Apple IIc

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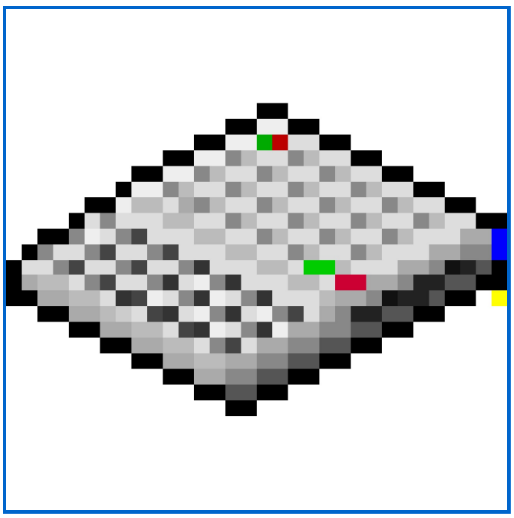

Apple IIc
Full Specifications

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The **Apple IIc**, the fourth model in the Apple II series of personal computers, was Apple's first endeavor to produce a portable computer. The end result was a luggable 7½ pound notebook-sized version of the Apple II that could easily be transported from place to place. The *c* in the name stood for *compact*, referring to the fact it was essentially a complete Apple II computer setup (minus display and power supply) squeezed into a small notebook sized housing. While sporting a built-in floppy drive and new rear peripheral expansion ports, it lacked the internal expansion slots and direct motherboard access of earlier Apple IIs, making it a closed system like the Macintosh. However that was the intended direction for this model—a more appliance-like machine, ready to use out of the box, requiring no technical know-how or experience to hook up and therefore attractive to first-time users.

Contents

History

The Apple IIc was released in April 1984, during an Apple-held event called *Apple II Forever*. The new machine was proclaimed as proof of Apple's long-term commitment to the Apple II series and its users, an assurance the company's older technology would not be forsaken or dropped with the recent introduction of the Macintosh. While essentially an Apple IIe computer in a smaller case, it was not a successor, but rather a portable version to complement it. One Apple II machine would be sold for users who required the expandability of slots, and another for those wanting the simplicity of a plug and play machine with portability in mind.

The machine introduced Apple's Snow White design language, notable for its elegant case styling and a sleek modern look which soon became the standard for most Apple equipment and computers, and continuing for nearly a decade after. The Apple IIc introduced a unique off-white coloring known as "Fog," chosen to enhance the Snow White design style.[1] It was the only Apple-made computer produced to use this color (other machines were typically beige or light gray), though various peripherals also shared it.[2] While relatively light-weight and compact in design, the Apple IIc was not a true portable in design as it lacked a built-in battery and display.

Codenames for the machine while under development included: Lollie, ET, Yoda, Teddy, VLC, IIb, IIp.

Overview of features

Improving the IIe

Technically the Apple IIc was an Apple IIe computer in a smaller case, retaining the same set of features. Building on the design, it did manage to offer a few minor improvements without affecting compatibility for the most part. It utilized the CMOS based 65C02 microprocessor (instead of a plain 6502) which added 27 new processor instructions and drew less power (but hampered compatibility

with a very small number of programs that used illegal opcodes of the 6502 processor, which were removed in the 65C02). The new ROM firmware allowed Applesoft BASIC to recognize lowercase characters and work better with an 80-column display, and fixed several bugs from the IIe ROM. In terms of video, the text display added 32 unique character symbols called "MouseText" which, when placed side by side, could display simplistic looking icons, windows and menus to recreate a graphical user interface completely out of text, similar in concept to IBM ANSI. A year later the Apple IIe would benefit from these improvements in the form of a four-chip upgrade called the Enhanced IIe.

Built-in cards and ports

The equivalent of five slot cards were built-in and integrated into the Apple IIc motherboard. These included: an Extended 80 Column Card, two Apple Super Serial Cards, a Mouse Card, and a floppy drive controller card. This meant the Apple IIc had 128 KB RAM, 80-column text, and Double-Hi-Resolution graphics built-in and available right out of the box, unlike its older sibling, the Apple IIe. It also meant less of a need for slots, as the most popular peripheral add-on cards were already built-in, ready for devices to be plugged into the rear ports of the machine. The built-in cards were mapped to phantom slots so software from slot-based Apple II models would know where to find them (i.e. mouse to virtual slot 4, serial cards to slot 1 and 2, floppy to slot 6, and so on). Of interest is that the entire Apple Disk II Card, used for controlling floppy drives, had been shrunk down into a single chip called the "IWM" which stood for Integrated Wozniak Machine.

