-A to the control character indicated by *t*. To change back to ^A, issue a ^t^A command. Serial Pro default: ^A

^A^A

Output the Command Character

The communications command character and entire command string are stripped from the output string. To include the command character in the output string, enter the current command character twice.

^AnD

Set Data Format

Sets the number of data bits and stop bits per character. Valid values for *n* are:

<u><i>n</i></u>		<u><i>n</i></u>	
0	8 Data, 1 Stop	4	8 Data, 2 Stop
1	7 Data, 1 Stop	5	7 Data, 2 Stop
2	6 Data, 1 Stop	6	6 Data, 2 Stop
3	5 Data, 1 Stop	7	5 Data, 2 Stop

^AnB

Set Baud Rate

Overrides the control-panel Baud rate option. Valid values for *n* are:

<u><i>n</i></u>	
0	Restore control panel setting
1	50 Baud
2	75 Baud
3	110 Baud
4	135 Baud
5	150 Baud
6	300 Baud
7	600 Baud
8	1200 Baud
9	1800 Baud
10	2400 Baud
11	3600 Baud
12	4800 Baud
13	7200 Baud
14	9600 Baud
15	19200 Baud

^AnC

Set Delay after Return

Sets amount of time delay after each carriage return (^M) character sent. Default is the control-panel setting. Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^AnF

Set Delay after Form Feed

Sets amount of time delay after each form feed (^L) character sent. The default is "no delay." Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^AnL

Set Delay after Line Feed

Sets amount of time delay after each line feed (^J) character sent. The default is "no delay." Valid values for *n* are:

<u><i>n</i></u>	
0	No delay
1	32 Milliseconds
2	250 Milliseconds
3	2 Seconds

^AnP

Set Parity

Selects the type of parity supported by the Serial Pro. Overrides the default value selected in the control panel. Valid values for *n* are:

<u><i>n</i></u>		<u><i>n</i></u>	
0	No Parity	4	No Parity
1	Odd Parity	5	Mark (Parity always=1)
2	No Parity	6	No Parity
3	Even Parity	7	Space(Parity always=0)

^AE E
^AE D

Screen Echo

When this feature is enabled, characters entered from the keyboard will be displayed on the screen and transmitted to the serial device. When disabled, the characters are only transmitted to the serial device.

^AnT

Translate LowerCase Characters (Apple II and Apple II Plus)

Translates all incoming lowercase characters in accordance with the translation option specified by *n*. Valid values for *n*:

<u><i>n</i></u>	
0	Translate lowercase to uppercase (Default)
1	Pass lowercase characters without change
2	Translate lowercase to inverse uppercase
3	Translate uppercase to uppercase inverse; lowercase to uppercase normal

^AnS

Redirect Output

Redirects output to the slot specified by *n*, where *n* is a value between 0 and 7. Note: ^A3S will redirect the output to the auxiliary slot of an Apple //e, enabling 80 column display.

^AB

Transmit Break

Transmits a 233 millisecond break signal.

- ^AR** **Reset Serial Pro**
- Resets the Serial Pro to its control-panel settings and communications-command default states. Also resets the PR# and IN# pointers.
- ^AZ** **Ignore Control Characters**
- All subsequent control characters sent through the Serial Pro will be ignored by the firmware. This command can only be cleared by a system Reset.
- ^AK E**
^AK D **Keyboard Enable/Disable**
- Subsequent input from the keyboard can be disabled with the ^AK D command. A system Reset or a ^AK E command from within a program will enable keyboard input. The default is keyboard-enabled.
- ^AL E**
^AL D **Line Feed Enable/Disable**
- Enabled, this feature inserts a line-feed character (^J) after each carriage return. Default is control-panel setting.
- ^AM E**
^AM D **Suppress Line Feed Enable/Disable**
- Enabled, this feature strips line-feed characters which are immediately preceded by a carriage return. Default state is disabled.
- ^AX E**
^AX D **XON/XOFF Enable/Disable**
- Enabled, the firmware stops sending characters whenever a ^S (XOFF) is received from the serial device. Transmission resumes when the serial device sends a ^Q (XON) character. Default state is enabled.

^AT

Enter Terminal Mode

In terminal mode, the Serial Pro emulates an simple computer terminal in full-duplex (echo off) mode. The Escape code sequences described on the next page and the full communications command set can be used while in terminal mode. A flashing underline cursor indicates that terminal mode is active.

^AQ

Exit Terminal Mode

This command exits terminal mode.

Escape Codes

This feature is only available in terminal mode. These codes enable the older Apple II and Apple II Plus computers to support lowercase letters and generate characters not available on the older keyboards.

Pressing the Escape key once will invoke lowercase mode; all subsequent letters input from the keyboard will be output from the Serial Pro as lowercase letters.

Two consecutive Escape characters while in lowercase mode will revert to uppercase (or normal) letter output.

While in lowercase mode, pressing the Escape key once will capitalize only the next letter and will remain in lowercase mode.

ESC n

Special Characters

The Escape key can be used in combination with the number keys to generate the following characters:

<u>n</u>	
1	ASCII file-separator (FS) code
2	ASCII unit-separator (US) code
3	[character
4	\ character
5	_ character
6	{ character
7	character
8	} character
9	~ character
0	ASCII escape (ESC) code
:	ASCII delete (DEL) code

Accessing the Clock from ProDOS

The easiest way to access the clock while in ProDOS is to use the ProDOS Get-Time MLI call given below:

```
JSR  $BF00 ;MLI Call
DFB  $82   ;Get-Time
```

The result will be placed in the System Global Page at the following locations in a packed binary format.

```
Date: $BF90-91  YYYYYYYM  MMMDDDDD
Time: $BF92-93  0000HHHHH  00MMMMMM
```

Accessing the Clock from BASIC

A special feature in the Serial Pro firmware enables programmers to read or set the Serial Pro directly from Applesoft BASIC.

Reading the Clock

The command to read the clock into a BASIC string variable is:

```
]CALL 49399 + s * 256,FM$,TM$
```

where:

s is the Serial Pro slot number.

