THE STORY OF "THE MOST PERSONAL COMPUTER"!

13-PERIPHERALS

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APPLE II PERIPHERALS

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The ability to add an external hardware device to a computer has been present from the earliest days of the first Altair to the present. In fact, the success of a computer has inevitably led to hackers designing something to make it do things it couldn't do before. The more popular the computer, the more variety found in hardware add-ons. The Apple II, designed by a hacker to be as expandable as possible, was once a leader as a platform for launching new and unique hardware gadgets. By 1991, the Apple II unfortunately no longer held the front position; it had been supplanted by the Macintosh and IBM PC and its clones. However, for a few years the Apple II still received the benefits from the "trickle-down" of some of the best new devices from other computers (SCSI disk devices and hand scanners, for example). This was due partly to gradually emerging standards that made it easier to design a single hardware device that would work on multiple computers, and in the case of the Macintosh, because of Apple's decision to make peripherals somewhat compatible between the two computer lines.

This chapter of the Apple II History will present an overview of hardware devices that were either significant in the advancement of the II, or unique, one-of-a-kind devices. This is definitely not a comprehensive list; it is limited to those peripherals about which the author has had personal experience or about which information could be located.

WHAT IS A PERIPHERAL?

A basic definition of a peripheral would be, "Something attached to a computer that makes it possible to do more than it could previously do." It is called a "peripheral" because it usually is connected to the computer after it leaves the factory. An argument could be made that something built-in is not a peripheral, but as things have changed over time there are some devices still called "peripherals" from force of habit, though they are now built-in (hard disks come to mind). Quite probably, in time many devices that were once considered optional accessories will become so essential that they will always be built-in.

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Recall that the earliest computers came with almost *nothing* built-in. They had a microprocessor, a little memory, some means of data input and display of results, the ability to access some or all of the signals from the microprocessor, and that was all. For those computers, the first things that users added were keyboards and TV monitors to make it easier to use them. Recognizing that the earliest hardware peripherals were keyboards and monitors highlights one fact: Nearly *everything* that is sold as a peripheral for a computer is either an input device, an output device, or an interface to make it possible to connect input and output devices. Exceptions are cards to add memory, co-processor cards to allow it to run software from another computer, and accelerators to make the computer run faster.

EARLY PERIPHERALS

With the release of the first Apple II, it offered an advantage over many of its competitors at the time. Two important "peripherals" were built-in: A keyboard, and the circuitry to allow easy connection of a TV monitor. It had, of course, the slots for inserting expansion cards (none were available), a game port (for attaching the include game paddles), a pin that could be used to connect an RF modulator (so a standard television could be used instead of a computer monitor), and a cassette interface. Since there were no cards available to plug into the slots, you would imagine that the Apple II couldn't make use of any other hardware. However, those early users who had a need usually found a way around these limits.

To get a printed copy of a program listing, for example, was no trivial matter. First, there were very few printers available. Those who could, obtained old used teletypes salvaged from mainframe computers. These noisy, massive clunkers often had no lowercase letters (not a big problem, since the Apple II didn't have it either), and printed at the blazing speed of 10 characters per second. To use these printers when there were yet no printer interface cards to make it easy to connect, hackers used a teletype driver written by Wozniak and distributed in the original Apple II Reference Manual (the "Red Book"). This driver sent characters to the printer through a connection to the game paddle port. One part of being a hacker was improvising with what was available.[1]

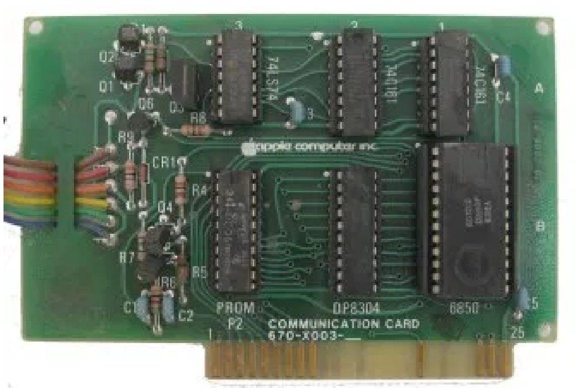
Another of the earliest devices designed for the Apple II came from the Apple Pugetsound Program Library Exchange (A.P.P.L.E.). They were involved in distributing Integer BASIC programs on cassette to members of the group. To make it easier to send those programs to the person responsible for duplicating the cassette, Darrell Aldrich designed a means of sending the programs over the telephone lines. There were no modems available at the time, so his "Apple Box" was attached to the phone line with alligator clips and then plugged into the cassette port on the Apple II. To send a program, you first called up the person who was to receive it and got the computers on each end connected to the Apple Box. The sender then used the SAVE command in BASIC to tell the computer to save a program to tape. In actuality, the program was being "saved" through the cassette "out" port to the Apple Box, and onto the phone line connected. At the other end of that phone line, the data went into the other Apple Box, which was connected to the cassette "in" port on the other Apple II. That computer was executing the LOAD command in BASIC to "load" the program from the Apple Box. A.P.P.L.E. sold about twenty of these Apple Boxes at $10 apiece.[2]

INTERFACE CARDS

One of the first interface cards made for the Apple II was released, naturally, by Apple. The Apple II Parallel Printer Interface Card was released in 1977 and sold for $180.[3] Wozniak wrote the firmware ROM, and managed to make it fit entirely in only 256 bytes. As a parallel device, it used eight wires to connect the computer with a printer, one line for each data bit in a byte. Various parallel devices also used one or more extra wires as control lines, including a "busy" line (so the receiving device could tell the sending device to stop until it was ready for more), and a "ready" line (so the receiving device could tell the sending device to resume transmission). Because each of the eight bits needed a separate wire, the cables for parallel devices looked like ribbons and were not very compact. Most of the early printers available required this type of interface.[4] A problem noticed with Apple's card, however, was an inability to properly handle these "busy" and "ready" signals (a process known as "handshaking"). One solution offered by a reader of Call-A.P.P.L.E. magazine in 1979 was to add a couple of chips to the card. If that was not done, however, the only way to do printouts that were very long was to either buy a 2K print buffer that could be used with some early printers, or use the "SPEED=" statement in Applesoft to slow down the speed at which data was sent to the printer.[5],[6]

Apple II Parallel Printer Interface Card – Photo credit: Yuji Takahashi

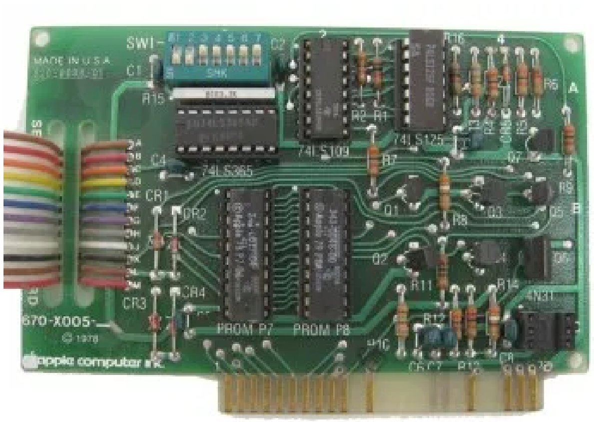
Apple released the Centronics parallel printer card in 1978. Selling for $225, it was specifically designed to work with Centronics brand printers.[7] It was similar to the Parallel Printer Interface, but had fewer control codes. The "Centronics standard" used seven data bits and three handshaking bits.[8] It would automatically send certain control codes to the printer when a program sent the proper command (such as a change in line width). As such, it was limited to properly working best with a Centronics printer, but other companies made Centronics "compatible" printers that used the same control codes and would work with it.[9]



Apple II Communications Card – Photo credit: Grinnell.edu web site

In April 1978 the Apple II Communications Interface Card came out, selling for $225.[10] It was intended for use with a modem, and provided full-duplex serial communications at speeds of 110 or 300-baud. It could be used to drive a serial printer, but the slow speed and lack of handshaking (telling the computer to stop sending data until what had been sent had been printed) limited its usefulness for that purpose. [11] As a device to connect to a modem, the low speed (by today's standards) was for several reasons. One was that most modems of the time were acoustic. With an acoustic modem you dialed up the number yourself, and when you made a connection you put the handset (which, unlike today, was very standard sized) into rubber sockets to seal out extraneous sound. A tiny speaker and microphone in the modem were then used to send and receive signals. These low speeds conformed to the Bell 103A dataset standard published by AT&T back in 1962. Although it was possible to use a modem to communicate at speeds greater than 300 baud, this equipment was more expensive and not as readily available.

The Apple II Serial Interface Card ($195) appeared in August of 1978.[12] Serial devices required fewer data transmission lines, and so could work with more compact cables. Instead of sending each byte as eight simultaneous bits as was done in parallel devices, serial interfaces send each byte as a series of eight bits, which only took two wires; one to send and one to receive data. Like the parallel cards, there were a couple of other wires that went with the data lines to control handshaking. Also, serial cards needed a means of letting the sending and receiving devices identify when a byte began and ended, and the speed at which data was being transmitted. This meant that some additional information, such as "start" bits, "stop" bits, and "parity" bits, was needed.



Apple II Serial Interface Card – Photo credit: Grinnell.edu web site

The original version of the Serial Interface Card had a ROM that was called the P8 ROM. It contained the on-card program that allowed a user to print or otherwise communicate with the card without having to know much on the hardware level. The P8 ROM didn't support handshaking that used two ASCII control characters named ETX (Control-C) and ACK (Control-F), so a later revision called the P8A ROM was released. This worked better with some printers, but unfortunately the P8A ROM was not compatible with some serial printers that had worked with the earlier P8 ROM.

Apple II Super Serial Card – Photo credit: Mike Loewen

The Apple Super Serial Card firmware was finished in January 1981. It was called "super" because it replaced both the older Serial Interface Card and the Communications Card. To change from one type of mode to another, however, called for switching a block on the card from one position to another (from printer position to modem position). The Super Serial Card was also able to emulate both the P8 and P8A Serial Cards, making it compatible with most older software written specifically for those cards.[13]

VIDEO CARDS

After getting a printer interface card (and printer), the next variety of peripheral cards popular for the Apple II and II Plus were ones that allowed display of 80 columns of text (which was rapidly becoming a standard outside the Apple II world). An early entry into this market was the Sup'R'Terminal card made by M&R Enterprises, the same company that made the Sup'R'Mod RF modulator for the Apple II. One of the most popular of the 80-column cards was the Videx Videoterm. Videx even made a display card that would display 132 columns card for the Apple II, but it never made much headway in the computer world (being supplanted by bit-mapped graphics displays, ala Macintosh).[14]

Many other companies made 80-column cards, but for the most part they were not very compatible with each other. One problem was deciding on a method to place the characters on the 80-column screen. With the standard Apple 40-column display, you could use either the standard routines in the Monitor, or directly "poke" characters to the screen. With these 80-column cards, they often used a standard from the non-Apple world, that of using special character sequences to indicate a screen position or other functions. For example, to put a character at row 12, column 2, a program needed to send an ESC, followed by a letter, followed by 12 and 02. Similar ESC sequences were used to clear the screen, scroll it up or down, or do other things that Apple's built-in screen routines could do.

When the Apple IIe was released, with its RAM-based method of displaying 80 columns of text, nearly all the older 80-column cards disappeared from the market. As of 1991, only Applied Engineering was still making a card for those remaining II and II Plus users that didn't yet have an 80-column display.

