

The Commodore 64: for home or business

The Commodore 64 is Commodore Computer's new entry in the personal computer stakes. With an advertised 64K of memory, high resolution graphics in 16 colours, and extensive sound effects and music capabilities, the new machine has a lot to offer the beginner and experienced computer hobbyists.

by PETER VERNON

In appearance, the Commodore 64 is very similar to the VIC-20. It has the same 400 x 200 x 65mm plastic console, in beige rather than white, and the same layout of 62 keys and four programmable function keys. Connections for peripheral equipment are also very much the same, with the exception of an additional control port on the right hand side of the console so that two joysticks or a lightpen can be used.

The rear of the unit is entirely taken up by connectors for software cartridges, television output, serial port and expansion connector. It is here that one notable departure from the VIC-20 format is evident. The Commodore 64 has a built-in television modulator rather than the external black box that caused such problems with the VIC-20.

The internal modulator operates only

on UHF channel 36, so if your television set does not have a UHF tuner, hard luck. On our lab TV set the picture was clear and steady, although exhibiting slight colour aberrations depending on the combination of background and text colours in use.

A separate 5-pin DIN connector provides outputs for a composite video signal for a colour monitor, and a separate audio channel. As the users' manual puts it; "Since the Commodore 64 furnishes a channel of high fidelity sound, you may wish to play it through a quality amplifier to realise the best sound possible".

Power for the computer is derived from a separate mains adapter, no doubt simplifying the manufacturing problems posed by varying international standards. The power supply does not have

its own power switch and should be switched off at the mains when not in use. The power switch for the computer is a small rocker switch on the right side of the console and a red LED on top of the console indicates that the unit is on.

Text display

Text on the Commodore 64 is displayed in a 40-column by 25-line format on a "background" screen surrounded by a coloured border. On first switching on the border and text is a light blue with the background screen medium blue — a little lacking in contrast.

The text colour can be changed from the keyboard by pressing the Control key in conjunction with one of the eight numeric keys which carry the colour names black, white, red, cyan, purple, green, blue and yellow. Pressing the "Commodore" key (marked with the Commodore logo) will give access to a second set of text colours in conjunction with the numeric keys. These colours are orange, brown, light red, three shades of grey, light green and light blue.

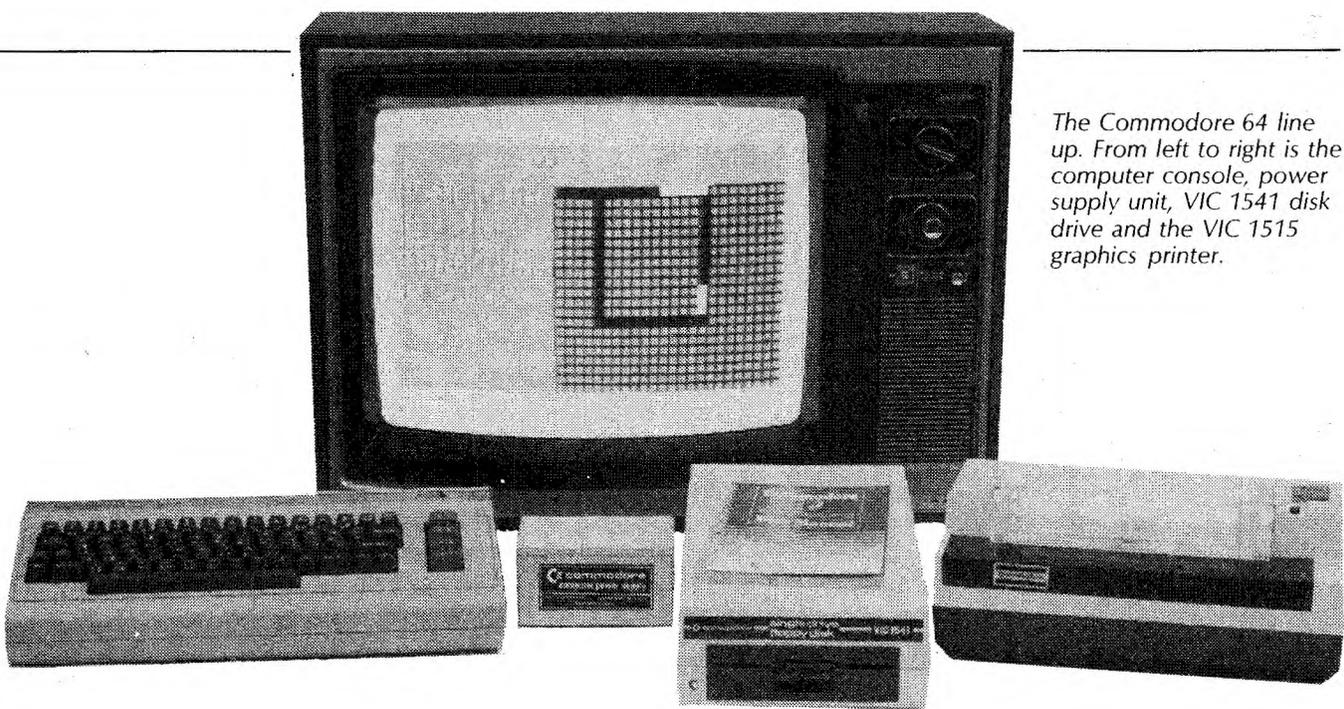
Text can be displayed in one of two modes, combining either uppercase and graphics or upper and lowercase. In the first mode, typing on the keyboard produces uppercase letters but pressing a key in conjunction with Shift produces the graphic symbol marked on the righthand front of the key. This is the mode entered when the computer is first switched on.