FM\$ is the format-select character.

TM\$ is the time character string.

The possible formats and their corresponding format-selection characters are given in Table 1. Table 2 provides the valid ranges for each of the values in the clock-output character string.

Table 1 - Clock output formats

Select character		Output-string format	Example
FM\$ = " "	(space)	MO/DD HH:MI:SS:WYY	12/02 14:15:22:041
FM\$ = ":"	(colon)	W MO/DD/YY HH:MM:SS	0 12/02/41 14:15:22
FM\$ = "%"	(percent)	WWW MMM DD HH:MM:SS PM	SUN DEC 02 02:15:22 PM
FM\$ = "&"	(ampersand)	WWW MMM DD HH:MM:SS	SUN DEC 02 14:15:22
FM\$ = "#"	(octothorpe)	MM, OW, DD, HH, MM, SS	12, 00, 02, 14, 15, 22

Table 2 - Clock read and set format value ranges

Year	YY	(00 - 99)
Month	MO	(01 - 12)
Date	DD	(01 - 28, 29, 30, 31 - Leap years are calculated)
Weekday	W	(0 - 6 - Sunday = 0, Monday = 1, etc.)
Hour	HH	(00 - 23)
Minute	MM	(00 - 59)
Second	SS	(00 - 59)

Setting the Clock

The command to set the Serial Pro clock from BASIC:

```
]CALL 49399 + s * 256,FM$,TM$
```

where:

s is the Serial Pro slot number.

FM\$ = "!" The exclamation point is the time-set character.

TM\$ is the time character string in this format:

YY/MM/DD W HH:MM:SS

The slashes, spaces, and colons in the clock-set character string are for programmer's convenience; all non-numeric characters are ignored by the Serial Pro firmware.

Assembly Language Programming Information

The following information is provided for hard-core assembly language programmers only.

BASIC Entry Points

- \$Cs00 Initialization Routine. The entry point used by PR# or IN# call from BASIC. The X and Y registers are unaffected; the A register is changed.
- \$Cs05 Input routine. The entry point used when reading from the card under BASIC. X and Y registers are unaffected; the A register contains the input character upon exit. If the IN# switch (KSW) has not been set, this will read from the keyboard instead of the serial port.
- \$Cs07 Output routine. The entry point used when writing to the card from BASIC. X and Y registers are unaffected. Upon entry, the A register contains the output character and it is returned changed. If the PR# switch (CSW) has not been set, this will output to the screen instead of the serial port.
- \$Cs11 Control-Panel access routine. Calling this point will activate the Serial Pro control panel.

Pascal 1.0 Entry Points

- \$C800 Initialization routine. On entry the X register contains \$Cs and Y contains \$s0. Registers are unchanged upon exit. Remember that the \$C800 space must be activated.
- \$C84D Read routine. The entry point used when reading from the card. On entry the X register contains \$Cs and Y contains \$s0. X is unchanged, Y is \$Cs, and A contains the input character. The input can come either from the keyboard or the serial port.
- \$C9AA Write routine. The entry point used when writing to the card. On entry the X register contains \$Cs, Y contains \$s0, and the accumulator contains the character to be written. X is returned with an error code, Y is \$Cs, and A is changed.
- \$Cs05, \$Cs07 These locations are used by Pascal 1.0 as device identification bytes. They are \$38 and \$18 respectively.

Pascal 1.1 Entry Points

Pascal 1.1 does not use direct entry calls. Instead, in the following locations are offsets from the \$Cs00 address. Calls should be made indirectly.

- \$Cs0D Initialization offset. On entry the X register contains \$Cs and Y contains \$s0. Upon exit Y is unchanged, X contains \$00, and A is changed. The \$C800 space is activated by this call.
- \$Cs0E Read offset. The entry point used when reading from the card. On entry the X register contains \$Cs and Y contains \$s0. X contains the error code, Y is \$Cs, and A contains the input character. Input can come either from the keyboard or the serial port.
- \$Cs0F Write offset. The entry point used when writing to the card. On entry the X register contains \$Cs, Y contains \$s0, and the accumulator contains the character to be written. X is returned with an error code, Y is \$Cs, and A is changed.
- \$Cs10 Status offset. The entry point used to check the status of the serial port. On entry the X register contains \$Cs, Y contains \$s0, and A contains the request code. When the request code is \$01 then the status call will return the receive-character-available status. When the request code is \$00, the status call will return the transmit-buffer-empty status. On exit, X and A are returned with the error code and Y is unchanged.

- \$Cs0B, \$Cs0C These locations are used by Pascal 1.1 as device signature bytes. They are \$01 and \$31 respectively. These bytes indicate a serial card which is compatible with Pascal 1.1.
- \$Cs11 This location is non-zero to indicate that control and interrupt calls from Pascal 1.1 are not supported in the firmware.
- \$CsFF Firmware revision level. This location contains the current firmware revision level in BCD format.

Register Map

The locations given in Table 3 can be used to access the hardware directly and without using the firmware.

Table 3 - Hardware Register Addresses

\$C084 + \$s0	6818 Clock/Ram Address Register (Write Only)
\$C085 + \$s0	6818 Clock/Ram Data Register
\$C086 + \$s0	Eprom Bank Register Clear (Write Only)
\$C087 + \$s0	Eprom Bank Register (Write Only)
\$C088 + \$s0	6551 Serial Controller Data Register
\$C089 + \$s0	6551 Serial Controller Status/Reset Register
\$C08A + \$s0	6551 Serial Controller Command Register
\$C08B + \$s0	6551 Serial Controller Control Register

Glossary

Applesoft BASIC The version of the BASIC programming language built into the Apple II Plus, //e, and IIGS computers. Applesoft BASIC programming mode is indicated by the right-square-bracket (]) screen prompt.

AppleWorks A ProDOS-based application program which combines a word processor, a data base, and a spreadsheet program into one integrated package.

Application program Often referred to as "off-the-shelf software," it is a computer program written for a particular purpose. AppleWriter, Access //, and AppleWorks are application programs.