Synetix SuperSprite board – Photo credit: Softalk magazine, Sep 1983

One unique video product was made by Synetix, Inc. around 1983. Their SuperSprite board plugged into slot 7 (which had access to some video signals not available on other slots), and was promoted as a graphics enhancement system. It worked by overlaying the hi-res screen with animated "sprite" graphics (programmable characters that moved independently on any screen background). Since each sprite was on its own "plane" on the screen, they didn't interfere with each other. Also, it didn't take extra effort by the 6502 microprocessor to manipulate the sprites; once the programmer placed the sprite on the screen and started it moving, it would continue until told to change. This was much easier than trying to program a hi-res game using standard Apple graphics. Unfortunately, at the price of $395 it never took off. (It was hard for developers to justify writing programs for only a few users that might have this card). Another company later made a similar card called the StarSprite, but it suffered the same fate. Even Apple's own double hi-res graphics, introduced on the IIe, had the same problem with a small supply of supporting software until the IIc and IIGS market got large enough to guarantee that enough owners had the capability of displaying double hi-res.[15]

Apple II Video Overlay Card demo – Photo credit: screen shot from Apple Computer video, "Welcome To The World of the Apple II Video Overlay Card"

In 1989, Apple Computer released the Apple II Video Overlay Card. It had to be installed into slot 3 on the Apple IIGS, but could be put in any slot except slot 1 on the IIe. This card made it possible to put screen images from an Apple IIe or IIGS onto video from other sources. The combined results could be displayed on a monitor and recorded onto a VCR. It included VideoMix, a program to manage the images being merged. The result was "broadcast quality", although it was marketed also to schools, to let students create video presentations.

Starting in 1994, work began by Sequential Systems on a new video card, the Second Sight card. The card was designed by Andrew Vogan (of CV Technology) and Joe Yandrofski (of Sequential Systems), with firmware done by Jawaid Bazyar and Tim Courtney. Primarily focused on the Apple IIGS, whose RBG monitors were no longer being manufactured by Apple, this card was intended to make it possible to use VGA or SVGA monitors that were plentiful in the PC world. (It was also possible to use this card on an Apple IIe.) The Second Sight was made to utilize all of the standard graphics modes of the IIGS, as well as handling some of the text and video modes specifically handled by SVGA monitors. (existing software would not work with these

SVGA modes). The card initially sold for $199.95, and over the space of about five years, over 400 units were sold.

ROM / RAM EXPANSION CARDS

All peripheral cards released for the Apple II up to the time of the Apple II Plus were usable only in slots 1 through 7. Slot 0 was designed differently, and until the release of the Applesoft Firmware Card ($200) in 1979 nothing had been built to make use of it. The Firmware Card contained ROM that paralleled the upper 12K of Apple II memory. If you recall from the Chapter 6, Integer BASIC and the ROM version of Applesoft covered the same space in memory, and so could not co-exist. When it was clear that a floating-point BASIC (Applesoft) was what many people wanted, the II Plus came out with Applesoft in ROM. To make sure that the previous Apple II owners were not left out, Apple released the Applesoft Firmware Card to plug into slot 0. It had a switch that allowed the user to select which BASIC should be active. In one position, the motherboard ROM would be selected, and in the other position the Applesoft and Autostart ROM was selected. Because there were quite a few Integer BASIC programs that Apple II Plus users wanted to run, the Firmware Card also came out in an Integer BASIC version with the old Monitor ROM, that allowed II Plus users to simulate owning a standard II.[16]

Applesoft Firmware Card – Photo credit: Mike Loewen

One of the benefits of the Integer BASIC ROM was the lack of something known as a “RESET vector” in the Autostart ROM. The

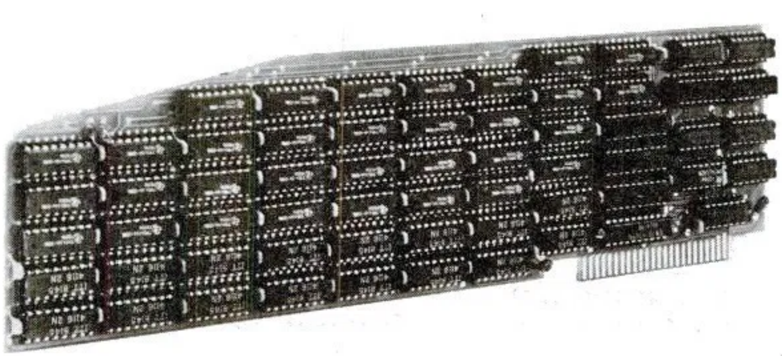
Autostart Monitor was called that because it would automatically try to boot the Disk II drive when the power was turned on, and jumped to a known memory location when the RESET key was pressed. This allowed the disk operating system to reconnect itself, but more importantly made it possible to create copy-protected software. Since the Autostart ROM made it possible for a programmer to do something on RESET that prevented a user from examining his program, it was popular with companies producing programs that they didn't want copied and freely given away. Usually, a RESET on a protected program would restart the program, erase the program from memory, or re-boot the disk. The Integer BASIC and Old Monitor ROM lacked this feature; a RESET would just drop the user into the Monitor. This, of course, was just what hackers and those who liked to break copy-protection wanted. The users with a non-Plus Apple II or with the Integer BASIC Firmware Card on a II Plus could prevent a RESET from restarting **anything**, allowing them to hack a program as much as they wanted.

Apple II Language Card – Photo Credit: François Michaud

The next card Apple released for slot 0 was called the Language Card. It was released in 1979 with Pascal, and expanded a 48K Apple II into a full 64K memory computer. It did not remove the upper 16K of ROM, but the card contained 16K of RAM that was electronically parallel to the ROM. Using "soft switches" (recall that these are memory locations that, when read or written to, caused something internally to change) one could switch out the ROM and switch in RAM memory. This extra memory was used to load the Pascal disk system, and under DOS 3.2 and 3.3, to load into RAM the version of BASIC that was not in the ROM. This was a more flexible alternative to the Firmware Card, and opened the way to other languages beyond BASIC for Apple II users.

In late 1979, programmers at Apple were using Apple II computers to do the Pascal coding for the Lisa project. They had hit the 64K barrier and needed yet more space. Burrell Smith, who later worked on the Macintosh, came up with the idea of adding an additional 16K bank of RAM to the Language Card. This custom 32K Language Card created an 80K Apple II, which the Lisa team used until the Lisa hardware and firmware was far enough along to be able to use the computer for coding.[17] However, Apple did not see this as a product to sell for the Apple II, and it was years later before a larger memory expansion option was available from Apple.

Since the only way to get Apple's Language Card was to buy the entire Pascal system ($495), it was too expensive for many users. Other companies eventually came out with similar cards that did not require purchasing Pascal, and some of them designed the cards with more "banks" of memory, making 256K or more of extra memory available. Saturn Systems was one early suppliers of the large RAM cards. As with Burrell Smith's hack, each 16K bank on the card would be switched in to the same memory space occupied by the Language Card RAM through the use of a special softswitch.[18]

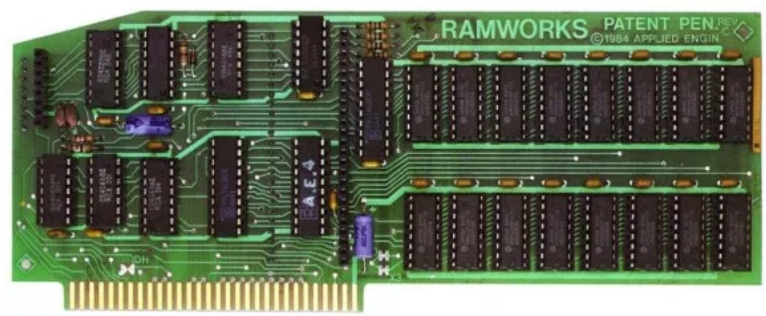


Synetix SSD – Photo credit: InfoWorld, Aug 9, 1982, p. 55.

The year 1982 appeared to be a significant year for the release of these devices, as a number of them were introduced that year. Many of these cards worked by simulating a floppy disk drive. Intel released the MPC BubDisk, using bubble memory technology (which did not lose its data when power was removed). However, at $895 for 128K, it was not very affordable for the home hobbyist.[19] Another product that was directed towards the corporate user came from Axlon. The RAMdisk 320, more expensive at $1395, functioned like two floppy disk drives, and was compatible with DOS 3.3, Pascal, or CP/M. It included a battery to hold the contents for up to 3 hours.[20] Synetix Industries in Redmond, Washington came out with their solid-state disk emulator, the Synetix 2202 SSD. For $550 it provided 147K (emulating a single disk drive), and for $950 one could get 294K for dual disk emulation, and was likewise compatible with DOS 3.3, Pascal, and CP/M.[21] Another release in 1982 came from Legend Industries, Ltd. One of their cards was called the 18SRC, and contained 18K of of static RAM that would retain its contents when the power was turned off (making it a kind of portable memory, similar to today's flash drives). The 128KDE offered 128K of additional storage. It would work like a Language Card if plugged into slot 0, and with the software accompanying the card, it emulated a floppy disk drive. It not only plugged into a slot but also had a ribbon cable that had to plug into onto of the RAM chip sockets on the motherboard, in order to access timing signals.[22],[23]

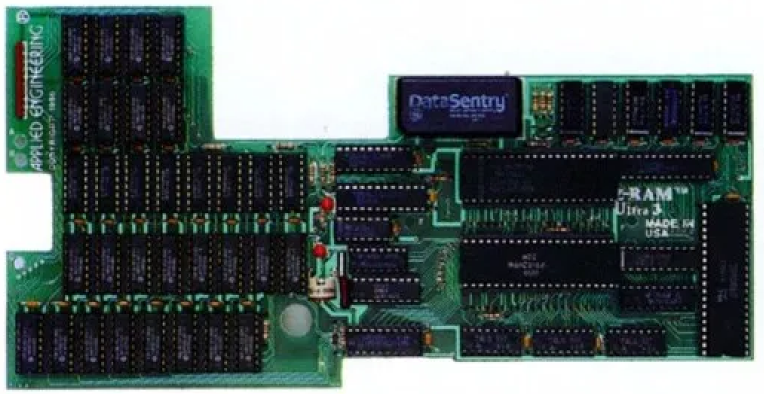
Extended 80-Column Card – Photo credit: François Michaud

When the Apple IIe was released, there were two different kinds of RAM cards that were made available for it, although the names were deceiving. The Apple IIe 80-Column Card was a very simple 1K memory card that plugged into the Auxiliary slot on the IIe motherboard, in line with slot 3. It mirrored the 1K of text memory from $400 to $7FF, and with the built-in Apple IIe firmware routines allowed display of 80-columns of text. The more useful Extended 80-Column Text Card duplicated the entire 64K RAM on the IIe motherboard (including the "Language Card" area that was built-in to the Apple IIe). Depending on what version motherboard was present on the IIe, a jumper on the card might have to be removed in order to support double hi-res graphics.