The second mode is activated by pressing the Shift key and the Commodore key. In this mode the keyboard produces lowercase letters, with Shift activating uppercase in normal typewriter fashion. In this mode, the graphics symbols marked on the lefthand front of each key can be printed by pressing the Commodore key in conjunction with the key showing the required graphics character.

These two text display modes actually use two different character generators, so both cannot be used together from the keyboard. Changing from one mode



The Commodore 64 keyboard provides 62 alphanumeric keys and four programmable functions. Upper and lowercase and two set of graphics symbols are available.



The Commodore 64 line up. From left to right is the computer console, power supply unit, VIC 1541 disk drive and the VIC 1515 graphics printer.

to the other affects the entire screen, not just those characters entered after the change is made.

Two other numeric keys carry the labels RVS ON and RVS OFF. Pressing Control and RVS ON activates an inverse mode which swaps the colours of the foreground and background. A space, for instance, becomes a solid block of colour in this mode while other characters are displayed in the current background colour on a block of the current foreground colour. The reverse colour mode remains in effect until the Return key is pressed or until disabled by a Control/RVS OFF key combination.

The colours of the screen background, text and border can also be changed by POKing particular colour code values to specific locations in memory as explained in the users' manual.

Cursor control keys are provided with automatic repeat so moving the cursor on the screen for editing programs is easy. The cursor movement controls can also be used from within a program with a PRINT statement. Pressing a cursor control key after opening quotation marks will not produce cursor movement but will display the control code as an inverse video graphic symbol. By PRINTing sequences of cursor control characters the cursor can be moved around the screen to duplicate the function of the Microsoft PRINT@ statement.

Clearing the screen from a program is done by PRINTing a CLR/HOME character between quote marks. When this key is pressed after opening quote marks a heart symbol is displayed in inverse video. When the PRINT statement is executed the screen will be cleared

and the cursor returned to the upper left corner of the display.

A feature of the Commodore 64 is its "full screen" editing. A program can be listed and various lines changed by moving the cursor to the desired point and re-typing. On pressing Return the alterations are incorporated in the program. Line numbers can be changed in this way, producing a copy of the old line with the new number (very handy when entering long programs which consist of lines with little variation, as in many graphics routines).

Sprites and graphics

The newest concept in graphics for home computers are "sprites", blocks of

definable graphics which are handled in a special way by the graphics display hardware. The Commodore 64 provides eight sprites, each defined on a 24 x 21 pixel grid and displayed in a bit-mapped graphics mode which offers a display of 320 x 200 pixels.

The definition of each sprite is stored in a 63 byte table in memory, with a pointer to the definition block maintained in a register in the video display chip. The shape of a sprite can thus be changed almost instantaneously by altering this pointer to select a new definition block.