ASCII An acronym for American Standard Code for Information Interchange. It is a standard 8-bit information code used by most computers and data terminals. Each of the 128 ASCII letters, numbers, special characters, and control characters is assigned a unique value from 0 to 127.

Auxiliary slot Similar in appearance to an expansion slot and often referred to as the AUX Connector, it is a separate, single connector inside the Apple //e for cards that add more auxiliary memory or enhance the computer's video display. Applied Engineering's RamWorks III is such a card. Serial Pro does not fit in the auxiliary slot.

BASIC Beginner's All-purpose Symbolic Instruction Code. It is one of the easiest computer programming languages to learn. See also Applesoft BASIC and Integer BASIC.

Baud Rate Data transmission speed, in bits-per-second. For example, 9600 bits-per-second is expressed as 9600 Baud.

BIT A BInary digiT; the element of computer information.

Board Computer jargon for printed circuit board. Synonymous with *card* (printed-circuit card).

Card Computer jargon for printed circuit card. Synonymous with *board* (printed circuit board).

Catalyst™ An application-program manager program produced by Quark.

Chip Computer jargon for integrated circuit. Also referred to as and I.C. A tiny wafer (chip) of silicon containing thousands of micro-electronic circuits encapsulated in a hard plastic case. See DIP Chip.

Clock driver A special operating system routine for interfacing the disk operating system and the clock-card circuitry.

Command character An ASCII control-code character which sets the Serial Pro firmware into command mode. The standard command character for the printer-device type is a Control-I. For the communications-device type, the command character is a Control-A.

Communications Device Type A special Serial Pro interface-command set specifically designed to support a modem. The Communications-Device Type is selected from the Serial Pro control panel DEVICE TYPE option.

Control code Any of the non-printing ASCII characters used to start, stop, or modify various data transmission functions or control the operation of a serial device. e.g. A line-feed character causes a printer to advance one line or a video display to scroll one line.

Control panel A permanent program built into the Serial Pro which displays a menu of options on the video screen and allows you to change the option settings with keyboard commands.

CP/AM The version of the CP/M operating system provided with Applied Engineering Z-80 based co-processor cards. CP/AM allows your Z-80 Plus-equipped computer to run CP/M programs (Apple disk format only).

CP/M An acronym for Control Program / Monitor. A disk operating system which supports the Z-80 microprocessor. To run CP/M (or CP/AM) on an Apple computer, you must have a Z-80 co-processor card installed. See also Z-80 Plus and CP/AM.

CR Delay The time delay following the transmission of an ASCII Carriage-Return character. Some older printers do not support handshaking and cannot print as fast as the data are transmitted. A Carriage Return delay allows time for the printer to complete a line. CR Delays of 32 MSEC, 250 MSEC, 2 SEC, or NO DELAY can be selected from the Serial Pro control panel. MSEC stands for millisecond; one MSEC equals 1/1000 of a second.

Data Bits Each ASCII character is coded into a series of bits called a data word. The DATA BITS control-panel option allows you to select a data word length of 5, 6, 7, or 8 bits.

DCE An acronym for Data Communications Equipment. As it relates to RS-232-C, a DCE device is one which carries data from a DTE to another DTE. Usually, this is a modem, but can be a simple null-modem cable.

Device Type This control panel option allows you to select one of the Serial Pro's four specialized interface-command sets. The DEVICE TYPES are: Printer, Communication, P8, and P8A. See Printer Device, Communications Device, and P8/P8A Emulation.

DIP Chip *DIP* is an acronym for Dual-Inline-Package and refers to the two-row pin arrangement of the plastic integrated-circuit case. See Chip.

DOS 3.3 Version 3.3 of the Apple Disk Operating System. See operating system.

DTE An acronym for Data Terminal Equipment. As it relates to RS-232-C, a DTE is a device which originates or terminates data. A DTE device can only communicate with another DTE device by means of a DCE device.

Edge connector The tab of gold-plated finger-like contacts along the lower edge of an accessory printed circuit board. The card's edge connector is inserted into one of the computer's slots.

Expansion slot One of seven narrow connectors (an Apple II has eight) on the main circuit board near the back of the computer.

Firmware Computer jargon for a computer program (software) permanently stored in a ROM chip (hardware) in the computer, accessory card, or peripheral device.

Full Duplex A serial communications link in which both DTE devices can transmit to each other at the same time.

Graphics This control-panel option provides graphics-printing support for most popular serial printers capable of printing graphics.

Half Duplex A serial communications link in which only one DTE device can transmit at a time.

Handshaking A predetermined sequence of signals used to start and stop the flow of data between the interface and the serial device. Software handshaking uses special control characters imbedded in the transmitted data to control the flow of data. Hardware handshaking controls the flow by switching electrical currents between the interface and device ON or OFF.

Hexadecimal Notation of numbers in base-16. (Decimal numbers are base-10.) Numbers written in hexadecimal notation are preceded by a dollar sign. (e.g. \$AA)

Integer BASIC A version of the BASIC programming language used by some of the earlier Apple II computers. See also BASIC. Integer BASIC programming mode is indicated by the right-caret (>) screen prompt.

Interface A combination of software and hardware devices that enable the computer to be connected to a peripheral device. Sometimes called a peripheral interface or peripheral card.

Interrupt A special signal, usually generated by a peripheral interface or device, which causes the computer to jump from the main program to a specific interrupt-handler subroutine.

Line Length This control-panel option determines the number of characters to be sent to the serial device before a carriage return is automatically inserted. Setting the line length from the control panel does not turn the Apple video display off. Video display lines longer than the number of columns on the screen will wrap around to the next line.

Modem An acronym for MOdulator DEModulator unit. It is a device which converts computer (digital) data into a form (analog signals) which can be transmitted over telephone lines, and vice versa.

Modem eliminator See Rollover cable.

Null Modem See Rollover cable.

Operating System A set of specialized programs which are loaded into a reserved portion of the computer's memory whenever a system disk is booted. These programs contain the instructions called upon by the application program (software) to manage and coordinate the routine input and output activities of the computer system (hardware).