RAMWorks 1985 – Photo credit: Applied Engineering 1986 catalog

When Applied Engineering came on the scene, they quickly became one of the most popular suppliers of RAM cards for the Apple II series. In 1984, they offered a card for the Apple IIe that went one step further than Apple's card. The MemoryMaster IIe card offered expansion in the Apple IIe Auxiliary slot to either 128K (for $169) or 192K of RAM (for $249), and otherwise worked just like Apple's card, and offered utilities to expand the memory on CP/M software, VisiCalc, and AppleWorks. The next version RAM card the company released in 1985 was the RamWorks card, also for the Auxiliary slot, which offered expansion to as much as 1 megabyte of RAM (for $649).



Z-RAM Ultra 3, 1987 – Photo credit: Applied Engineering 1987 catalog

By this time they were also offering memory expansion for the Apple IIc, with the Z-RAM card that offered 256K ($449) or 512K ($549) of additional RAM for this supposedly unexpandable computer, as well as a Z-80 coprocessor to allow access to CP/M software. In 1987 the lineup had expanded to Z-RAM Ultra 1, Ultra 2, and Ultra 3, with capacity increasing to a full megabyte of RAM, a clock, and the CP/M option (costing $459 for all the options).

RAMWorks II 1986 – Applied Engineering 1986 catalog

In 1986, AE was offering additional memory cards. They introduced the RAMWorks II card, with options of expanding to as much as 3 megabytes (for $1599), and up to 16 megabytes with additional plugin cards. Like the original RAMWorks, they offered an optional RGB video output module for the card. Additionally, they now sold a card called RAMFactor, intended for use in a standard Apple II slot (which meant it worked on an Apple II or II Plus, as well as a Franklin Ace). The RAMFactor also could be expanded to 16 megabytes of RAM with additional plugin cards. Additionally, a battery backup device called RAMCharger would keep the contents of memory active even in the case of a power failure. In 1987 the next version, RAMWorks III, offered the same expansion options, for slightly lower cost.

The release of the Apple IIGS provided yet another opportunity for creation of larger RAM memory cards. Apple offered its own Apple IIGS Memory Expansion Card, but started at 256K and went only up to 1 megabyte of storage. Although other companies made memory cards, Applied Engineering was again at the forefront in 1987 with two cards, the GS-RAM (up to 1.5 megabytes for $379) and GS-RAM Ultra (up to 4 megabytes for $1959). By 1990 they were offering an additional card, GS-RAM Plus, which raised the maximum capacity to 6 megabytes.

COPROCESSORS

In the years when the Apple II was in production, there were still a significant number of 8080 and Z-80-based microcomputers on the market. For those computers, the CP/M (Control Program for Microcomputers) operating system was commonly used, and there were important programs released that only ran under that system (***WordStar*** for word processing and ***dBase*** for database management), and it was possible to get more programming languages than were available to run directly on the Apple II. One way to have the best of both worlds was to make use of a coprocessor card. This card would allow the Apple II to be used as a type of host computer, handling input and output, while all of the data processing took place on a card plugged into one of the slots on the Apple II motherboard.

One of the first and most significant coprocessor card created for the Apple II was the Microsoft Z-80 Softcard, which sold for around $300. First introduced at the Fourth West Coast Computer Faire in March 1980, this card allowed the Apple II to run software written for the Z-80 microprocessor. Although the Disk II used a different method of recording data than was used by Z-80 computers, Apple II users managed to get programs such as ***WordStar*** transferred to the Apple CP/M system. Microsoft worked to make it compatible with the 80-column cards that were coming out at the time, since most CP/M software expected a screen of that size.[24],[25]

Microsoft SoftCard – Photo credit: personal

Microsoft soon found that they would have to change the name of the product to "Microsoft SoftCard", since Zilog (maker of the Z-80 processor used in the SoftCard) threatened a lawsuit over the use of their trademarked "Z-80" name. When it was available for purchase, it sold 5,000 units in just three months, and by the end of 1981 it had become Microsoft's best-selling retail product. This was surprising in two ways: First, it was a hardware product sold by a company that primarily dealt in software; and second, the software that ran on the card, particularly the CP/M operating system, was written primarily by Microsoft's competitors. CP/M was at this time in low favor at Microsoft, as much of their energy and efforts were being put into Microsoft's own MS-DOS on the new 16-bit IBM PC. Nevertheless, Microsoft put considerable effort in marketing the SoftCard, to the extent of selling it in colorful boxes and creating documentation that looked professional, much different from many products sold then for the Apple II. Their success resulted ultimately in making CP/M on the Apple II the most popular platform on which CP/M was ever run.[26]

After the arrival of the IBM Personal Computer and its wide acceptance by the business world, there was interest in a co-processor for the Apple II that would run IBM software. A company called Rana, which had been producing disk drives for the

Rana Systems disk drives – Photo credit: Tony Diaz

Apple II for several years, came out with the Rana 8086/2 sometime in 1984. This was a system that plugged into slots on a II Plus or IIe, and would allow the user to run programs written for the IBM PC. It would also read disks formatted for that computer (which also used a completely different data recording system than the one used by the Apple II). One Rana owner, John Russ, wrote to *A2-Central* (then called *Open-Apple*) to tell of his experience with it: "We also have one of the Rana 8086/2 boxes, with two [Rana] Elite II compatible drives and a more-or-less (mostly less) IBM-PC compatible computer inside it. Nice idea. Terrible execution. The drives are half-high instead of the full height drives used in the normal Elite II, and are very unreliable for reading or writing in either the Apple or IBM format … And this product again shows that Rana has no knowledgeable technical folks (or they lock them up very well). We have identified several fatal incompatibilities with IBM programs, such as the system crashing totally if any attempt to generate any sound (even a beep) occurs in a program, or if inverse characters are sent to the display … The response from Rana has been no response at all, except that we can return the system if we want to. Curious attitude for a company, isn't it?"[27] By August 1985 Rana was trying to reorganize under Chapter 11, and the product was never upgraded or fixed.

A co-processor called the ALF 8088 had limited distribution. It worked with the CP/M-86 operating system, which was used by some computers just before the release of the IBM PC.[28]

Even the Motorola 68000 processor used in the Macintosh came as a co-processor for the Apple II. The Gnome Card worked on the II Plus and IIe, but like other 68000 cards for the II, it didn't make a major impact, with the exception of those who wanted to do cross development (create programs for a computer using a microprocessor other than the one you are using).

PC Transporter 1988 – Photo credit: Applied Engineering 1988 catalog

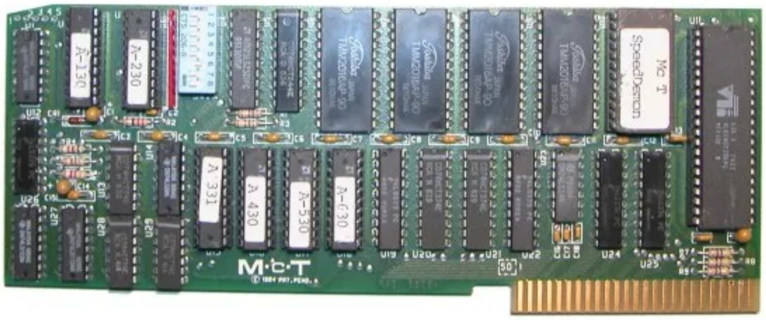
The most successful device in this category was the PC Transporter, produced by Applied Engineering. It was originally designed by a company in the San Jose area called The Engineering Department (TED). The founder was Wendell Sander, a hardware engineer who formerly had worked at Apple and was involved in the design of the Apple III and parts of the SWIM chip (Sander-Wozniak Integrated Machine)[29] used in the IIc and IIGS. Around 1986 Applied Engineering began discussions with TED about buying the PC Transporter to sell and market it. At that time, the board was about four times the size it eventually became. AE's people were able to shrink a lot of the components down to just a few custom ASIC chips. The software that helped manage the board originally came from TED also.[30] It was finally released in November 1987, and included a card that plugged into any of the motherboard slots (except slot 3) and one or more IBM-style disk drives. The PC Transporter used an 8086 processor and ran about three times as fast as the original IBM PC. It used its own RAM memory, up to a maximum of 768K, which could be used as a RAMdisk by ProDOS (when not in PC-mode). It used some of the main Apple memory for the interface code that lets the PC Transporter communicate with the hardware.

The PC Transporter underwent some minor hardware changes and several sets of software changes (mostly bug fixes but a few new features). The major reasons for hardware changes came about because of the availability of cheaper RAM (the original RAM was quite expensive and difficult to obtain). Additionally, changes were made to make the onboard "ROM" software-based, which made it easier to distribute system upgrades that enhanced hardware performance.[31],[32],[33] The major limitation for this product was a reluctance by Applied Engineering to match the changes that have happened in the MS-DOS world and come out with a version of the Transporter that used a more advanced microprocessor (80286, 386, or 486). By 1991, this had become more of a limitation for those who wish to use both MS-DOS and Apple II software on the same Apple II computer, since advanced software **needing** those more powerful processors was being released for MS-DOS.

ACCELERATORS

Many computer users will find that after they initially begin to use their computer that they want it to run faster. It took about five years for technology to appear that could accelerate the speed of the Apple II. Once these devices began to be available, several companies provided solutions.

Number Nine Computer Corporation appeared on the scene briefly in 1982 with what may be the earliest accelerator for the Apple II and II Plus. The Number Nine Apple Booster card, selling for $598, increased the speed from the stock 1 MHz to 3.58 MHz. It used 64K of RAM on the card, basically running the Apple II on the RAM on this card, using the actual Apple II for input and output.[34]



M-c-T SpeedDemon – Photo credit: Tony Diaz

Microcomputer Technologies (M-c-T) released the SpeedDemon by around 1983, selling for $295. It made use of a 65c02 processor, running at 3.58 MHz, and using only 4K of static RAM for a cache (making it unnecessary to refresh any dynamic RAM on the card). The concept of "cache" of memory was to keep track of frequently accessed bits of memory, and put them into faster RAM than could be found on the Apple II board. Accessing this RAM from the cache was faster than getting it from the slower RAM on the Apple II, which made many program functions work more quickly. When accessing peripheral cards, it was possible to configure the SpeedDemon to slow down for slot 6 (where the disk drive usually was placed), and optionally could do the same for slots 4 and 5.

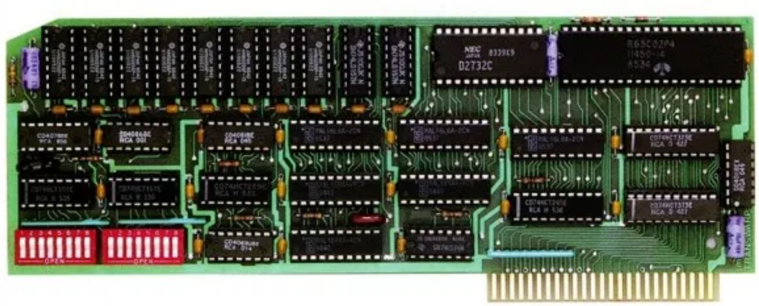
The SpeedDemon was later sold by the Apple Pugetsound Program Library Exchange under the name "Mach 3.5", for only $199. [35],[36]

In 1983, Number Nine Corporation's accelerator was back on the market, but this time being sold in an improved form as the Accelerator II, sold by Saturn Systems. Like the Apple Booster card, it had 64K of RAM on the card, and would run programs on the fast RAM on the card. It could be configured to give each slot fast or normal speed.