Two other locations in each sprite register enable sprites to be expanded by a factor of two in either (or both of) the horizontal or vertical dimensions.

Commodore 64 Specifications

Processor	6510 (equivalent to the 6502)
RAM	64K, 38911 bytes usable from Basic
Keyboard	Full size typewriter style, 62 keys plus 4 programmable function keys
Display	UHF channel 36 or colour video monitor, 16 colours, 40 x 25 lines text display, 320 x 200 graphics resolution, eight sprites.
Sound and music	Three voices, each with a 9 octave range, selectable waveforms, volume and ADSR parameters
Interfaces	Serial port for cassette interface, cartridge connector, two games connector ports, expansion port, direct video and audio connections, cassette recorder, plus optional cartridges.
Peripherals	Plug in program cartridges, disk drive, dot matrix printer, other peripherals require specialised interface cartridges.
Documentation	Users' manual — good for beginners, but lacking details of advanced capabilities. "Programmers Reference Guide" is available separately.

The Commodore 64 computer

Sprites are moved on the screen simply by updating the X and Y-coordinates of the upper lefthand corner of the block by entering new values into a "sprite position register" with the Basic POKE statement. The display hardware incorporates a priority feature which allows one sprite to move over the top of another. The sprite with the lowest priority is obscured by the higher priority sprite and reappears automatically as the higher priority shape moves on.

Text is the lowest priority (apart from the background) so all sprites are displayed on top of text. Once enabled, sprites remain on the screen until they are disabled, again by a POKE to a sprite register. Two sprite display modes are available, one which produces single colour images and the other which produces multi-colour images, with up to three colours per sprite.

Interactions between sprites set bits in a "sprite collision register" which can be accessed with a PEEK statement to determine contacts between sprites or between sprites and a background object — a convenient feature when writing games programs, for example.

In addition to sprites the Commodore 64 allows the programmer to shift the entire character set memory into RAM and redefine any character, again either in single or multi-colour modes. With an extended character set definition high resolution graphics can be displayed on a 320 x 200 pixel grid, and freely mixed with text.

Commodore's approach to graphics, sound and other special features of their computer appears to be to provide a standard Basic interpreter, with special features activated by POKE statements referring to particular memory locations. Unlike Microsoft Basic there are no special graphics or sound statements. The Basic of the Commodore 64 in fact is exactly the same as that of the VIC-20 and the Commodore PET computers.

Sound effects and music

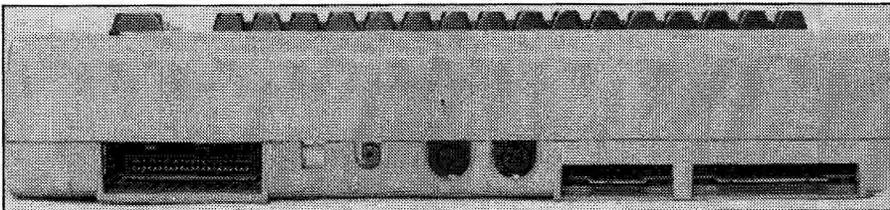
The Commodore 64 provides three voice sound with a nine octave range. Volume, waveform, attack/decay, and sustain and release parameters can be specified by entering certain codes into memory. Notes are specified in two entries as high and low settings because there are more frequencies available than the 255 which can be specified in a single byte.

Duration of each note is set by a delay loop within the program, with each note turned on and then turned off after the required delay.

The waveforms available are triangle, sawtooth, square wave and noise. "At-

tack" refers to the time taken for the sound to reach full volume. The "decay" parameter specifies the rate at which the sound falls from its highest volume setting to zero or the sustain volume. The "sustain" setting, as the name implies, specifies how long the sound remains at full volume, while the "release" setting specifies a rate at which the note returns to zero following sustain.

Each voice can be independently controlled and since sound is produced by a dedicated 6581 "SID" chip (Sound Interface Device) processing can continue in parallel with sound effects. A multitude of effects can be produced by mixing the various voices, each with independent parameters. Echoes, vibrato and varying waveforms can be set up to duplicate most musical instruments.



Rear view of the Commodore 64 console shows the cartridge slot on the left, modulated RF output, DIN connector for direct video and audio, serial port and VIA and expansion connectors.

