

Apple II

Technical Notes



Developer Technical Support

Apple IIe

#10: The Apple IIe Card for the Macintosh LC

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This Technical Note discusses all the miscellaneous differences we know of between an enhanced Apple IIe and the Apple IIe Card for the Macintosh LC running version 1.0 of the IIe Startup application. This Note also contains routines needed to check and change the speed of the Apple IIe Card.

Changes since July 1991: Revised this Note to conform to the latest release of the Apple IIe Card software, version 2.2.1.

The Apple IIe Card for the Macintosh LC was designed to act as much like an enhanced Apple IIe as possible. For this reason, you should refer to the Apple IIe Technical Reference Manual for most technical information. However, our implementation of an Apple IIe is not completely perfect, so that's why we wrote this Note. The next several sections of this Note describe the differences we know of between an enhanced Apple IIe and the Apple IIe Card for the Macintosh LC. The Apple IIe Card can be identified using the routine in Apple II Miscellaneous Technical Note #2 or the identification bytes listed in Apple II Miscellaneous Technical Note #7.

The current version of the Apple IIe Card software can be downloaded from the A2Central.com web site at <http://www.a2central.com/stuff/applesoftware>.

Keyboard

The Apple IIe Card option panel allows the user to set three keyboard parameters not available on an Apple IIe: delay until repeat, repeat rate, and type ahead. The ability to set these parameters is also available on the Apple IIGS. If your application has trouble with the settings of any of these parameters, your documentation should make note of it.

The keyboard layout available to the user of an Apple IIe Card may be quite different than an Apple IIe since any Apple Desktop Bus (ADB) keyboard might be attached to the Macintosh LC. Because of the variations in ADB keyboard layouts, applications should not depend on any specific key placement.

The single-wire Shift-key modification which allows software to read the state of the shift-key with the PB2 switch input is not implemented.

Game I/O Signals

The game I/O signals are all handled by the Apple IIe Card hardware. The only game I/O signals available from the Apple IIe Card are those available at the 9 pin D-type miniature connector. The Apple IIe Card does not have a 16-pin DIP socket for game I/O signals, so the AN0–AN3 annunciator outputs and the STROBE[⌘] output are not available.

Soft Switch Differences

The following soft switches are not implemented on the Apple IIe Card:

Name	Access	Address	Comment
CASSIN	R	\$C060	There is no cassette I/O
CASSO	W	\$C020	There is no cassette I/O
IOUDIS	W	\$C07E	There is no IOU to disable
IOUDIS	W	\$C07F	There is no IOU to enable
RDIODIS	R7	\$C07E	There is no IOUDIS switch to read

The RDDHIRES (\$C07F) soft switch is not implemented in version 1.0 of the IIe Startup application. This soft switch may or may not be implemented in a future version of the IIe Startup application.

The VBL (\$C019) soft switch cycles at 60 Hz, but it is not synchronized with the Macintosh LC video. This may cause flicker in some animation displays that depend on VBLs.

Monitor Routines

Several Monitor routine act different on the Apple IIe Card then they do on an Apple IIe. Here's a list of those routines:

Subroutine	Address	Comment
BELL	\$FF3A	The Apple IIe Card option panel allows the bell tone produced by the BELL subroutines to be set to a Macintosh sound. BELL on an Apple IIe will generate a 1 kHz tone for approximately 0.1 second. Since the duration of Macintosh sounds may or may not be 0.1 second (most sounds are much longer than 0.1 second), you should not depend on the BELL subroutines for timing.
BELL1	\$FBDD	See BELL.
GETLN	\$FD6A	The GETLN input subroutines treats the Delete key the same as the Backspace key (◆). This is the same way the Delete key is treated by GETLN on an Apple IIGS. The AppleSoft BASIC INPUT statement calls GETLN, so it is also affected.
GETLNZ	\$FD67	See GETLN.
GETLN1	\$FD6F	See GETLN.
PREAD	\$FB1E	The PREAD subroutine timing is not adjusted for the fast (1.9 MHz) 65C02 processor speed. The AppleSoft BASIC PDL function calls PREAD, so it is also affected.
READ	\$FEFD	The READ cassette subroutine is not implemented and consists of a single RTS instruction.
WAIT	\$FDA8	The WAIT subroutine timing is not adjusted for the fast (1.9 MHz) 65C02 processor speed.