Saturns Systems Accelerator II – Photo credit: Advertisement, Softalk, April 1983

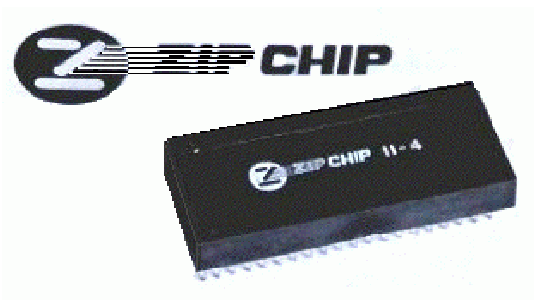
Accelerator IIe – Photo credit: Tony Diaz

Although the Accelerator II worked on the Apple II and II Plus, it gave inconsistent results on an Apple IIe. Another problem Saturn Systems faced was the need to change their company name, due to conflict with another business. The new company, Titan Technologies, released the Accelerator IIe in 1984. The new card used the 65c02 processor, and added another 16K of RAM to which the Apple IIe ROM code was copied, for faster execution. However, the additional 64K of auxiliary RAM from the extended 80-column card available for the IIe was *not* accelerated by this card.[37]



TransWarp – Photo credit: Applied Engineering 1986 catalog

In 1986 Applied Engineering introduced the TransWarp accelerator board. This product lasted in the marketplace longer than any of the other ones, possibly because AE did far more advertising than the companies producing the older boards. The original TransWarp was available with a 65c02 processor and 256K of high-speed RAM for $249, or a 65802 for $338. The 256K of RAM was divided into four 64K banks. The first bank held a copy of the Apple II ROM from $D000-$FFFF; the second held a copy of the motherboard RAM; and the third and fourth banks were for expansion RAM (such as what was in the second 64K bank of RAM in a 128K Apple IIe). The card could also be controlled to an extent via software; storing a value at memory address $C074 could set the card to default speed (0), normal 1 MHz speed (1), or shut the card down completely (3). Also, although the TransWarp could not accelerate a CP/M card plugged into the Apple II, it was at least compatible with such cards. The earlier accelerator cards often could not be used on a computer with a CP/M card installed.[38]



Zip Chip 4 MHz – Photo credit: Yuji Takahashi's Apple II World

The next step in accelerator technology was to put all the components of an accelerator board into a single chip. These accelerators on a chip made it possible to speed up even the Apple IIc, which did not have physical slots. This technology came to market when two rivals, the Zip Chip and the Rocket Chip, were released. The Zip Chip, sold by Zip Technology, was introduced at AppleFest in May 1988, and the Rocket Chip, sold by Bits and Pieces Technology soon after. Running at 4 MHz, the Zip Chip was a direct replacement for the 6502 or 65c02 on the Apple II motherboard. It contained its caching RAM within the housing for the processor, the difference being mostly in height (or thickness) of the integrated circuit. Installing it was a bit more tricky than simply putting a board into a slot; the 6502 had to be removed from the motherboard with a chip puller, and the Zip Chip installed (in the correct orientation) in its place. Software to control the speed of the chip was included, and allowed about ten different speeds, including the standard 1 MHz speed (some games simply were too fast to play at 4 MHz, and software that depended on timing loops to produce music had to be slowed down to sound right). The controlling software also let the user determine which (if any) of the peripheral cards should be accelerated. The Zip Chip even allowed the user to decide whether to run all sound at standard speed or at the fast speed.

Rocket Chip – Photo credit: unknown

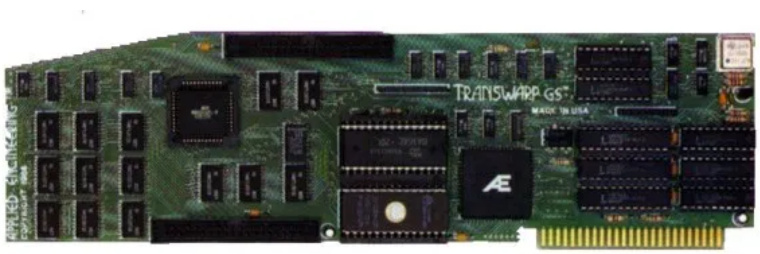
The Rocket Chip, made by Bits And Pieces Technologies, was almost exactly the same as the Zip Chip, with a few minor exceptions. It was sold with the ability to run programs at 5 MHz, and could be slowed down below the 1 MHz speed (down to 0.05 MHz). Later, when Zip came out with an 8 MHz version of their Zip chip, a 10 MHz Rocket Chip was introduced.

The rivalry between Zip Technologies and Bits And Pieces Technologies came from a mutual blaming of theft of technical information. The Bits & Pieces people insisted that they had done the original work on a single chip accelerator with the Zip people, but had all the plans and specifications taken away without their permission. Consequently, they had to form their own company and start from scratch to design their own chip. Zip, on the other hand, insisted that Bits & Pieces had stolen the technology from them. The problem eventually came to court, and it was decided that Zip Technologies was the originator of the technique and the Rocket Chip had to stop production.

Applied Engineering's next version of their plugin-board accelerator, the TransWarp II, did the acceleration using technology licensed from Bits and Pieces. This made it unnecessary to use the high-speed RAM used on the original TransWarp. Early TransWarp II boards ran at 2.5 MHz; later versions pushed this speed to 3.58 or 7.16 MHz. A control panel on the computer was used to change settings on the card, much as the Zip Chip and Rocket Chip used. However, when Bits and

Pieces lost its court case, Applied Engineering had to also cease sales of the TransWarp II.

By 1989, the market for accelerators for 8-bit Apple II computers was waning, but owners of the 16-bit Apple IIGS were clamoring for faster speed. This was made more important after the release of GS/OS System 5 in 1989. With its Mac-like desktop (but in color), the IIGS could do more, but at a price of a hit in performance. Applied Engineering met this demand with the release of the TransWarp GS in 1989, which sold for $399. It offered a top speed of 7 MHz (compared to the native Apple IIGS "fast" speed of 2.8 MHz). It worked in slot 3 or 4 on the IIGS, and could be configured via GS/OS Control Panels or via the text-based Classic Desk Accessories.



TransWarp GS 1989 – Photo credit: Applied Engineering 1989 catalog

The TransWarp GS was popular because it made the Apple IIGS more usable in its graphic desktop mode (and of course it also accelerated text-based software). It was also popular for those who dared to physically modify the card to run even faster than the 7 MHz speed at which it was rated. One method was to increase the amount of RAM used for caching from 8K to 32K. The other modification was to change the oscillator on the board from 28 MHz to 40 MHz. If successful, this could result in a speed increase to as much as 10 MHz, and if done along with the cache RAM upgrade gave users an Apple IIGS as much as three times the performance of certain tasks on the computer. Applied Engineering would also make this modification, for about $109, for those who feared damaging their card by doing it themselves. [39], [40].

Zip Technology got into the Apple IIGS accelerator market in 1990 with the ZipGS card. The card used some new technology that combined the functions of several individual chips onto a single chip. It sold at $199 to get 7 MHz speed, and higher prices to get faster speeds of 8 or 9 MHz, or with larger RAM cache sizes. The product also advertised a lower power draw, which was supposed to make it run cooler.

Originally, Zip Technology had promised three different versions of their accelerator: The Zip GS, Zip GS Plus, and Zip GSX. The first two were to be simple 65816 replacements, just as the older Zip Chip had been a replacement for the 6502 or 65c02 microprocessor on 8-bit Apple II computers. However, these chip-based versions never appeared; adding the cache and other hardware to a 65816 made it too large to work well in a IIGS, because it blocked access to four slots. The product that eventually was released was the Zip GSX card, which had a ribbon cable that plugged into the 65816 socket on the motherboard after removing the original processor. As with the TransWarp, there were Classic Desk Accessory and Control Panel connections to change settings for the card.

Zip Technology caused some frustration amongst users that wanted a IIGS accelerator. The product was announced, and then nothing appeared for quite a while. It appeared that they were funding the research and development of the Zip GSX with money from early orders; it was not until nearly a year had passed before the product began to ship. They further irritated customers by shipping new orders first, and filling the older orders later.

In comparing the two accelerators for the Apple IIGS that made it to market, they differed in some small ways. The TransWarp GS was more careful to accelerate the firmware and the IIGS user experience, whereas the Zip GSX was strictly a hardware accelerator. Because of the difference, the Zip GSX did its job and didn’t always slow for certain tasks (some of the IIGS diagnostic tests would always fail when the Zip GSX was on), where the TransWarp did handle some of those details.

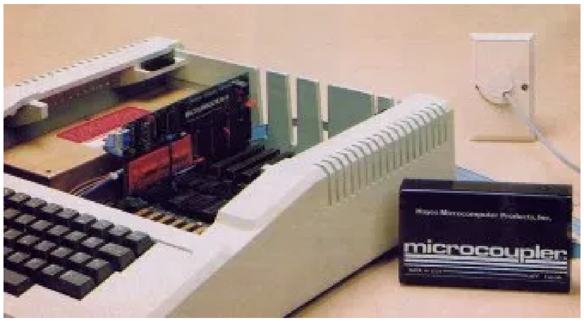
(Click here for more information about Zip Technology and their involvement in the Apple IIc Plus).

MODEMS

A modem is a unique peripheral device, because it makes use of two-way communication, sending and receiving data to and from the computer. Modems connect to computers in two ways, either as internal or external. Internal modems had all the functions on a plug-in card, and attached to that card was either a line to an acoustic coupler (on the earliest modems), or the phone line itself was attached to the card. External modems were, naturally, external to the computer case. They attached to the computer's serial port, usually on a serial interface card that was itself plugged into the motherboard. The modem plugged into the serial card, and then the phone line plugged into the external modem.

Standards had been created as far back as 1958 for transmission of computer data over standard telephone lines. The Bell 101 dataset published that year could handle 110 baud (referring approximately to 110 bits per second), and the Bell 103 dataset from 1962 allowed for 300 baud connections. Both 101 and 103 datasets allowed for simultaneous two way data transfer. In the 1970s, the Bell 202 standard was created, which could do 1200 baud as half-duplex (one computer at a time sending information); the Bell 212 standard allowed 1200 baud full-duplex operation (computers on both ends transmitting simultaneously). From the standpoint of the user connected, a half-duplex connection did not echo keypresses back to the user. For example, in half-duplex when "A" was typed, the user did not see "A" on the screen, unless the software was set to do a local echo. In full-duplex mode, the local echo was not necessary, since the character typed was sent back to the originating computer.

The primary problem with internal modem cards was that every different computer required a different card for its own unique card architecture. The advantage of an external modem (from the point of view of the manufacturer) was that it was possible to build one style that worked on many computers, as long as they had the same type of serial port (card) in the computer.



Hayes Micromodem II, 1980 – Photo credit: Advertisement, Softalk, November 1980, back cover

D.C. Hayes was one of the first companies to create a modem affordable to the home or hobby computer user. Its first product was made for the S-100 bus on Altair or similar computers. The success of this first product led to the creation of the Hayes Micromodem 100 (for S-100 computers) and the Hayes Micromodem II (for the Apple II). Released in 1979 and selling for $379, this product worked at the standard transmission speeds of the day, 110 and 300 baud. Although the Micromodem II was a card that plugged into (usually) slot 2 on the Apple II, it had an external box, the “Microcoupler”, to which the phone line was attached.