Commodore Basic

The Basic used by the Commodore 64 (and the VIC-20) is very similar to the Microsoft version. String handling is identical and mathematical and logical operators are standard. Arithmetic is to ten digit precision, with scientific notation covering values from 2.93×10^{-39} to 1.701×10^{98} . Basic statements and functions are shown in Table 1.

Most Basic keywords can be entered in an abbreviated form by typing the first letter of the keyword, then Shift and the second letter of the instruction. This procedure will produce a graphics symbol on the screen but when listed the program will show the full form of each keyword.

The statements TI and TI\$ are actually system defined variables which contain the current count of the Commodore 64's clock. The difference between the

two is that TI contains the number of counts of the clock since the system was turned on while TI\$ uses this count to display the time in hours, minutes and seconds since start-up.

This count is based on the mains frequency, and the clock runs slow, leading us to believe that the basic timing software has not been changed to suit the 50Hz mains frequency used in Australia. One "second" as reported by the Commodore 64 (60 clock interrupts, or "ticks") actually has a duration of 1.2 seconds.

The GET statement is the Commodore equivalent of INKEY\$, and extensive use is made of file handling statements such as OPEN, CLOSE and CMD.

What gives the Commodore 64 a great deal of its versatility is its interrupt driven Input/Output structure and the serial data communications bus used with all peripheral devices.

The single serial port at the rear of the Commodore 64 console is used to connect a "Datasette" recorder or a disk drive, with the VIC-1515 graphics printer "daisy-chained" to the disk drive unit. All peripherals are treated as "logical files", and output from the computer is handled in the same way by the printer, disk drive or cassette recorder, allowing very sophisticated storage and manipulation of data from within a program.

Once a communication channel has been set up with the OPEN statement for instance, the statement CMD will transfer output from the screen to the device specified. From that point all PRINT and LIST commands will send data to the peripheral device. The commands for printing a listing for example, are:

```
OPEN 3,4  
CMD3  
LIST
```

Commodore 64 Basic statements and functions

```
ABS, AND, ASC, ATN, CHR$, CLOSE, CLR, CMD, CONT, DATA, DEF, DIM,  
END, EXP, FOR . . . NEXT, FRE, GET, GET#, GOSUB, GOTO, INPUT, IN-  
PUT#, LEFT$, LIST, LOAD, MID$, NOT, OPEN, PEEK, POKE, PRINT,  
PRINT#, READ, RESTORE, RETURN, RIGHT$, RND, RUN, SAVE, SGN,  
SIN, SPC, SQR, STEP, STOP, STR$, SYS, TAB, THEN,USR, VAL, VERIFY,  
WAIT
```

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At the conclusion of the listing the printer must be de-activated (called "unlistening" by Commodore) and the printer file closed with;
PRINT#3 (a blank line)
CLOSE3

Similarly, to record data in a disk file the commands would be;
OPEN 2,8
CMD2
PRINT#3 (list of data items)
The disk must also be "unlistened" and the I/O file CLOSED in the same way as a printer file.

Input can be handled in the same way by use of the GET# statement, allowing cassette or disk data files to be used by a program in exactly the same way the keyboard is normally used.

Although Commodore make a big point of the 64K memory of the computer, there are actually just 38,911 bytes available for Basic programs and data. The remainder is taken up by video memory, character generator memory and memory mapped-sound and display controllers.

One criticism of the Commodore 64 is that there is no Reset switch. Pressing RUN/STOP and RESTORE will re-initialise pointers to the character set definitions etc but it will not return control to Basic if the microprocessor is in an endless loop. With so many locations in memory dealt with directly by POKE statements it is easy to make a mistake that may be fatal to a program, and the absence of a Reset switch is annoying at these times.

Peripherals and expansion

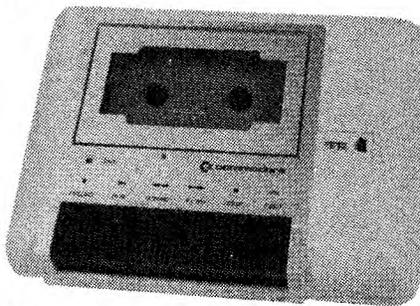
As with the VIC-20 only Commodore peripherals can be used with the Commodore 64 unless the user builds or buys special-purpose interfaces. The 30 character per second VIC 1515 graphics printer can be used for listings, text or high resolution dot graphics, and can reproduce the full graphics character set of the computer without any special preparation or commands.