WRITE

\$FECD

The WRITE cassette subroutine is not implemented and consists of a single RTS instruction.

Memory Access and Timing

When the 65C02 accesses certain key I/O locations or writes to the active Apple IIe display memory, it is “Trapped” (or halted temporarily) and the address accessed and data read or written is latched so the information is available to the IIe Startup application running on the Macintosh LC. After the IIe Startup application has gathered the data, it allows the 65C02 to continue. Access to Trapped memory locations will cause problems with timing sensitive 65C02 code. The following table lists the Trapped access areas and what type of access (Read or Write) will cause the Trap to activate on the Apple IIe Card

Address	R/W	Description
Display Areas		
\$400-7FF	Write	Text/LoRes page 1 stores
\$800-BFF	Write	Text/LoRes page 2 stores
\$2000-3FFF	Write	HiRes/Dbl-HiRes page 1 stores
\$4000-5FFF	Write	HiRes/Dbl-HiRes page 2 stores
Internal Soft Switch and I/O Areas		
\$C000-C001	Write	80STORE soft switches
\$C00C-C00D	Write	80COL soft switches
\$C00E-C00F	Write	ALTCHARSET soft switches
\$C050-C057	R/W	Display soft switches
\$C058-C05F	R/W	Annunciators
\$C070	R/W	PDLTRIG
I/O Slot accesses		
\$C090-C09F	R/W	Slot 1 Hardware accesses
\$C0A0-C0AF	R/W	Slot 2 Hardware accesses
\$C0B0-C0BF	R/W	Slot 3 Hardware accesses
\$C0C0-C0CF	R/W	Slot 4 Hardware accesses
\$C0D0-C0DF	R/W	Slot 5 Hardware accesses
\$C0E8-C0E9	R/W	Slot 6 Disk 5.25" Motor on/off switch
\$C0F0-C0FF	R/W	Slot 7 Hardware accesses
\$CFFF	R/W	Shared \$C8-space switch

Notes:

1. The “Screen-Hole” areas in the above address ranges do not trap. These are the \$xx78–7F and \$xxF8–FF address ranges in the display areas.
2. Display writes do not trap when the Slot 6 motor switch is on.
3. The auxiliary text pages will be trapped whenever 80COL (\$C00D) is on, unless the current screen mode is a full screen graphics mode.
4. The auxiliary HiRes pages will be trapped only when Double HiRes is being displayed.

Cassette I/O

The Apple IIe Card does not have the cassette tape input and output miniature phone jacks and the Monitor cassette routines `READ` and `WRITE` do nothing.

65C02 Processor Speed

The 65C02 processor on the Apple IIe Card can be run at two speeds; the normal Apple IIe 1 MHz or a fast speed of approximately 1.9 MHz. Normally, the 65C02 processor speed setting should be left at whatever the user of the system set it to with the Apple IIe Card option panel. However, we know there are some times when an application must change the speed of the system so we've provided safe routines to change the speed and to obtain the speed setting of the Apple IIe Card option panel. Below are four short assembly language routines you can use to manipulate the 65C02 processor speed of the Apple IIe Option Card for the Macintosh LC.

Warning: You **must** ensure your application is running on an Apple IIe Card before calling these routines. See Apple II Miscellaneous Technical Notes #2 and #7 for Apple II Family identification information.

```

;-----
;
; GetOptPanelSpeed
;
; Get the option panel's current speed setting. This may or may not be the
; current speed of the Apple IIe Option Card -- It is the speed the user has
; asked for via the option panel.
;
; The A, X and Y registers are not changed.
; The n, z and c flags are affected.
; The c flag (carry) will hold result:
;     0 = Normal Speed
;     1 = Fast Speed
;
; WARNING: Location $c05c is a read-only soft switch. You must never
; modify the contents of this location.
;-----
;
GetOptPanelSpeed    pha                ; store the A reg
                   lda $c05c          ; get option panel speed (in bit 2)
                   lsr a               ; and move it into the carry flag
                   lsr a
                   lsr a
                   pla                ; restore the A reg
                   rts

;-----
;
; SetToOptPanelSpeed
;
; Get the option panel's current speed setting and set the Apple IIe Option
; Card to that speed.
;
; The A, X and Y registers are not changed.
; The n, z and c flags are affected.
;-----
;
SetToOptPanelSpeed  jsr GetOptPanelSpeed ; Get the default speed
                   bcs SetFastSpeed    ; branch to SetFastSpeed
;                                     bcc SetNormalSpeed ; fall through to SetNormalSpeed