Another company that sold modem hardware for early microcomputers was Novation. Novation was in business as far back as 1970, selling an acoustic coupler that could be added onto Model 33 teletypes.[41] Around 1980, they created the Novation CAT, a 300 baud external modem that used an acoustic coupler. In 1981 they brought out a better product, the Novation Apple-Cat II. This was a 300 baud modem that used the Bell 202 protocol. It also included software for BSR protocols (an early version of X-10) for control of home electronic appliances that were plugged into BSR-compatible modules. With additional hardware and software, it could work as a home answering machine, controlling a connected cassette recorder. A clock module could be added, to allow date and time stamping of files (with appropriate DOS extensions). Further, the Cat had a serial port that allowed another connection of a serial device, such as a printer or even an external second modem.

Novation also advertised one important advantage of using the Apple-Cat II. A standard telephone handset could be added to the module that would be mounted on the back of the computer, and

Novation Apple-Cat II with telephone cradle – Photo credit: Product brochure

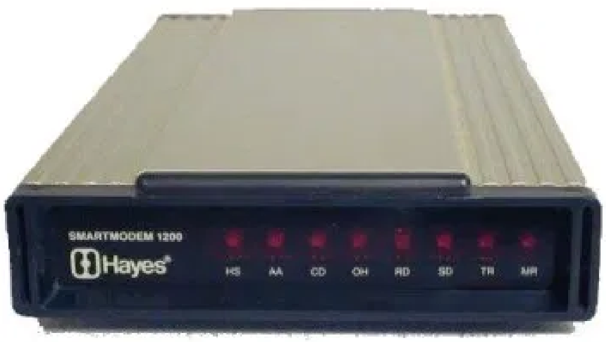
they included a type of cradle that went into the ventilation slots on the side of the Apple II. This made the computer look like a very large telephone, but it allowed it to really work as a standard phone if desired. Dialing was done from the keyboard, using included software. Additional programs were custom created that would allow distortion of the user's voice while on the telephone.

Finally, the Apple-Cat had a built-in tone generator, which was used by some programmers to create music software. Unfortunately , Novation never heavily promoted this feature of the Apple-Cat, or it might have been used by games to provide better sound effects. The hacker community made use of it to simulate many telephone network features, such as the sound of a dime, nickel, or quarter being dropped into a pay phone, or the ring sound on an American or U.K. telephone line.

Novation later offered full-duplex 212 performance. This was accomplished through a second expansion board that was plugged into a free slot on the Apple II, with a ribbon cable connecting the two boards. If there were no free slots available for the expansion board, it was possible to remove a chip from the second board, connect with the same ribbon cable, and lie that board horizontally on top of the Apple II power supply (with double-sided tape to hold it in place, and to electrically isolate the board from the metal power supply).[42],[43],[44]

In 1981, Micromate Electronics was offering the Micronet modem, ranging from an acoustic modem at $179 to a direct connect modem that did not need an interface card, for $289.[45]

As a followup to the Micromodem II, Hayes began to design external modems, for connection to an RS-232 serial interface card. To make this work, the company had to create a set of commands that could be sent from the computer to control functions (dialing, hanging up, etc.), and the modem had to be able to distinguish these commands from the data being sent from the serial port. This led to the creation of what became known as the Hayes command set, instructions for control of the modem. These were in such widespread use, that “Hayes compatibility” became a selling feature for other modems that connected to a serial port. In 1981, the Smartmodem 300 was released, setting the standard for others that followed.

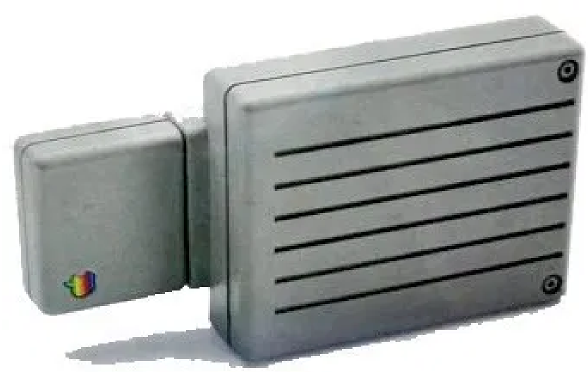


Hayes Smartmodem 1200 – Photo credit: 50 Best Technology Products, http://www.zhaoniupai.com/blog/archives/687.html

By 1982, the Smartmodem 1200 was announced, selling for $699. The Smartmodem 2400 came out in 1985 for $549.[46] Many other companies created modems that were compatible with the Hayes standard, usually selling them for lower prices than Hayes. By the late 1980s, Applied Engineering was selling two slot-based modems, the DataLink 1200 and the DataLink 2400, compatible with the Apple II Plus, IIe, and IIGS.

Apple Modem 1200, beige and white – Photo credit: François Michaud

In 1984, Apple released a pair of modems with its own name on it: The Apple Modem 300 ($300) and Apple Modem 1200 ($500). These were released in beige and white versions, and connected via serial cables to the Macintosh or to any Apple II with a Super Serial Card or similar interface.



Apple Personal Modem 300/1200 – Photo credit: Tony Diaz

The following year they company introduced the Apple Personal Modem for $399, which worked at 300 or 1200 baud, but was more expensive than similar products of the time. By the later 1980s it was no longer in production, as the company had moved on to internal modems that were Macintosh-specific.

Over the following years, as standards were developed to handle it, modem speeds continued to increase, jumping to 4800 baud, then 9600, then 14,400 (or 14.4K), 28.8K, 33.6K, and then finally hitting the maximum possible on phone lines, 56K. The Apple IIGS was capable of connecting via at least a 28.8K modem.

INPUT DEVICES

The primary input device for the Apple II was, of course, the built-in keyboard. There were expanded keyboards available for the II and II Plus, bypassing the uppercase-only limit. There was once even a keyboard that had plug-in modules that would redefine specialized function keys to make them specific for different programs. Another company sold pressure sensitive pads that were attached to the Apple II keyboard above the top row and could be programmed to generate series of keypresses. The original IIe had a socket for the addition of an external numeric keypad, and the IIGS and later versions of the IIe had this keypad built-in. Because of the detached keyboard in the IIGS it was possible to select between a couple of different versions of keyboards offered by Apple as well as from some third party companies.

The next most commonly used input device after the keyboard was the set of game paddles included with every II and II Plus. But some users needed more specialized ways to input data to the computer. A large number of interesting input devices were made available through the years; here follows a brief description of some of them.

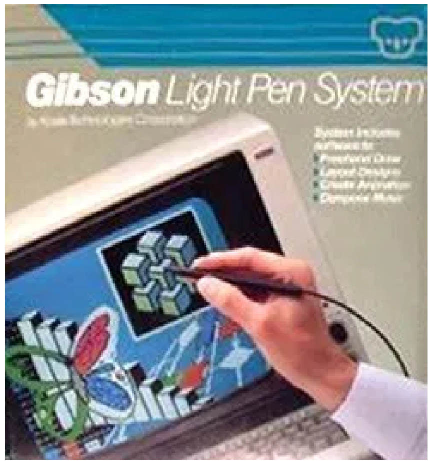
Apple Graphics Tablet – Photo credit: Scott King, www.myapplespace.com/photo/apple-graphics-tablet-1979

Creating pictures on the hi-res graphics screen was always a challenge. Using the game paddles or a joystick is one method that could be used, but it was difficult getting accurate lines and curves. Apple addressed this problem when they released the Apple Graphics Tablet in the late 1970s, which sold for about $650. This was a large flat surface, about thirty inches square, with a grid printed on the surface. Using a stylus attached to a wire leading to the tablet, and appropriate software, this could be used to draw pictures on the Apple II hi-res screen. There were two different releases of the Apple Graphics Tablet. The original one, which was released when the II Plus was the latest machine, was discontinued by FCC order because of RFI (radio frequency interference) problems. The second version, to correct that problem, was released after the IIe was in production. It used two DB-9 connectors to install on the back plate of the computer, leading to the peripheral card plugged into a slot inside. (These DB-9 connectors are the same type used on the back of the IIc and IIGS for connection of a joystick).[47]

Koala Pad – Photo credit: "Tablet History: 14 Devices That Laid the Groundwork for the iPad", Mashable.com

Koala Technologies made several graphics-based input devices for the Apple II and other computers. Their first product was the Koala Pad. Released in 1983 and selling originally for $125, this was a small graphics pad (about 4×4 inches drawing space, in an 8×6 inch case) that plugged into the game I/O socket. It was compatible with any software that used a joystick. Using a finger or the supplied stylus, a user could draw on the pad and produce pictures on the hi-res screen with the supplied software or with some other software packages.

In November 1984 Koala released Muppet Learning Keys for $79.95. This was a device to aid preschoolers in using a computer. It was intended to help children ages three and over to learn letters, numbers, and colors, using the Muppets from Sesame Street as a learning aid. The unit used various contact surfaces to send user responses to the computer, and it attached to the Apple II via the game I/O port.[48]



Gibson Light Pen – Photo credit: Computer History Museum, http://www.computerhistory.org/collections/accession/102674112

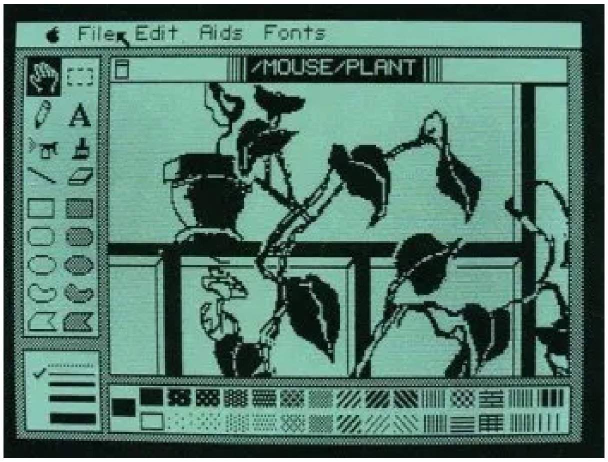
The Gibson Light Pen System was also sold by Koala Technologies in 1985 for $350. Using a card in slot 7, this device used a special pen that allowed drawing directly on the computer's monitor screen.

Other devices have been released to aid in graphics manipulation on the Apple II. The Computer Colorworks released the Digital Paintbrush System in 1984 for $299. It worked on either the II Plus or IIe, and used a stylus attached by two thin dacron lines to potentiometers within the tablet, which tracked the position of the stylus. Movements of the stylus (tracing over a picture) were translated into drawings on the hi-res screen. The software included allowed creation of curves and lines, and used ***Fontrix*** fonts for lettering. (***Fontrix*** was a program that could produce detailed hi-res graphics pictures, and had many characters styles, or fonts, available to label those pictures). A unique feature of the Digital Paintbrush was the ability to connect two computers using the system via a modem and phone line and allow both users to draw pictures that would appear on both computers simultaneously.[49]

Apple IIc Mouse – Photo credit: Vectronics Apple World

One input device that perhaps made the most inroads in the Apple II world was the one that was unique and essential to the Macintosh: The mouse. The original design work for the mouse on the Mac was done by Burrell Smith, using a part of the 6522 VIA chip on that computer to generate interrupt signals when the mouse was moved so the software could draw it on the Mac screen. Because the Apple III used the same 6522 chip, Andy Hertzfeld and Dan Kotke worked in their spare time on a way to use a mouse on that computer, and display and move a cursor on its screen.