P8 & P8A ROM Emulation By choosing one of these device types, the Serial Pro will emulate the ROM used on the early Apple II Serial Interface Card.

Parallel A form of data transmission in which each bit of a character is sent simultaneously along separate wires. Contrast: Serial.

Parity An error-checking feature in which a bit appended to an array of bits to make the sum of the bits always even or always odd.

Pascal A popular programming language which emphasizes a structured approach to computer programming.

Peripheral A device which is connected to and operated by the computer but is not part of the computer. Printers, disk drives, and game paddles are peripheral devices.

Printer Device Type A special Serial Pro interface-command set specifically designed to support a printer. The Printer Device Type is one of the four selectable from the Serial Pro control-panel DEVICE TYPE option.

ProDOS Apple Computer's PROfessional Disk Operating System.

Rollover cable A serial communications cable in which certain wires have been purposely crossed to emulate the function of a DCE device. Often called a modem-eliminator or null-modem cable.

ROM An acronym for Read Only Memory. A set of computer programs permanently stored in a ROM chip is often referred to as firmware.

RS-232-C A set of technical specifications and standards established by the Electronic Industries Association to provide compatibility between serial devices. The least confusing part of the of the entire document is its title—
"EIA Recommended Standard 232-C: Interface between data terminal equipment and data communications equipment employing serial binary data interchange."

Serial A form of data transmission in which each character is sent one bit at a time along a single wire. Contrast: Parallel.

Stop Bits One or two bits that signify the end of an individual ASCII character.

Terminal Mode An operating state of the Communications command set which allows the computer to emulate a simple (dumb) computer terminal.

XON/XOFF An abbreviation of Transmit ON/Transmit OFF. When the XOFF character (Control-S) is received by the Serial Pro, the transmission of characters is stopped until and XON character (Control-Q) is received.

Z-80 A type of microprocessor which supports the CP/M operating system.

Z-80 Plus Applied Engineering's Z-80 co-processor card for the Apple II, II Plus, IIe, and IIGS computers. See CP/AM.

Z-Ram Ultra Applied Engineering's memory expansion, clock, and Z-80 co-processor accessory card for the Apple //c computer.

Appendix A

Accessing the Control Panel

Normally, the Serial Pro's control panel is accessed by activating the Serial Pro from BASIC with an IN#s command (*s* is the number of the slot containing the Serial Pro), entering the appropriate command character (Control-I or Control-A, depending on the active command set), and then entering a question-mark. The PR#s command can also be used to activate the card, but the AE.PRO: prompt will not appear in response to the command character.

In the event that you cannot enter the control panel in the manner described above, you are probably stuck in P8 or P8A emulation and must access the control panel via its firmware entry point.

- To access the control panel from BASIC (indicated by the] or > prompts):

]CALL 49169 + 256 * *s* (*where s is the Serial Pro slot number*)

- To access the control panel from the Monitor ROM (indicated by the asterisk * prompt):

*Cs11G (*where s is the Serial Pro slot number*)

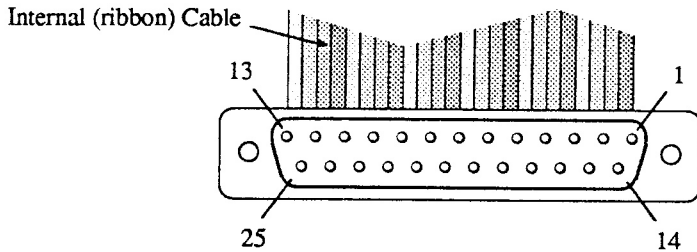
This page left blank intentionally

The Serial Connection

Serial Connector Pin Assignments

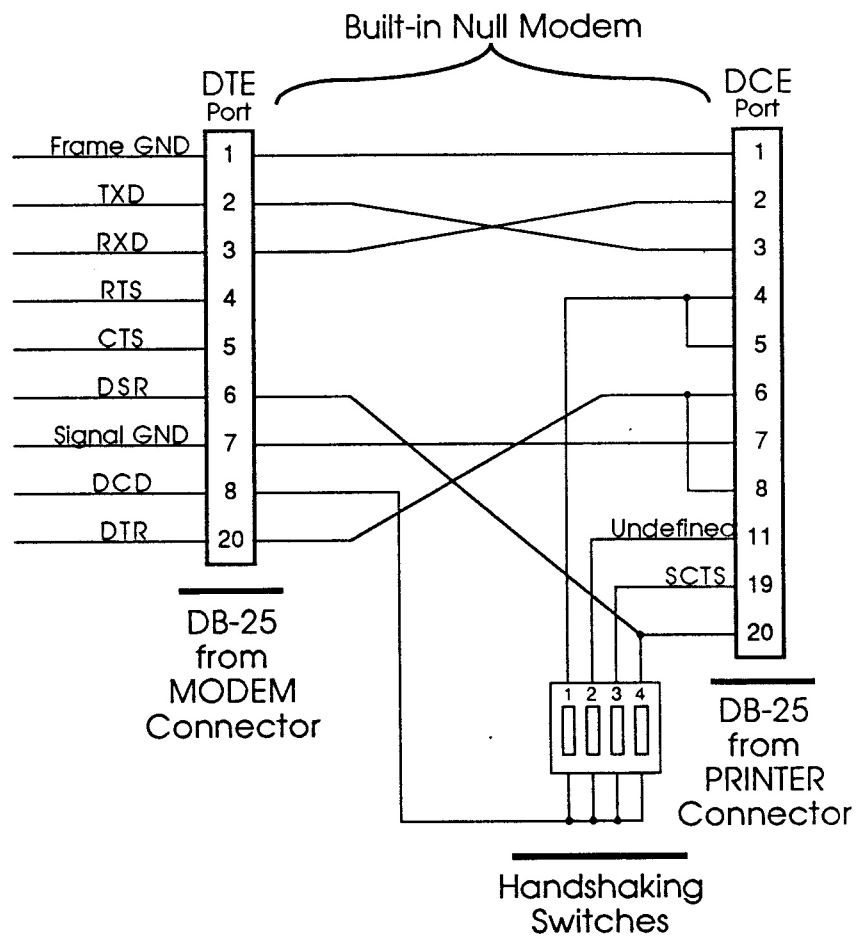
Figure B1 lists the DB-25 connector pins supported by the Serial Pro when the internal cable is attached to the MODEM connector (port). These pin assignments comply with RS-232-C specifications for a DTE device. When the internal cable is attached to the PRINTER port, the Serial Pro becomes a DCE device as a result of the built-in null-modem adapter. Figure B2 on the following page illustrates the effect of the null-modem feature on the signals of the PRINTER port DB-25 connector. The hardware handshaking switches are described in Appendix C.