```

```
;-----  
;  
; SetNormalSpeed  
;  
; Set the Apple IIe Option Card to "Normal" speed.  
;  
; The A, X and Y registers are not changed.  
; The z flag may be changed.  
;  
; WARNING: All bits at location $c02b are reserved except for bit 3.  
; In order to manipulate bit 3 at location $c02b and leave the other  
; reserved bits untouched, you must use a read-modify-write technique.  
; The test-and-set-bit (TSB) instruction or the test-and-reset-bit (TSR)  
; instruction can be used to accomplish this. Both of these instructions  
; allow you to modify any one bit and leave the others untouched.  
;  
;-----  
;  
SetNormalSpeed      pha  
                    lda #$04  
                    trb $c02b          ;reset bit 2 to 0  
                    pla  
                    rts  
  
;-----  
;  
; SetFastSpeed  
;  
; Set the Apple IIe Option Card to "Fast" speed.  
;  
; The A, X and Y registers are not changed.  
; The z flag may be changed.  
;  
; WARNING: All bits at location $c02b are reserved except for bit 3.  
; In order to manipulate bit 3 at location $c02b and leave the other  
; reserved bits untouched, you must use a read-modify-write technique.  
; The test-and-set-bit (TSB) instruction or the test-and-reset-bit (TSR)  
; instruction can be used to accomplish this. Both of these instructions  
; allow you to modify any one bit and leave the others untouched.  
;  
;-----  
;  
SetFastSpeed        pha  
                    lda #$04  
                    tsb $c02b         ;set bit 2 to 1  
                    pla  
                    rts
```

Peripheral Cards

The Apple IIe Card does not have any real peripheral cards. Instead, it has a simulated slot architecture that allows pseudo-I/O devices to be flexibly mapped into the various Apple II I/O slot spaces. The subsections of this section describe the various pseudo-I/O devices available to the Apple IIe Card.

Video

The 80-column video firmware is always in slot 3. The 80-column firmware acts just like the 80-column firmware in an Apple IIe or IIc. The Macintosh LC monitor is always used for the display device. There is no NTSC compatible video signal available from the Apple IIe Card.

The Apple IIe Card option panel allows the user to set the display to monochrome or color. When the display is in color mode, the “color fringes” seen in Apple IIe graphics may be more distinct on the high resolution color video monitors used with the Macintosh LC than they are on composite color video monitors or television sets commonly used with the Apple IIe.

The character set used by the Apple IIe Card is the same character set used on the enhanced Apple IIe with two differences: the character set can be either normal or inverse by the Apple IIe Card option panel and the flashing display format does not flash. When the inverse character set is selected, the whole text display is inverted (graphics display modes are not affected). When the flashing display format is used, characters are shown as black text on a red background (or red text on a black background if the inverse character set is selected).

The IIe Startup application updates the Macintosh LC’s display every time a change is made to the active display pages in the Apple IIe Card’s RAM. Applications that attempt to animate over 1/3 of the display screen will not perform as fast on the Apple IIe Card as the do an Apple IIe. See the Memory Access and Timing section of this Note for more information.

Memory Expansion Card

The memory expansion card device can be mapped to any slot space except slot 3 (where the video firmware always resides) or slot 6 (where the Apple Disk 5.25 always resides).

The memory card pseudo-I/O device looks like an Apple II Memory Expansion Card. It can be accessed through firmware routines or it can be accessed via hardware I/O addresses. It can be configured to have 256K, 512K, 768K or 1024K RAM with the Apple IIe Card option panel.

AppleShare Card

The AppleShare Card emulates an Apple II Workstation Card to provide support for network booting and accessing disks shared using AppleShare or Macintosh file sharing.

Printer Card

The printer card is used to connect the Apple IIe Card to either a direct-connected or networked printer. This card emulates a serial-connected ImageWriter II printer but prints to whatever printer is selected in the Macintosh Chooser.