To help with the graphics, they asked for help from Bill Budge. He was an Apple II programmer who had written some fast graphics routines, and had previously created games on the Apple II (Raster Blaster in 1981 and later Pinball Construction Set in 1982). They were able to get a simple graphic-based word processor going on the Apple III, but since that computer was not selling well, decided they needed to make this work on the Apple II. It took some clever hardware and software work between Smith, Hertzfeld, and Budge to implement it on the Apple II (which did not have easy access to video timing signals as was possible on the Apple III or the Mac). By the summer of 1981 they had the mouse-driven graphical word processor running on the Apple II, even using proportional text. Steve Jobs ultimately heard about the project and insisted that he be given a demonstration. After he saw it, Jobs said that the hardware part of it belonged to Apple, since it was created with company resources. It was turned over to the Apple II division, and they ultimately created a card that used quite a few more chips than their original design had required.



MousePaint on Apple IIe – Photo credit: Vectronic's Apple World

Naturally, a mouse for the Apple II did not appear until after the Macintosh was released (it was not allowable to upstage Job's special project). In May 1984, five months after the Macintosh came out, and one month after the release of the Apple IIc, Apple announced availability of the AppleMouse II. It came with an interface card for the Apple IIe, or the mouse alone for the Apple IIc (with a plug for the IIc joystick port; the built-in hardware and firmware was already designed to handle the mouse). Bundled with the AppleMouse II was a program called MousePaint. Written by Bill Budge, this program was not the word processor that had been originally used to demonstrate the mouse, but instead it was a graphics program based on MacPaint that came with the original Macintosh. MousePaint used the standard hi-res graphics screen and worked only under the ProDOS operating system, but gave Apple II users the ability to do graphics in much the same way as Macintosh users. It also offered a feature the Mac didn't have – color. The AppleMouse II also made it possible for programmers to design software that used the mouse as a pointing and input control device. However, many programs using this device on the IIe or IIc were not graphic-based, but rather were text-based, and usually made use of the MouseText characters that were built into the Apple IIc and in the Enhanced IIe.

ComputerEyes was a video acquisition system sold by Digital Vision, Inc., and was released in July 1984. The product was a black box, 4 by 4 by 1.75 inches in size, that attached to an Apple

Computer Eyes image – Photo credit: The Apple II Review, Spring 1986, pp. 17-18

II with a game I/O socket. Any video source that could output NTSC video or standard non-interlaced video could be used for input to the box. Compatible video sources included video players (VHS or Betamax), video disc players, or consumer video cameras. That video signal was converted to a pixelated image that could be displayed on the Apple II hi-res screen. The program included with the ComputerEyes hardware could be used to adjust the synchronization of the video source and the computer, capture the images (either normal or grey-scale), and save those images to a disk. With the grey-scale option, eight different versions of the image were created and superimposed on each other. ComputerEyes sold for $129.95 ($349.95 with a video camera).[50],[51]

Digital Visions came out with versions of ComputerEyes that worked on other popular computers in the 1980s and 1990s, including the Commodore 64, Atari, Amiga and IBM PC. They also had a ComputerEyes GS card that ran on the Apple IIGS, though picture scanning was felt to be rather slow.

MUSIC AND VOICE SYNTHESIS

Apple II computers have been involved in sound from the beginning, with Wozniak's decision to include a speaker so he could make sounds for an Apple II version of *Breakout*. As simple as it was, some enterprising programmers have even managed to make this single-voice speaker sound like two and even three different voices (tones) simultaneously (*Electric Duet* is an example of such a product). But that was not enough for those who wanted to have better quality music production, and so production of synthesizer cards was in full swing by the early 1980s. Some of those cards included the following:

ALF Music Card (ALF Products, Inc.) was strictly a music synthesizer, with some included software to aid in producing the music. The Mountain Music System (Mountain Computer, Inc.) was a more advanced sixteen oscillator (voice) digital synthesizer, also with software to control it. Soundchaser System (Passport Designs, Inc.) was a package that included the Mountain Music System (using slots 4 and 5), plus the Soundchaser, which was a piano-style keyboard for music input, whose card went in slot 7. It allowed four track recording and sound manipulation, using the Apple II primarily as a controller. This was one of the most advanced music hardware system available in the days before the release of the IIGS.

alphaSyntauri – Photo credit: Bill Cone, www.synthony.com

The alphaSyntauri was a significant music product for the Apple II. It was released early in its life, in 1980. For $1,500, it could duplicate some of the features of contemporary digital synthesizers that cost as much as $40,000. It came with a keyboard, foot pedals to control some of the sounds, game paddles to control other effects, a card to plug into the Apple II, and a sound generation card (such as the Mountain Music System). It could play 16 notes at the same time, and could have even more capabilities depending on the type of keyboard that was attached. The software was written in a combination of 6502 assembly language and BASIC, which made it possible to customize some functions. Some well-known musicians, such as Herbie Hancock and *Emerson, Lake & Palmer* keyboard performer Keith Emerson used the alphaSyntauri system in their performances.[52],[53]

The Drum-Key (made by PVI) was specifically a percussion synthesizer. It required an external amplifier and used included software to produce a wide variety of drum and other percussion sounds.[54]

Street Electronics Cricket – Photo credit: Advertisement, Softalk, June 1984, p. 79.

Beginning in the late 1970s there were several speech synthesizers available for the Apple and other home computers. One brand was the TextTalker, and another (made by Mountain Hardware for $279) was the Supertalker. In the 1980s two other popular brands were the Echo II (slot-based) and Cricket (for the modem port on the IIc) synthesizers, made by Street Electronics. These latter also included the ability to produce a robotic voice, a female voice, sound effects, and stereo music. Some games released at the time had enhanced sound output when one of these two devices were detected. For speech reproduction, they used a method of accepting ASCII text from the computer in the form of "phonemes" to describe and produce voice through a built-in speaker. They used this approach because English words have a variety of pronunciation depending on their context. Properly programmed, the voice synthesizers could pronounce the word "root" to rhyme with either "boot" or "foot". It wasn't until the IIGS came out with the built-in capability of speech reproduction (via the Ensoniq chip) that software making use of that feature became available in any quantity.

Sweet Micro Systems produced one of the most popular sound cards for the Apple II. Their original products appeared on the market in 1981, and were called the "Sound" series. These cards utilized music and sound microchips that were significantly advanced over the one-bit sound that had been designed into the Apple II. These cards came in four different versions: Sound I, which could produce sound effects and music; Speech I, for speech using phonemes, as well as some sound effects; Sound II, which had two audio outputs, each of which produced music and sound effects; and Sound/Speech I, also with two audio outputs, one for music and one for speech.

After the early success of Sweet Micro Systems' Sound series, they redesigned the card, named it "Mockingboard", and sold a new set of sound cards for the Apple II. There were initially three versions, models A through C. The Mockingboard A sold for $99, had two audio outputs (which made stereo sound possible), and had a better music and sound synthesizer. This card also had two empty sockets that made it possible to add speech synthesis to either or both outputs. With these chips and the right programming, it was possible for the card to sing in two voices, in harmony.

Mockingboard C – Photo credit: www.apple2world.jp

The Mockingboard B, for $89, was not a board but was their product name for the speech synthesizer chip to add to the Mockingboard A. The Mockingboard C, for $179, was simply a

Mockingboard A with a Mockingboard B chip upgrade already installed.

In 1985, Sweet Micro Systems released a version of their sound board for the Apple IIc. The Mockingboard D, which sold for $195, was an external device that connected to the IIc via one of the serial ports. It offered the capability of doing stereo music, speech synthesis, and sound effects.

A software company, Mindscape, released a music program called ***Bank Street Music Writer*** in 1986. It was released for the Commodore 64 and Atari 800 (using the sound capabilities built into those computers), while the IBM PC and Apple II versions required add-on sound hardware. They contracted with Sweet Micro Systems and another version of ther sound card, called the Mockingboard M, was bundled with ***Bank Street Music Writer*** on the Apple II version. This card had two music generator chips and had an open spot for the speech chip to be installed as an option. Sound could be played through a headphone jack, and a modification to the board allowed sound to be played through the Apple II speaker.

In 2005, Henry Courbis of ReactiveMicro.com produced a fully functioning modern clone of the Mockingboard C, called the Mockingboard v1, which sold for $60. Since he was not equipped for larger scale production and had delays in meeting demand for it, another enterprising hacker, Tom Arnold, produced a clone of this clone in 2010, and sold it through the ReactiveMIcro web site as the Mockingboard v1a.

A number of games were produced to offer additional sound capabilities when a Mockingboard was detected. The most elaborate use was Ultima V, which supported *two* Mockinboards, utilizing eight out of twelve possible "voices" (sounds).[55],[56]

In the 1980s, Applied Engineering also began to offer an audio card, called the Phasor. It worked on the Apple II Plus and IIe, offered 12 music and sound effect channels, as well as speech synthesis. It was compatible with software for the ALF and Mockingboard.

Applied Engineering made an enhanced audio output card for the Apple IIGS that they released in 1989. The Sonic Blaster was a stereo card for both output *and* input of audio for the IIGS, and sold for $129. Their Audio Animator that came out the same year offered these features and MIDI input/output, for $239. ECON Technologies offered the SoundMeister and SoundMeister Pro cards, which offered stereo sound, line and amplified outputs, and microphone and line level input (for recording and digitizing sound).

ROBOTS AND DEVICE CONTROL

Although used primarily for education purposes, there were at least two robotic devices made to work with the Apple II. TOPO (made by Androbot, Inc.), and the Tasman Turtle ($1000, with a smaller version called the Tot for $300) were in use during the mid-1980s. Both used the Logo language to control movement of the robot on the floor. Logo has a graphics command set called “turtle” graphics to simplify the concept for children. A small triangle on the hi-res screen was called a “turtle”, and it could be given software commands to move forward, turn, draw, or move without drawing. When TOPO or the Tasman Turtle were connected to an Apple II, the Logo language could be configured to send the same turtle graphics commands to the physical “turtle” robot on the floor. This gave students a concrete example of what their logo programs would do in “drawing” a graphics picture.

Education was not the only place where robotics was used in an Apple II. With A/D (analog/digital) converter cards, it was possible to take information from devices such as a wind speed sensor and convert it into digital information that could be stored and analyzed. It was also possible for a computer program to take this information and send a command signal back to another device (for example, to activate a motor that raises and lowers a cloth deck cover, depending on how windy it is). Although not a “robot” in the sense that people usually view robots, a computer-controlled device that can automatically carry out a series of complex actions *is* a robot.

A set of home devices that could be controlled or programmed with an Apple II was the BSR/X-10 system. One of the first available for the Apple II was the Introl/X-10 made by Mountain Hardware for $279. This protocol for controlling electric devices in a home had been available for years, and programs existed for the Apple II series (including the IIc) that allowed easier programming of the X-10 devices, ranging from security systems to light timers to lawn sprinkler systems.

MISCELLANEOUS HARDWARE

Here follows a short list of some other items that could be found for sale in a typical issue of an Apple computer magazine in the early 1980s:

RESET KEY PROTECTOR, which prevented accidental RESET on the earliest models of the Apple II, was available for only $3.25 from Special Systems Design. This was necessary because the RESET key, on the upper right of the keyboard, was easy to press because it had the same spring action as the other keys on the keyboard. Various methods (like this product) were used to stiffen that key, and make it harder to press.