Figure B1 - DB-25 Pin-out for MODEM connector



<u>Pin</u>	<u>Signal</u>
1	Frame Ground (FGND)
2	Transmit Data (TXD)
3	Receive Data (RXD)
4	Request to Send (RTS)
5	Clear to Send (CTS)
6	Data Set Ready (DSR)
7	Signal Ground (SGND)
8	Data Carrier Detect (DCD)
20	Data Terminal Ready (DTR)

Figure B2 - Diagram of Serial Pro's Null-Modem Feature



The Hardware Handshaking Switches

Serial devices exchange special signals to tell each other that they are present and ready to start sending or receiving data. Some signals may also be exchanged to control the flow of data between the two devices. These signals are called hardware-handshaking signals and are sent along interface-cable wires other than the ones which carry the data between the Serial Pro and the serial device.

Don't confuse hardware handshaking with software handshaking, which uses special characters (XON/XOFF) inserted along with the data to control the flow of data.

Don't worry! You can't damage anything with the handshaking switches. If the current switch setting doesn't work, you can experiment with other switch settings. If that doesn't work, read the instructions that came with your serial device.

When the internal cable is attached to the PRINTER connector and all handshaking switches are OPEN, Data Terminal Ready (DB-25 pin 20) is the only line monitored as the hardware handshaking line from your printer. While this does support most of the more popular serial printers, some printers may send their handshaking signals on different pins. The handshaking switches enable the Serial Pro to monitor alternate pins for of flow-control hardware handshaking. The handshaking switches are part of the built-in null-modem adapter and only affect the PRINTER connector. See Figure B2.

Setting the Switches

The hardware handshaking switch block is located next to the PRINTER connector on the Serial Pro. Press in at the top of the switch to CLOSE the switch. Use a small pointed object, like a wooden toothpick or bent-out paperclip to change a switch setting; never use a pencil or pen. To set a switch back to the OPEN position, press in at the bottom of the switch, nearest the word "OPEN" on the switch block.

- Switch 1 When closed, selects pin 4 (Request To Send) as the flow-control handshaking line. Some of the printers which use this line are: Data General TP2; Heath H-25; Olympia ESW102/103; QUME Sprint 5; and Smith-Corona TP1.
- Switch 2 When closed, selects pin 11 which is, according to RS-232-C specifications, undefined and is used by some serial printers as a printer-ready signal. Some Centronics, Texas Instruments, and Epson serial printers may use this pin.
- Switch 3 When closed, selects pin 19 (Secondary Request To Send) as the handshaking line. Some of the printers that use this pin are the Anadex DP8000/9000, Bell TP-1000, Lear Seigler 310, NEC 3500/7700, and Digital Equipment (DEC) LA-series serial printers.
- Switch 4 When closed, selects pin 20 (Data Terminal Ready) as not only the device-available handshaking line but also as the data-flow-control line. Some Diablo, C.Itoh, Okidata, Qume, Tektronics, or Xerox printers may use this handshaking signal.

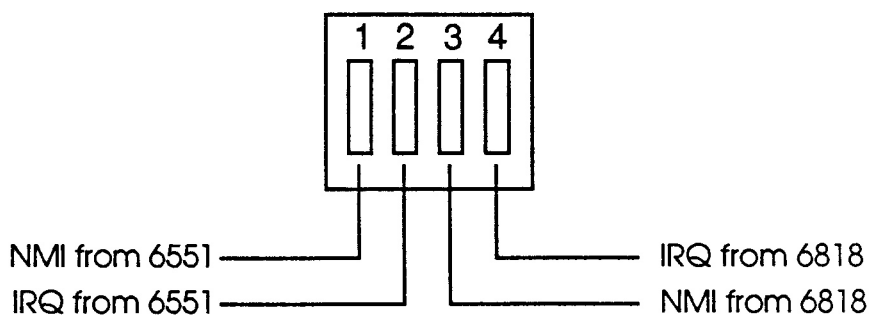
Appendix D

The Interrupt-Request Switches

The Serial Pro is capable of sending Maskable (IRQ) and Non Maskable (NMI) interrupts to the CPU from the 6551 Asynchronous Communications Interface Adaptor (ACIA) chip and the 6818 clock chip. The interrupt switches, shown in Figure D1, select the source and type of the interrupt request. Normally all switches are in the OPEN position, which disables all interrupt requests from the Serial Pro.

The use of interrupts applies only to the Apple IIe and Apple IIgs. The Apple II and Apple II Plus do not support interrupts.

Figure D1 - Serial Pro Interrupt-Request Switches



This page left blank intentionally

Serial Pro Clock Chip

The clock chip on the Serial Pro is the 6818. In addition to the clock circuitry the chip has 50 memory locations. The 50 locations are used as nonvolatile Ram to record the setup parameters for the card. This memory and the clock itself is accessed indirectly through Address and Data Registers on the Apple Peripheral slot.

Accessing the Clock Chip

The clock chip uses multiplexed Data and Address pins. The access will take place in two parts. In the first part, the address byte is written to the Address Register. In the second part, data is written to or read from the Data Register. Writing the address byte to the Address Register will start the cycle by latching in the address and leaving the clock chip enabled. Reading or writing to the Data Register concludes the cycle and disables the chip. Before starting a series of accesses, particularly during initialization, read the Data Register to clear any false cycle that may have been started by random writes. Afterwards, regular Address/Data cycles can be used.