Serial Cards

The serial card devices can be mapped to any slot space except slot 3 (where the video firmware always resides) or slot 6 (where the Apple Disk 5.25 always resides). These can be used for modems or other serial devices, but you should use the Printer Card device for directly-connected or networked printers.

The serial card pseudo-I/O devices look very much like Apple Super Serial Cards. They are compatible with software that uses the standard BASIC or Pascal firmware entry points of an Super Serial Card and with most software that talks directly to the 6551 Asynchronous Communications Interface Adaptor (ACIA) hardware addresses of an Super Serial Card. The differences between the modem or printer port devices and a Super Serial Card are:

- Speed - When software talks directly to the 6551 hardware addresses, the maximum throughput rate is somewhere between 240 and 480 characters per second although any baud rate can be used.
- Delays - Since the IIe Startup application passes all characters from the serial cards to the Macintosh LC's serial driver, there may be a delay between the time you give the port device a character and when the Macintosh serial driver actually sends it.
- 6551 echo-mode - This 6551 mode (set by accessing the 6551 command register) is not supported by the serial card devices.
- Hardware handshake lines - Since the Macintosh LC only has one input (HSKi) and one output (HSKo) handshake lines, not all 6551 hardware handshaking is available. HSKi is mapped to the 6551 CTS line which cannot be read from software but does control handshaking. HSKo is mapped to the 6551 DTR line and can be enabled or disabled with the 6551 command register.. The DCD and DSR 6551 inputs will always return true.

Mouse

The mouse device can be mapped to any slot space except slot 3 (where the video firmware always resides) or slot 6 (where the Apple Disk 5.25 always resides). The mouse pseudo-I/O device is compatible with software that uses the standard AppleMouse II or Apple IIc mouse firmware. The AppleMouse II hardware is not emulated by this pseudo-I/O device.

Mouse tracking (mouse speed) can be set by the Apple IIe Card option panel.

SmartPort Devices

The SmartPort devices can be mapped only into slot 5. SmartPort on the Apple IIe Card can support one external UniDisk 3.5 drive and either one or two internal Macintosh LC SuperDrives.

If an UniDisk 3.5 drive is used, it is connected to the Apple IIe Card's disk drive connector and is controlled by the IWM disk controller unit on the Apple IIe Card.

The internal Macintosh LC SuperDrives return the same device type and subtype as an UniDisk 3.5 drive. However, the internal SuperDrives only support standard SmartPort calls and do not support any UniDisk 3.5 specific SmartPort calls. The internal SuperDrives are controlled by the Macintosh LC hardware and cannot be accessed by the IWM on the Apple IIe Card.

Apple Disk 5.25 Drives

The Apple Disk 5.25 drives can be mapped only into slot 6. Either one or two external Apple Disk 5.25 drives can be connected to the Apple IIe Card's disk drive connector and they are controlled by the IWM disk controller unit on the Apple IIe Card.

Copy protection schemes that access video or I/O locations between sector or block reads and that depend on timing and will most likely fail on the Apple IIe Card.

Clock

The clock device can be mapped to any slot space except slot 3 (where the video firmware always resides) or slot 6 (where the Apple Disk 5.25 always resides). The firmware of the clock pseudo-I/O device looks just like the firmware of a ProDOS compatible clock. Clock card hardware is not emulated.

Conclusion

Most current Apple IIe applications run perfectly on the Apple IIe Card with no changes. By avoiding the few known differences listed in this Technical Note, you should be able to write new Apple IIe applications without adding code to special case for the Apple IIe Card. In applications that have special timing requirements, you can force the Apple IIe Card to run at 1 MHz by identifying the Apple IIe Card and using the processor speed routines supplied in this Note.

Further Reference

- *Apple IIe Card for the Macintosh LC User's Manual*
- *Apple IIe Technical Reference Manual*
- *Apple IIc Technical Reference Manual*
- *Apple IIgs Firmware Reference*
- *Apple II Memory Expansion Card Reference Manual*
- *AppleMouse II User's Manual*
- *ProDOS 8 Technical Reference Manual*
- Apple II Miscellaneous Technical Note #2: Apple II Family Identification Routines
- Apple II Miscellaneous Technical Note #7: Apple II Family Identification
- SmartPort Technical Note #4, SmartPort Device Types
- SmartPort Technical Note #7, SmartPort Subtype Codes