In the rear of the machine were its expansion ports, mostly for providing access to its built-in cards. The standard DE-9 joystick connector doubled as a mouse interface, compatible with the same mice used by the Lisa and early Macintosh computers. Two serial ports were provided primarily to support a printer and modem, and a floppy port connector supported a single external 5¼-inch drive (and later "intelligent" devices such as 3½-inch drives and hard disks). A Video Expansion port provided rudimentary signals for add-on adapters but alone could not directly generate a video signal (Apple produced a LCD display and an RF-modulator for this port; the latter shipped with early IIcs). A port connector tied into an internal 12-volt power converter for attaching batteries; this is where the infamous external powersupply (dubbed "brick on a leash" by users) that was included plugged in. The same composite video port found on earlier Apple II models remained present; however, gone were the cassette ports and internal DIP-16 game port.

Built-in accessories and keyboard

The Apple IIc had a built-in 5¼-inch floppy drive (140 KB) along the right side of the case—the first Apple II model to include such a feature. Along the left side of the case was a dial to control the volume of the internal speaker, along with a ⅛-inch monaural audio jack for headphones or an external speaker. A fold-out carrying handle doubled as a way to prop up the back end of the machine to angle the keyboard for typing, if desired.

The keyboard layout mirrored that of the Apple IIe; however, the "Reset" key had been moved above the "Esc" key. Two toggle switches were also located in the same area: an "80/40"-column switch for (specially-written) software to detect which text video mode to start up in, and a "Keyboard" switch to select between QWERTY and Dvorak layout—or between US and national layout on non-American machines. The keyboard itself was built into the front half of the case, much like a notebook computer, and had a rubber mat placed beneath the keycaps which acted as a liquid spill guard.

Technical specifications

Microprocessor

- 65C02 running at 1.023 MHz
- 8-bit data bus

Memory

- 128 KB RAM built-in
- 32 KB ROM built-in (16 KB ROM in original)
- Expandable from 128 KB to 1 MB (only through non-conventional methods in original)

Video

- 40 and 80 columns text, with 24 lines[3]
- Low-Resolution: 40×48 (15 colors)
- High-Resolution: 280×192 (6 colors)[4]
- Double-Low-Resolution: 80×48 (15 colors)
- Double-High-Resolution: 560×192 (15 colors)[4]

Audio

- Built-in speaker; 1-bit toggling
- User adjustable volume (manual dial control)

Built-in storage

- Slim-line internal 5.25 floppy drive
- 140 KB, single-sided

Internal connectors

- Memory Expansion Card connector (34-pin)*

** Only available on ROM 3 motherboard and higher; original IIc: NONE*

Specialized chip controllers

- IWM (Integrated Wozniak Machine) for floppy drives
- Dual 6551 ACIA chips for serial I/O

External connectors

- Joystick/Mouse (DE-9)
- Printer, serial-1 (DIN-5)
- modem, serial-2 (DIN-5)
- Video Expansion Port (D-15)
- Floppy drive SmartPort (D-19)

- 12 Volt DC connector input (DIN-7, male)
- NTSC composite video output (RCA connector)
- Audio-out (⅛-inch mono phono jack)

Revisions

The Apple IIc was in production between April 1984 until August 1988, and during this time accrued some minor changes. These modifications included three new ROM updates, a bug-fix correction to the original motherboard, a newly revised motherboard, and a slight cosmetic change to the external appearance of the machine.

Original IIc (ROM version '255')

The initial ROM, installed in machines produced during the first year and a half of production, was 16 KB in size. The only device which could be connected to the disk port was (one) external 5¼-inch floppy drive; software could be booted from this external drive by typing the command "PR#7." The serial port did not mask incoming linefeed characters or support the XON/XOFF protocol, unlike all later firmware revisions to come. There was no self-test diagnostic present in this ROM, holding down the solid-Apple key during cold boot merely cycled unusual patterns on screen which served no useful purpose or indication of the machine's health.