Clock Chip Address Register

(Write Only at \$C080 +s4)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-x-	-x-	--Clock/RAM Address--					

Bits 0-5, Address- Address of Clock Byte to be accessed
Bits 6 and 7, Not Used

Clock Chip Data Register

(\$C080 +s5)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
--Clock/RAM Data--							

Bits 0-7, Data-Read/Write from/to Clock Chip

In working with the clock registers, care must be taken to avoid the double read cycles inherent in the 6502 on the indexed addressing modes. The best solution is to use absolute addressing or be sure the base of the index is outside of the \$C0nx page. Below is a sample program.

Read

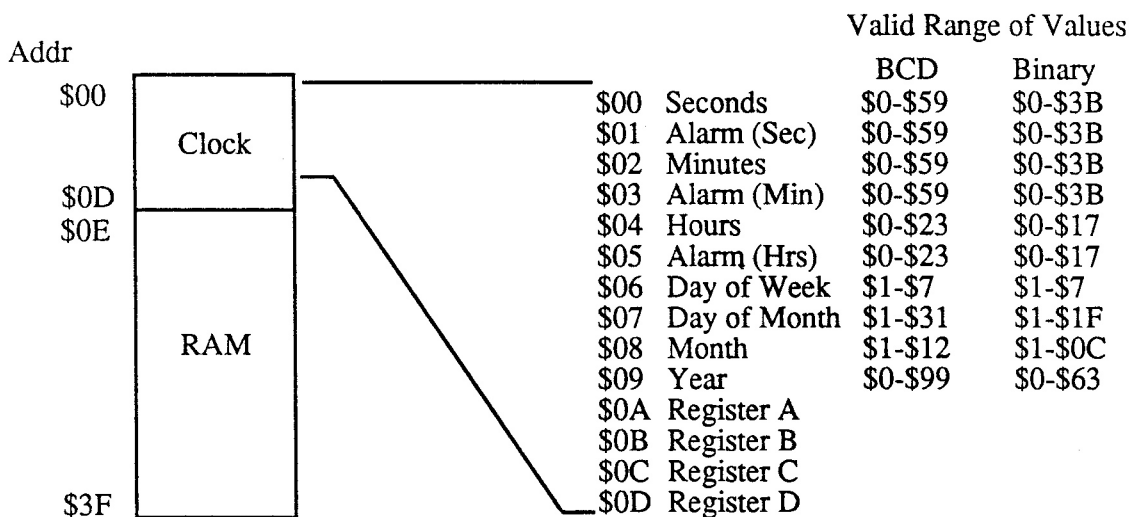
```
LDY #Slot.Number    Load slot of card ($n0)
LDA #Clock Addr     Prepare address byte
STA ($C084),Y       Indexed reference to clock address register
LDA ($C085),Y       Read clock data
```

Write

```
LDY #Slot.Number    Load slot of card ($n0)
LDA #Clock.Addr     Prepare address byte
STA ($C084),Y       Indexed reference to clock address register
LDA #Clock.Data     Fetch data to be written
STA ($C085),Y       Write clock data
```

Clock Chip Address Map

The diagram below contains a description of the addresses for the clock chip.



In the 12 Hour Mode, the ranges of the Hours and Alarm (Hrs) are:
 AM- \$01-\$12 (BCD) \$01-\$0C (Binary)
 PM- \$81-\$92 \$81-\$8C

Clock Chip Control Registers

The clock circuit is controlled primarily through the four control registers located at addresses \$0A, \$0B, \$0C, \$0D. The table below detail each individual register.

Register A-

Register A controls whether or not the clock is enabled and the frequency of the external crystal. The crystal on the Serial Pro is a 32.768 KHz crystal and must always be selected.

Also, this register controls the periodic interrupt rate. This interrupt is used to provide a regular or heartbeat interrupt.

Bit 7 of this register is the Update In Progress bit. When this bit is high, the clock's values will be changing. The bit must be equal to 0 before reading the clock registers in order to get an accurate reading.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
UIP	-External Crystal-			-Rate Select-			

Bits 0-3	Rate Sel	Select the Periodic Interrupt Rate, See Below
Bits 4-6	Xtal	Select Oscillator Frequency, See Below
Bit 7	Update InPrg	1= Yes Update is in progress 0= No Update, Clock Data is Valid

Periodic Interrupt Rate with the 32.768 KHz Crystal

B3	B2	B1	B0		B3	B2	B1	B0	
0	0	0	0	None	1	0	0	0	256 Hz
0	0	0	1	256Hz	1	0	0	1	128 Hz
0	0	1	0	128 Hz	1	0	1	0	64 Hz
0	0	1	1	8192 Hz	1	0	1	1	32 Hz
0	1	0	0	4096 Hz	1	1	0	0	16 Hz
0	1	0	1	2048 Hz	1	1	0	1	8 Hz
0	1	1	0	1024 Hz	1	1	1	0	4 Hz
0	1	1	1	512 Hz	1	1	1	1	2 Hz

External Crystal Frequency

B6	B5	B4	
0	0	0	4.194304 MHz Oscillator, Enable Counters
0	0	1	1.048576 MHz Oscilator, Enable Counters
0	1	0	32.768 KHz Oscilator, Enable Counters
1	1	x	None, Disable Clock and Reset Counters

Register B-

Control Register B sets the clock mode, 24 hour/12 hour and the data type, BCD (Serial Pro default) or binary. It also enable/disables interrupts on the clock update and alarm timeout and periodic interrupt.

Bit 7 of Register B is used to stop the clock. When set to 1, the clock will actually lose time until the bit is returned to 0.

Bit 3 is an enable on the square wave output (pin 23). The frequency of the square wave is determined by the periodic interrupt bits in Register A. On the Serial Pro, the square wave output is not connected.

Bit 0 allows the clock to automatically adjust for Daylight Savings Time.