DOUBLEDOS PLUS was a Disk II interface card modification that had a switch to allow the user to easily switch between DOS 3.2 and DOS 3.3. It sold for $39, by Tymac.[57],[58]

CLOCKS, such as the Apple Clock made by Mountain Hardware, for $199. A clock made it possible to time and date

IIc System Clock – Photo credit: Applied Engineering catalog

stamp files,
and identify which version of a file was the most recent. The Thunderclock, created by Thunderware in 1980, was such a popular clock card that ProDOS actually included drivers for it when it was first released. Nearly all cards released after this had to emulate at least the major functions of the Thunderclock. Later, a popular hardware add-on was the No-Slot Clock, made by Dallas Semiconductor. To do the installation, it was necessary to remove a chip from the motherboard on an Apple II motherboard (or IIe, IIc, or IIc Plus), plugging in the No-Slot Clock, and then re-installing that chip into the No-Slot Clock. A simpler clock for the Apple IIc was Applied Engineering's IIc System Clock. This external box plugged into a serial port on the IIc, and with appropriate software patched into ProDOS would read time from that clock for date and time stamping files. The serial port would not be permanently tied up, as a serial device could still plug into this box and be used as usual.

Quickie hand scanner – Photo credit: François Michaud

SCANNERS – The earliest device that was able to scan images into an Apple II was the ThunderScan from Thunderware. They released this product in 1984 for both the Apple II and Macintosh. It replaced the ribbon cartridge on an ImageWriter printer with an optical scanner. It would (very slowly) scan a document threaded into the printer, one line at a time, moving back and forth just like the print head would move to print a page. It could take as long as a half hour to scan an 8 by 10 piece of paper.

In 1990 a hand scanner was released from a company in Japan. Two American companies promptly wrote software to control it, and sold it under their own names. Vitesse released the Quickie hand scanner in February 1990 for $199. It worked by placing a document in the included plastic tray, and then the scanner was pulled down first the left side and then the right side of the document. The software could then reassemble it into a single image. Later, Vitesse sold InWords for $75, software that could do OCR (optical character recognition), making it possible to change a document into a text file.

That same year, Thunderware released the same scanner under the name LightningScan GS. It offered the same scanning options as did the Quickie. A comparison posted on comp.sys.apple2 back in 1997 suggested that the LightningScan software favored scanning of photographs, and that the Quickie was better at scanning line art.[59]

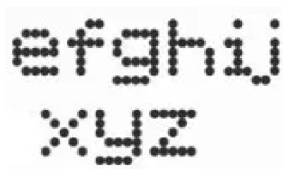
In 1994, Vitesse released Quickie-C, a $99 Apple IIGS NDA (new desk accessory) that would allow scanning of color with the Quickie scanner. However, the software reputedly unstable and did not work well. In fact, some opinions on comp.sys.apple2 in the late 1990s alleged that the earlier version of the Quickie software worked better than later versions.[60],[61]

PRINTERS

By the late 1970s and early 1980s many printers were available for use with home computers. However, the cost was often over $1,000, which limited the number of people who could afford to buy one. Most printers offered 96 characters in the standard ASCII set, including both upper and lowercase characters. The cheaper printers could only print uppercase characters, while some of the more expensive ones were capable of accepting programmable characters or had built-in graphics characters.

There were two main types of printers available. One type operated like a typewriter by striking a piece of metal type against a ribbon and onto the paper. This type of printer was often called an "impact" or "letter quality" printer. It used either a type ball like IBM's Selectric typewriters, or a wheel with spokes that radiated out from the center, with the type characters at the end of the spokes. This latter type of letter quality printer was also called a "daisy wheel" printer, because the changeable print wheels looked something like a daisy. Businesses used this type of printer more commonly than the dot-matrix variety, because of the quality of output. They were quite expensive, often costing more than $2,000 and were beyond the reach of the average home hobbyist.

The other type of printer in common use was dot matrix. These less expensive printers formed characters with a series of pins in a vertical row that struck the ribbon and produced dots on the paper. As the print head moved across the paper, the dots were printed in patterns that resembled (sometimes vaguely) letters and numbers. The matrix used to form a character was usually referred to as the number of horizontal dots by the number of vertical dots. A 5×7 matrix, for example, used up to five dots across and up to seven dots down. Some printers (like some computers of the time) did not use "descenders" on the lowercase letters that drop below the baseline ("g", "j", "p", "q", and "y"). To print lowercase letters with descenders often required nine or more vertical pins. Over time, print technology improved the appearance of dot matrix printing, first by increasing the vertical printing density to 9 or more dots, which allowed creation of true descenders on those lower case letters, and later by adding additional horizontal printing to get rid of the "dot" appearance.



8-pin dot matrix – notice the single dot used for descenders

The Centronics 730 may well have been the first "standard" printer for the Apple II (as well as for many other microcomputers). It used a parallel cable whose pin layout went on to also become a standard for use with personal computers. The parallel cable pin layout on the plug was still in use by the

1990s.[62] Centronics also had several other models, including the 737 and 739. A less expensive printer made by Centronics, the 779, used 5×7 dot matrix characters, and could print in sizes from 10 to 16.5 cpi (characters per inch), ranging from 60 cps (characters per second) at 10 cpi to 100 cps at 16.5 cpi. It also had a one-line buffer (which held up to 132 characters), but printed a limited 64 character ASCII set, all uppercase plus some special characters. As mentioned before, most personal computers of the time didn't have lowercase anyway, so this limitation wasn't necessarily a drawback. The better printers made by Centronics had a larger matrix and could produce true descenders on lowercase characters.[63],[64]

A company named Trendcom made two printers that were significant in the history of the Apple II. They had two models, the 100 and the 200. Instead of using the mechanics solenoids that drove pins in a print head, these were thermal printers that needed a special heat-sensitive paper. Their operation was very quiet, about as loud as sliding your finger across a piece of paper. They were inexpensive compared to other printers of the day (most of which cost over $1,000), although the printing looked very much like that produced by a dot-matrix printer. The Trendcom Model 100 printed 40 characters per line on paper that was about 4 1/2 inches wide. The Model 200 could print 80 columns per line on paper 8 1/2 inches wide. Compared to the first printer offered by Radio Shack for their TRS-80 computer (which was also a thermal printer but used an ugly silver paper), the Trendcom printers were very nice.

Apple Silentype Printer – Photo credit: François Michaud

The significance of the Trendcom printer was that Apple chose it as the first printer they released under the Apple name. It could be programmed to control printing of each dot in a column, and so was ideal as an inexpensive means of printing Apple II hi-res graphics. Apple included a special interface card and announced the printer as the "Apple Silentype" in June 1979. It was available to purchase in March 1980, selling for $599. It was identical to Trendcom's Model 200 except for the Apple logo in the lower left corner of the front cover.[65] One legend suggests that part of the popularity of this printer at Apple stemmed from the fact that its small size allowed it to fit under the seat of Steve Wozniak's private airplane.[66],[67],[68] Andy Hertzfeld, who later wrote much of the ROM code for the original Macintosh, wrote the firmware for the Silentype printer.[69]

Epson MX-80 – Photo credit: unknown

Epson was another company that began early in the business of supplying printers for personal computers, and is one of the few that survives to this day. It got its start in the printer business with the Epson MX-80, one of the first dot matrix printers that sold for less than $1,000. Popular with computer hobbyists of the time, it was capable of printing Apple II hi-res graphics with the optional Graphtrax ROMs. A later version of this printer, the Epson MX-100, became available in early 1982. The MX-100 was a wide carriage model, and could print hi-res graphics without the need to add any special hardware. Epson printers were unique because they had a special feature called a "double print" mode where a line was printed normally, then the paper was advanced 1/216 of an inch and the same line printed again. This filled in some gaps between dots on individual letters, and made printouts more pleasing to the eye. Another feature used in these printers was a "print enhancement" mode, in which the pins hit the ribbon harder and made it possible to make multiple copies using carbons.[70],[71] Integral Data Systems was also an early manufacturer of printers. Their IDS 125 and IDS 225 printers came out in 1979 (the 225 sold for around $900).[72] These printers used a 7×7 matrix for creating characters. The IDS 125 used a pressure feed method (similar to the method used by typewriters to hold paper in place), while the IDS 225 used a tractor feed mechanism. The IDS printers had the flexibility of being useable with either parallel or serial interfaces (with serial speeds up to 1200 baud). It could do plotting of dot graphics, and also had an optional graphics character set built-in.[73]

Integral Data Systems, Paper Tiger, Apple Orchard, May 1980 – Photo credit: personal

By the late 1970s Integral Data Systems upgraded their printers, giving them more capabilities and flashier names. Their Paper Tiger line of printers (models 440 and 460) had an attractive typeface, and used two vertical rows of pins in the print head, slightly offset from each other. This produced overlapping dots to achieve a more solid appearance. Some models could print up to 160 cps, and of course upper and lowercase characters were supported. They were also capable of reproducing Apple II hi-res graphics (with the appropriate software). IDS also sold a printer called the Prism, which could print in color using a special multicolored ribbon.[74]

Anadex, MPI, and Microtek were other manufacturer of early printers.

HP Deskjet 500 – Photo credit: Wikipedia

Although Apple II users made use of many brands of printers during the years of its active use, it was hard to move forward to newer or better technology, as the increasing sophistication of printers made it difficult use without more complex drivers to allow the computer to communicate with the printer. However, those drivers were being created for the PC and for the Macintosh, but very few were made available for older computers. One exception was the Hewlett-Packard DeskJet 500 inkjet printer. In 1993, this printer was selling for only $299, and made it possible to get high quality print output from an Apple IIe, IIc, or IIGS. It was possible to use this printer from AppleWorks, and with proper drivers, output from the Apple IIGS and its graphics-based software was also possible. Later revisions of the DeskJet series, the 520 and 560c, were also useable with these Apple II models. However, these newer HP printers did not come with serial connectors, and so a parallel interface card was necessary to connect them.