Serial port timing fix

The original Apple IIc motherboard (manufactured between April and November 1984) derived the timing for its two serial ports through a 74LS161 TTL logic chip. It was later found that this method's timing was 3% slower than the minimum requirement specified and caused some third party (i.e. non-Apple) modems and printers, which operated at 1200 bits per second (baud) or faster, to function improperly. Slower serial devices operating at 300 baud or less were unaffected, as well as some faster devices which could tolerate the deviation. The solution to ensure all devices were compatible was to replace the TTL chip with an oscillator during manufacture. Apple would swap affected motherboards for users who could prove they had an incompatible serial device (e.g. a third-party 1200-baud modem which presented problems; not all did). It is important to note the problem did not affect all owners; it was more or less a hit-or-miss issue depending on the specific device connected.

UniDisk 3.5 support (ROM version '0')

This update, introduced November 1985, came in the form of an upgrade to the ROM firmware which doubled in size from 16 KB to 32 KB. The new ROM supported "intelligent" devices such as Apple's UniDisk 3½-inch (800 KB) floppy drive, in addition to an external 5¼-inch floppy drive. A new self-test diagnostic was provided for testing built-in RAM and other signs of logic faults. The Mini-Assembler, absent since the days of the Apple II Plus, made a return, and new Monitor "Step" and "Trace" commands were added as well. The upgraded ROM added rudimentary support for an external AppleTalk networking device which was yet to be developed. When attempting to boot virtual slot 7, users would encounter the message "APPLETALK OFFLINE." The IIc however had no built-in networking capabilities, and no external device was ever released. The upgrade consisted of a single chip swap (and a trivial motherboard modification), which Apple provided free only to persons who purchased a UniDisk 3.5 drive. A small sticker with an icon of a 3½-inch floppy diskette was

placed next to the existing 5¼-inch diskette icon above the floppy drive port indicating the machine had been upgraded.

Memory Expansion IIc (ROM version '3')

Introduced in September 1986 simultaneously with the Apple IIGS, this model introduced a new motherboard, new keyboard and new color scheme[5]. The original Apple IIc had no expansion options and required third-party cards to perform various hardware tricks. This could be done by removing the CPU and MMU chips and squeezing a special board into these sockets, which then used bank switching to expand memory (RAM). This was similar to the function of the auxiliary slot in the original Apple IIe. The new motherboard added a 34-pin socket for plugging in memory cards directly, which allowed for the addressing of up to 1 megabyte of memory using Slinky-type memory cards. The onboard chip count was reduced from sixteen memory chips (64K×1) to four (64K×4). The new firmware removed the code for the cancelled AppleTalk networking device and replaced it with support for memory cards. Bumping out the non-supported AppleTalk functionality, memory now lived in virtual slot 4, and mouse support moved to slot 7. The new keyboard no longer had the rubber anti-spill mat and offered generally more tactile and responsive keys that felt more "clicky." At the same time the color of the keyboard, floppy drive latch, and power supply cords changed from beige to light grey, which matched the new Platinum color scheme of the Apple IIGS. The case style, however, remained Snow White. Owners of the previous IIc model were entitled to a free motherboard upgrade if they purchased one of Apple's IIc memory expansion boards (they did not receive the new keyboard or the cosmetic changes).

Memory Expansion fix (ROM version '4')

In January 1988 a new ROM firmware update was issued to address bugs in the new memory expandable IIc. Changes included better detection of installed RAM chips, correction of a problem when using the serial modem port in terminal-mode, and a bug fix for keyboard buffering. The ROM upgrade was available free of charge only to owners of the memory expansion IIc. This was the final change to the Apple IIc until superseded by the **Apple IIc Plus** (identified as ROM version '5').

International versions

Like the Apple IIe before it, the Apple IIc keyboard differed depending on what region of the world it was sold in. Sometimes the differences were very minor, such as extra local language characters and symbols printed on certain keycaps (e.g. French accented characters on Canadian IIc such as "á," "é," "ç," etc., or the British Pound "£" symbol on the UK IIc) while other times the layout and shape of keys greatly differed (e.g. European IIc). In order to access the local character set, the "Keyboard" switch above the keyboard (used for switching between QWERTY and DVORAK layouts on US models; a feature not available in international IIcs—the feature had in fact been intended to switch between international keyboards; the DVORAK layout was merely added to give the switch a function on US IIcs) was depressed, which would instantly switch text video from the US character set to the local set. In some countries these localized IIcs also supported 50 Hz PAL video and the different 220/240 volt power of that region by means of a different external power supply—this was a very simple change, since the IIc had an internal 12 volt power converter. The international versions replaced any English wording printed on the case (specifically the "keyboard" toggle switch, "Power" and "Disk Use" drive activity labels) with graphical icon symbols that could be universally understood.