Note: Bit 0 will not function with the Hitachi chip supplied with the Serial Pro. If you want your card to recognize Daylight Savings Time you will need to replace the Hitachi chip with the Motorola 6818.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SET	PIE	AIE	UIE	SqWEn	DMode	24/12	DSE

Bit 0,	DlitSavEn-	1 = Yes Daylight Savings 0 = Don't Auto Set Daylight Savings
Bit 1,	24 vs. 12 Hr-	1 = 24 Hour Mode 0 = 12 Hour Mode
Bit 2,	Data Mode-	1 = Binary 0 = Clock Data in BCD
Bit 3,	Sq Wave En-	1 = Yes Signal Wave 0 = No Signal on Pin 23 (Rate Sel)
Bit 4,	UpdateIntEn-	1 = Yes Update Interrupt 0 = No Interrupt on Clock Update
Bit 5,	AlarmInt En-	1 = Yes Alarm Interrupt 0 = No Interrupt on Alarm Match
Bit 6,	PeriodIntEn-	1 = Yes Per Interrupt 0 = No Interrupt at Rate Sel Freq.
Bit 7,	Set Clock-	1 = Hold Clock 0 = Allow Clock to Update

Register C- (Read Only)

Register C contains the interrupt flags. When any one of these three types of interrupts (update, alarm, or periodic) is set, then Bit 7 is set. The flags are cleared by reading this register so if more than one interrupt is being used, check all the bits in the byte that is read because they cannot be read again.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IF	PF	AF	UF	-x-	-x-	-x-	-x-

Bits 0-3, Not Used- Always 0

Bit 4, UpdateIntFl- 1 = Yes Update Interupt
0 = No Update Interupt Present

Bit 5, AlarmIntFlg- 1 = Yes Alarm Interupt
0 = No Alarm Interupt Present

Bit 6, Periodic Flag (PF) 1 = Yes Periodic Interupt
0 = No Periodic Interupt Present

Bit 7, Interupt Flag (IF) 1 = Yes Enable Interupt
0 = No Enabled Interupt Present

Register D- (Read Only)

Register D contains one bit, the Valid Time and Ram (VTR) bit. The VTR bit is the indication of whether the chip is being powered up for the first time. If it is, the chip will need to be completely initialized. This bit is set to 1 after it is read and will not change back unless the chip is completely powered down.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
VTR	-x-	-x-	-x-	-x-	-x-	-x-	-x-

Bits 0-6, Not Used- Always 0

Bit 7, ValidTimRam 1 = Data is Valid
0 = Data Invalid, Power was Off

Reading the Clock

The clock registers are shown in the Address map above. The format of the data in the registers are controlled by bit 2 of Register B. When reading the clock, use the Update In Progress bit (Register A) to make sure that the clock data is available to be read. During an update (approx. 1.948 mSec each Sec), the data read from the clock is invalid while it is being changed. If the UIP bit is clear the data will be valid for at least 244 microSec (the chip sets the UIP and then waits 244 microSec before beginning the update). The Update Interupt occurs immediately after each update and is a convenient way to generate a 1 Second interupt and make sure the data is okay to read. The Ram addresses are always available and are not affected by the update cycles.

An image of the time registers \$00 through \$09 are maintained by the firmware in the battery ram locations \$10 through \$19. A firmware call to \$CsA9 will safely update these locations to the current time.

Setting the Clock

When setting the clock, use the SET bit (Register B) to halt the clock updates until all bytes are set. This will prevent the counters from rippling over values as they are set. The Divider Select bits (Register A) can be set to '111'b and then back to '010'b to clear the counter chains. The values for the time can be written as binary or BCD (Register B, DMode) and either can be used (as long as all bytes are initialized under that mode). The Serial Pro uses BCD because it is easier to change to ASCII.

Do not initialize the time to 23:59:59 on the 28th, 29th, or 30th of any month because the counters will not properly recognize the end of the month (ex. April 30th will increment to April 31st instead of May 1st).

Clock Interrupts

The interrupts for the clock are routed through DIP Switch 1 (the one opposite the connectors) with position #4 for Maskable interrupts (IRQ) and position #3 for Nonmaskable interrupts (NMI). These must be closed (on) for their respective interrupts to occur. Interrupts can be generated by the Alarm, the Periodic counters or the Clock update pulse allowing a wide range of time scales (Hours, Min, Sec, down to 8192 Hz). All interrupts must be enabled by Control Register B. Their state can be read from Control Register C. The interrupts can be used in a polled system by not closing the switches.

The alarm interrupt allows you to generate an interrupt at a specific hour, minute, and/or second. You can also set one of the registers to a "Don't Care" state by setting the upper two bits (B7 and B6) to one. For example, setting the hour and the minute alarm registers to a Don't Care state will generate an interrupt once a minute on a specific second count.

The Periodic interrupts are controlled through Control Register A. With the crystal on the Serial Pro, you can have an interrupt rate from 8192 Hz down to 2Hz in Binary increments.

The Update interrupt, if enabled, occurs after each update of the clock registers (once a second).

Appendix F

Serial Pro Battery Ram Allocation

The Serial Pro includes a Clock/Ram chip that is backed up by the on-board battery. The list below details the bytes of the Ram that are used by the firmware for the control panel and the power up default values. Programmers may use unallocated bytes for non-volatile memory for their own programs as long as they follow the described access protocol.

The Battery Ram resides inside the clock chip as addresses \$0E through \$3F. Refer to **Accessing the Clock Chip** in Appendix E for instruction on reading and writing to the Battery Ram.

The Ram locations in use currently are:

<u>Address</u>	<u>Functions</u>
\$00 - \$09	Time registers as detailed in Appendix E.
\$0A - \$0D	Control registers (Appendix E).
\$0E - \$0F	Not used but reserved.
\$10 - \$19	Ram image of the time registers \$00 - \$09. There is a firmware routine at \$CsA9 that will safely update this Ram image to the current time. Unlike the time registers, this information is always available.
\$1A - \$1F	Not used - available for programmer use.
\$20 - \$21	Ram signature bytes. The serial pro firmware will look for the bytes 'AE 55' in these locations to decide if the chip has been initialized. If they don't match, it will load the default control panel values.
\$22	Mode byte. This byte determines what mode the Serial Pro is in. \$00 Communications Mode \$01 P8 emulation mode \$02 Printer mode (default) \$03 P8A emulation mode

\$23

Serial chip Control Register default. This is an image of the 6551 Control Register. The default value is \$18.