APPLE’S PRINTERS

After the Silentype printer was released in 1979, Apple looked for another printer that would produce better, more permanent output than could be achieved with a thermal printer. One of the main problems with thermal paper was that with time the printing could fade, especially if cellophane tape was used on the paper. The Apple Dot Matrix Printer was released in October 1982 for $699. Made from a modified C. Itoh printer, it was one of the first few dot-matrix printers that sold for under $1,000. Apple needed it as a better quality printer than the Silentype to help promote the Apple III as a business computer. More importantly, it was chosen by Apple because it was capable of doing heavy-duty graphics reproduction (such as output from the Apple Lisa computer, still in development at that time). Known also as the Apple DMP, it used a custom ROM programmed by Apple to control the printer's features.[75]

Apple Letter Quality Printer – Photo credit: Apple III Information Analyst Brochure, 1980

Because Apple was looking for as many business solutions for its customers as it could find, they also announced at the same time as the DMP a daisy wheel printer called the Apple Letter Quality Printer. Costing a hefty $2,195, and made from a modified Qume brand printer, this printer could print at only 40 cps, but did produce very good quality output. It was released with the Lisa and IIe in January 1983.[76],[77]

The Apple ImageWriter was released in December 1983 as the successor to the Apple DMP. Also made by C. Itoh, the ImageWriter had a faster print speed (120 cps), and could print in eight different pitches (character widths). It was a very reliable, sturdy printer, and sold originally for $675. Later, a wide carriage version whose abilities were otherwise identical was made available. The ImageWriter II replaced both in September 1985. While the original Apple DMP and the ImageWriter I came in the same beige color as the Apple II, II Plus, and IIe, the ImageWriter II was the same platinum color as the Apple IIGS and the newer

ImageWriter – Photo credit: Vectronic's Apple World

Macintosh computers. Styled a little differently, the ImageWriter II could do everything the original ImageWriter could do, plus it was capable of printing MouseText characters and could print in color (using a special multicolored ribbon).[78], [79]

Apple Scribe Printer – Photo credit: Christian Rehberg, <www.classiccomputer.de>

As part of its promotion of The Apple IIc, a new printer was released. The Apple Scribe came in the same "Snow White" color as the IIc and was low in cost at $299. It was a thermal printer, but was a significant advancement over the old Silentype. It could print on regular paper (instead of special heat sensitive paper), and could print in four colors. It did this using a unique heat-transfer method and a wax-impregnated ribbon. Utilizing overlapping dots, the Scribe could print in a "near letter quality" mode at 50 cps (characters per second), and a draft and graphics mode at 80 cps. Its major limitation, however, was a print quality that overall was often not as good as some dot-matrix printers, and a ribbon that was expensive and needed to be replaced too often.

The Scribe was eventually discontinued due to these problems and low sales.[80]

In 1984 Hewlett-Packard introduced the LaserJet laser printer. This was a significant breakthrough in printer quality, and was capable of producing documents that looked professionally typeset. Apple decided to develop its own laser printer, and in January of 1985 released the LaserWriter. Although not speedy printers (with best output at four pages a minute by the early 1990s), and very expensive (over $2,000), they were popular with those who wanted high quality printing. At Apple, the new LaserWriter was supported only on the Macintosh, but since the printer did its work through a page description language called "PostScript", it was entirely possible for an Apple II to print on a laser printer. It was only necessary to learn the PostScript language, create a file that gave the necessary commands, and send that file to the printer through a serial interface card. Don Lancaster, long-time Apple II supporter and hacker, wrote a series of articles called "Ask The Guru" in the magazine *Computer Shopper*, and he gave many examples of using a laser printer with an Apple II.

Unfortunately, for many years there was a perception that it was not possible to use a laser printer with an Apple II, even the more advanced IIGS. This was partly because there were few software packages for the Apple II that would produce output as PostScript files that could be properly interpreted on a laser printer. However, programs such as *Publish-It!* could print to a PostScript-capable laser printer, even on the Apple IIc. All that was necessary was to have the right cable to connect the two devices.

By the late 1980s, a new kind of print technology became available for sale. Inkjet printers worked somewhat like a dot-matrix printer, but the print head sprayed ink through as many as 64 holes in patterns to form characters as it moved across the paper. The advantage over dot-matrix impact printers was the ability to form more solid characters. In fact, the quality of printout with an ink-jet printer could be almost as good as that obtained with a laser printer. The advantage over laser printers was cost. In the early 1990s, the best price for a laser printer was over $1,500, but the cost of inkjet printers was as low as $300-$500. The disadvantage for Apple II users was that although it was easy to get the printers to print text, printing graphics was difficult due to insufficient interest in producing print drivers for the Apple II. It was possible to use some of the printers in a mode that emulated older dot-matrix printers, and so for those printers it was more feasible to try on an Apple II. These ink-jet printers could even produce graphics, as long as the emulated dot-matrix mode supported graphics.

Apple entered the ink-jet printer market in May 1991 when it released the Apple StyleWriter. A modification of Canon's BubbleJet series, this printer did excellent reproduction of text and graphics – on a Macintosh. It was not until the release of GS/OS System 6 that Apple released drivers to make it possible to use this printer on the IIGS. Drivers for later versions of the StyleWriter were never made available for the IIGS. Unlike the inkjet printers sold by Hewlett Packard, the StyleWriter did not have a built-in set of fonts. Instead, it was entirely graphics-driven, and required the computer to send all text as it appeared on the screen. This was appropriate for the Macintosh and for 16-bit software on the IIGS, but would not have been of much use on 8-bit models of the Apple II.

To provide maximum flexibility on font creation and reproduction, the StyleWriter was built to receive its text in the form of dynamically created bitmapped fonts, using the new TrueType font technology. With TrueType, a single font that could be resized over a large range under software control. The older Macintosh (and GS/OS) font methods required a separate font for each size in a family to print (i.e., Courier 8 for 8-point type, Courier 10 for 10-point type, and so on; with TrueType there was just a single Courier font file). , which made it possible to have a single font that can be made any size under software control (instead of having a separate font for each size to print). In early 1992, this TrueType technology came to GS/OS through ***Pointless***, an extension released by Westcode Software.

Although not quite a printer, the Apple Color Plotter was released in June of 1984. It had an advantage over printers, in that it could draw smooth lines and curves. Using four colored pens in a rotating pen head, and selecting them at the computer's command, the Color Plotter worked by moving the paper up and down to draw vertical lines, and the pen left and right to draw horizontal lines. Control of the plotter was accomplished by sending text commands through a serial card, and consisted of two letter commands (DA = Draw Absolute, DR = Draw Relative, etc.) followed by parameters. It could move the pen without drawing, plot points, draw lines, arcs, and circles, and print text at any location, tilt, rotation, or scale. Lines could be drawn as solid or as patterns of dots.

Presumably this product did not take off because of the limited need for this type of graphics, and the price. Because of the continuously improving quality of graphics and printers, plotters are no longer much in use. The right software can reproduce drawings with an inkjet or laser printer in as good or better detail than a plotter can.[81]

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13 Comments on "13-Peripherals"

Charles Smollin

December 4, 2011

"In fact, the Phone Company was quite certain that speeds over 300 baud were not possible with any modem. …"

Dr. Robert W Lucky (Bell Labs) and others calculated the capacity of a phone line at 23,500 bps in 1968 [1] but no one knew how to get there. Achieving near theoretical (Shannon) capacity became possible in the late 90's after certain discoveries in coding theory and their adoption by standards bodies like ITU-T and companies making modem chip sets like Rockwell.

The original modem was only 300 bps because it used binary signals and used a frequency for "0" and a frequency for "1". Efficient digital communications systems use a somewhat larger set of symbols than just two and a more efficient way of representing these m symbols on the analog waves that the modem transmits over the wire. Perhaps we could get one of these advanced modem signals to go over an acoustic coupler at 56K with aggressive equalization, maybe not, but why bother!

[1] R. W. Lucky, J Salz and E J Waldon, Principles of Data Communications Mg-Graw Hill 1968 pp. 35-38

Reply

Steven

December 4, 2011

Charles, thanks for the comment! Perhaps i'll have to adjust my statement to reflect this information.

Reply

Dj

February 23, 2013

Being a modem nerd, and an Apple II geek, I can't help but notice a few great modems of note missing from the modem section.

1) The Apple acoustic modem (Novation CAT with Apple branding)
2) The Micromodem IIe, while the Micromodem II is mentioned, its successor which moved the DAA electronics inside the card, eliminated the microcoupler and improved disconnect supervision capabilities.
3) The Transcend SSM, which was a very popular micromodem compatible,
4) The Zoom Modem IIe, also a popular micromodem compatible,
5) The Prometheus 1200A, perhaps (I may be wrong here) the first internal Hayes AT-command set compatible Apple II modem.
6) The AE Datalink 2400, perhaps (again, I may be wrong here) the first internal 2400 bps modem for the Apple II.

Give my BBS a "call" sometime, or "call" my Diversi-Dial station.
http://bbs.impakt.net
http://rmac.d-dial.com
Both sites include a flash-based telnet client which will attach your browser to a real modem, and dial up another modem on the answer side.

cheers,

dj

Reply

AppleманY

June 3, 2016

I have just – after over 30 years – restarted my Old Apple][Europlus and my A2M2010P Monitor.

I have a Digitek 80 Column card with U/L/C on shift which I recall worked fine but I dont seem to have manual for it. Anyone got one they would be willing to scan and email to me?

Thanks

Colin

Reply

Chris

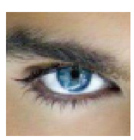
October 28, 2017

The SWIM was never in a IIgs or any Apple II. SWIM was in Macs and the SuperDrive card, but never integrated in an Apple II directly (i.e. part of the motherboard). IIgs and IIc (and IIc+) had the IWM.

Reply

Richard Fleming

November 15, 2017



There was a Canon inkjet printer supported by the Apple Lisa 2. Even though the Lisa doesn't display color, it's possible to set colors in the updated Lisa program(s). It may just be LisaDraw that supports color printing. Still, there was an inkjet around '84 or so that Apple decided to specifically change the Lisa software to support.

Reply

Bob

March 8, 2018

The SWIM chip was originally designed by The Engineering Department (TED) to be used in the PC Transporter, but since Apple owned much of the underlying technology, an agreement was made to let TED design it and use it, but also give the design back to Apple to use in subsequent Apple products. TED also directly sold other Mac peripheral products based on the SWIM chip through a marketing subsidiary. These primarily targeted increasing the capacity of floppy disks and giving the Mac the ability to read/write IBM formatted disks (which the SWIM chip was capable of).

Speaking of PC Transporter, TED also designed the ASICs that were used in the original Applied Engineering PC Transporter product. AE later did a cost reduction (targeting mainly the memory) and revved one of the two large ASICs. I'm not sure the other large ASIC (graphics chip) ever went through any revisions though I hope it did since I made a (simple and dumb) mistake in designing it that ended up requiring an additional 40,000 or so test vectors to get the chip set up properly to validate the output signals on a semiconductor tester. That additional time on the tester translated to cost, too. Of course, all of this was a long time ago and my memory is starting to get fuzzy.

I notice that Network cards are left out of this dialog. There were some good ones.

Reply

laurent

September 27, 2018

Greetings,

Just to chime in on this really awesome site regarding an additional input peripheral. The VERSAWRITER, this was a very important device with many early graphics story games. Mystery House was one of my favorites !!!

Peace

Reply

Steve Mencik

January 11, 2019

I'm surprised there was no mention of First Class Peripherals Sider hard drive that was made for the IIe. 10MB of hard disk space for $695. Supported Apple DoS, ProDoS, and Apple Pascal among others.

Reply

Steven Weyhrich

January 12, 2019

Steve, thanks for your comments. Yes, the Sider was an important peripheral, and should have been mentioned. Maybe some day I will be able to add something about it.

Reply

James W Walker

March 25, 2019

Hi I remember a TAPE II digital tape system some time around 1978. I believe I was deciding to buy one or the DISK II. I remember that DOS was stored above HIMEM and accessed with a CTL-D and TOS was stored below LOMEM and was accessed with CTL-T allowing both system use.

Reply

Steven Weyhrich

March 25, 2019

I would love to see something like that. Does anyone remember this, or where there might be an archived copy?

Reply

James W Walker

May 7, 2019

I just found the tape of Apple Integer Basic Checkbook. I found this program to be unusable in the audio tape format. I believe that is why I was researching the TAPE II and the DISK II. It is quite possible that the TAPE II was never brought to the consumer market. I finally elected to get the 140K TAPE II.

Reply

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