Add-on accessories

Portability enhancements

File:Apple IIc Flat Panel Display.jpg
Apple IIc *Flat Panel Display*.

At the time of the Apple IIc's release, Apple announced an optional black and white (1-bit) LCD screen designed specifically for the machine called the *Apple Flat Panel Display*. While it was welcomed as a means of making the IIc more portable, it did not integrate well as a portable solution, not attaching in a secure or permanent manner and not able to fold-over face down. Instead, it sat atop the machine (temporarily wedging its support stand inside the top vertical grooves of the case) and connected via ribbon cable to a somewhat bulky rear port connector. Its main shortcoming was that it suffered from a very poor contrast and no backlighting, making it very difficult to view without a strong external light source. The display itself had an odd aspect ratio as well, making graphics look vertically squashed. A third-party company would later introduce a work-alike LCD screen called the *C-Vue*, which looked and functioned very much like Apple's product, albeit with a reportedly slight improvement in viewability. Consequently both sold poorly and had a very short market life span, making these displays fairly uncommon (and as a result, extremely rare today).

Third parties also offered external rechargeable battery units for the Apple IIc (e.g. *Prairie Pack*) with up to eight hours per charge or longer. Although they aided in making the machine more of a true portable, they were nonetheless bulky and heavy, and added more pieces that would have to be carried. Adapter cables were sold as well that allowed the Apple IIc to plug into an automobile's DC power cigarette lighter.

To help transport the Apple IIc and its accessory pieces around, Apple sold a nylon carrying case with shoulder strap that had a compartment for the computer, its external power supply, and the cables. It had enough room to squeeze in one of the abovementioned LCD display units. The case was grey in color with a stitched on Apple logo in the upper left corner.

Expansion capabilities

While the Apple IIc had many built-in features to offer, many users wanted to extend the machine's capabilities beyond what Apple provided. It proved difficult since the IIc was a closed system that initially was designed with no expansion capabilities; however, many companies figured out ingenious ways of squeezing enhancements inside the tiny case. Real-time clocks, memory expansion, and coprocessors were popular, and some companies even managed to combine all three into a single add-on board. Typically, in order to add these options, key chips on the motherboard were pulled and moved onto the expansion board offering the new features, and the board was then placed into the empty sockets. While sometimes a tight squeeze, this trickery worked quite well, and most importantly of all offered users a way to expand memory—something Apple did not themselves support until the Memory Expansion IIc model was introduced.

Some companies devised a method for squeezing in an entire CPU accelerator product, by means of placing all the specialized circuitry (i.e. cache and logic) into one tall chip that outright replaced the

40-pin 65C02 microprocessor, speeding up the machine from 4–10 MHz. Notable examples are the Zip Chip and Rocket Chip.

Although the IIc lacked a SCSI or IDE interface, external hard drives were produced by third parties that connected through the floppy SmartPort as an innovative alternative connection method (e.g. *ProApp*, *Chinook*, *C-Drive*). While these specialized hard drives were relatively slow due to the nature of how data was transferred through this interface (designed primarily for floppy drives) they did allow for true mass storage. Other innovations that used existing expansion ports lead to add-on speech and music synthesis products by means of external devices that plugged into the IIc's serial ports. Two such popular devices were the *Mockingboard-D* and *Echo IIc*.

General accessories

For those wishing to use the Apple IIc as a standard desktop machine, Apple sold an optional small 9-inch monochrome CRT display with an elevated stand or alternatively a 14-inch color composite monitor. A mouse was another popular add-on, especially since it required no interface card and simply plugged directly into back of the machine (MousePaint, a clone of the popular MacPaint, shipped with the IIc's mouse). An external 5¼-inch floppy drive, matching the style of the IIc, was also made available. Later 3½-inch floppy storage became an option with the "intelligent" UniDisk 3.5 which contained its own miniature computer inside (CPU, RAM, firmware) to overcome the issue of using a high-speed floppy drive on a 1 MHz machine. Template:Timeline of Apple II Family