Bit 7	Number	0 = 1 bit
	of stop bits	1 = 2 bits
Bit 6	Word length	00 = 8 bits
and 5		01 = 7 bits
		10 = 6 bits
		11 = 5 bits
Bit 4	Receiver	0 = external
	clock source	1 = internal

Bits 3-0--Baud rate as per the table below.

Baud Rates

0000 - External 16x Clock	1000 - 1200 Baud
0001 - 50 Baud	1001 - 1800 Baud
0010 - 75 Baud	1010 - 2400 Baud
0011 - 110 Baud	1011 - 3600 Baud
0100 - 135 Baud	1100 - 4800 Baud
0101 - 150 Baud	1101 - 7200 Baud
0110 - 300 Baud	1110 - 9600 Baud
0111 - 600 Baud	1111 - 19200 Baud

\$24

Serial chip Command Register default. This is an image of the 6551 Command Register. The default value is \$0B.

Bits 7	Parity selection	00 = odd
and 6		01 = even
		10 = mark-always one
		11 = space-always zero
Bit 5	Parity enable	0 = no parity
		1 = enabled
Bit 4	Receiver echo	0 = no echo-normal mode
		1 = echo transmitted characters

Bits 3 and 2--Transmit control as per the table below

Bit 1	Receiver	0 = enabled
	interrupt	1 = disabled
Bit 0	DTR signal	0 = DTR high-disabled
		1 = DTR low-enabled

Transmit Control

00 - /RTS high (off), transmit disabled, transmit interrupts disabled
01 - /RTS low (on), transmit enabled, transmit interrupts disabled
10 - /RTS low (on), transmit enabled, transmit interrupts enabled
11 - /RTS low (on), transmit break, transmit interrupts disabled

\$25 Printer line length. A return character is sent after printing the number of characters in each line specified here. The standard values are 40 (\$28), 72 (\$48), 80 (\$50), 132 (\$84). The value 0 (\$00) stands for unlimited. The default value is \$28.

\$26 Delay and case translation flags. lower case character translation mode. The default value is \$00.

Bits 7 and 6	Lower Case translation mode	00 = lower case converted to upper case 01 = no conversion 10 = lower case converted to inverse upper case 11 = lower case converted to upper case and upper case converted to inverse upper case
Bits 5 and 4	Carriage return delay	as below
Bits 3 and 2	Line feed delay	as below
Bits 1 and 0	Form feed delay	00 = no delay 01 = 32 mSec 10 = 250 mSec 11 = 2 Sec

\$27 Not used but reserved.

\$28 Handshake byte. The default value is \$00.

Bit 7	Local echo	0 = no local echo 1 = echo characters to the screen
Bit 3	XON/XOFF handshaking	0 = disable 1 = use XON/XOFF
Bit 0	Line feed after return	0 = disable 1 = add line feed

The other bits are unused.

\$29 Graphics printer. One of the printers in the table below will be selected as the default. The firmware will select \$08 - Anadex.

Printer Types

\$00 - Epson	\$03 - IDS	\$06 - ImageWriter
\$01 - NEC 8023	\$04 - Okidata 84	\$07 - Mannesmann Talley
\$02 - Anadex	\$05 - Other Okidata	\$08 - Anadex

\$2A Graphics print control byte. This byte is used during graphics printing to hold the options as the command line is disassembled.

Bit 7 Side by side ('S')
Bit 6 Inverse ('I')
Bit 5 Page 2 ('2')
Bit 0 Rotated ('R').

\$2B - \$2C Firmware scratch pad locations.

\$2D - \$3F Not used - available for programmers.

Where to Get More Information

About the Serial Pro For most user applications, this manual provides all of the information required to install and set up your Serial Pro card.

About Your Serial Device For specific information about your printer, modem, or other serial device, you should refer to the instruction manual that came with the device. If the manual doesn't have the information you need or you don't have the manual, contact the manufacturer of the device or the dealer from whom you purchased the device.

About Interface Cables By attaching the internal cable to either the PRINTER or MODEM connector, virtually all serial devices will work using a "straight-through" cable or a ready-made cable designed to connect your device to an Apple Super Serial Card. These cables are sold most computer dealers. With the information provided in Appendix B of this manual, the dealer will be able to pick the right cable for your device.

Building your own serial cable is not recommended unless you are an experienced technician with the proper tools and knowledge of data communications. Although, most of the larger bookstores have books on RS-232-C data communications which will tell you what you need and how to build your own serial cables.

If You Have Questions

If the answer to your question cannot be found in one of your user's manuals, please contact the dealer from whom you purchased the Serial Pro or your serial device. Most dealers are knowledgeable and have the resources to readily answer your question. In the event that the dealer cannot answer your question, Applied Engineering has a staff of technicians dedicated to answering specific technical questions about Applied Engineering products and software.

Technical Support representatives are available between the hours of 9 AM and 5 PM Central time, Monday through Friday. The telephone number is (214) 241-6069. Please call only this number for technical support, as our sales-office number cannot transfer calls to the support lines.

The support representatives are experienced in many of the applications of Applied Engineering products, but in order to provide a quick and effective answer to your question, they will need to know as much as possible about the hardware and software specifically related to your question. While most technical questions can be answered in one telephone conversation, some questions may require research by the technical support representative. Please be sure to make a note of the representative's name, just in case you need to call back with any additional information or follow-up on an previous call.

Applied Engineering Technical Support

(214) 241-6069

Hours:

9 AM to 5 PM CST Monday through Friday

— o —

Serial Pro User's Manual

Hours:

24 hours a day - 7 days a week