The "Datasette" recorder is a standard cassette mechanism adapted by Commodore for digital recording and communication on the serial I/O bus of the system. The same recorder in a slightly different package is used by the VIC-20.

The recorder can be programmed to accept data files and read back data in a number of ways, and provision has been made for motor control, an advantage of the system. During cassette operations there are display messages such as "PRESS PLAY ON THE RECORDER" and the Commodore 64 can read the status of the Datasette's controls before power is supplied to the recorder.

A new disk drive has been produced

specifically for the Commodore 64 computer, and the existing VIC-20 disk drive cannot be used. In the future however, the Commodore 64 drive will be re-programmed so that it can be used by the VIC-20. Disk performance is lamentably slow, limited by the serial communications scheme used for transferring data to and from the computer. On the plus side the disk drive is easy to use and in combination with Commodore Basic, is versatile.



The Commodore 64 "Datasette" recorder.

The cartridge slot of the Commodore 64 is of a different configuration to that of the VIC-20. No doubt many VIC-20 programs could be run on the '64 with only minor changes, but users will need to invest in an entirely new collection of cartridges if they switch from the VIC-20.

Expansion cartridges will be available to allow the Commodore 64 to use standard printers, modems and other peripherals, and an IEEE-488 cartridge will allow use of the full range of Commodore peripherals with the system, including daisy-wheel printers and 20cm disk drives.

The "user port" at the rear of the Commodore 64 console provides access to the bus of the 6510 microprocessor and two uncommitted ports of the 6521 VIA (Versatile Interface Adapter). As with the VIC-20 there is plenty of scope for the hobbyist or experimenter who wishes to add their own hardware devices to the system, although special precautions will have to be taken to avoid addressing conflicts between the add-on equipment and the Commodore's 64K memory complement.

Software and expanded Basic

The range of program cartridges available for the Commodore 64 is as yet rather limited. The excellent screen resolution and sound effects of the machine mean that "arcade style" video games will probably be strongly supported, while a word processor, database manager and a spreadsheet calculator for the system are in an advanced state of preparation.

The word processing program, called "Easy Script" is supplied with an extensive users' manual and allows the Commodore 64 with either disk or cassette storage to be used as a word processor. Justification and centring, headers and foot-notes, page numbering and various line and page lengths are supported in addition to standard word processing features.

We were also supplied with a draft copy of the manual for "Easymail 64", a mailing list maintenance program capable of storing, sorting and searching lists of up to 700 names and addresses. Use of the system requires at least one disk drive and a printer.

Commodore also supplied a manual for the soon-to-come "Simon's Basic", a disk extension of Commodore Basic which moves away from the emphasis on PEEKs and POKEs for activating special features of the system. "Simon's Basic" adds programming aids such as a TRACE command, text handling commands, extra arithmetic operators, graphics plotting commands including DRAW, CIRCLE and PAINT and music commands including WAVE and ENVELOPE to simplify sound synthesis.

Structured programming commands including REPEAT ... UNTIL, LOOP ... EXIT, procedure calls and local and global variables are also included.

Other statements support the use of joysticks and a lightpen and simplify disk program use and file handling.

Simon's Basic will be available either on disk or as a cartridge, and will considerably simplify the use of the Commodore 64's extensive features.

Machine language programmers will be interested in the "64MON" cartridge, a machine language monitor and debugging program which includes a line-by-line assembler. The instruction set of the 6510 is identical to that of the 6502, and the "Commodore 64 Programmer's Reference Guide" (\$25) contains all the information necessary to use the full capabilities of the system from machine language.

Conclusions

The Commodore 64 is a system with a lot of potential. If it proves even half as popular as the VIC-20 it will have a large following. It has much to offer to the enthusiast interested in computer graphics, and its sound capabilities are equal to systems of much higher price. Coupled with existing and soon-to-come business and home management software it is an exceptional all-round computer system.

The Commodore 64 is priced at \$699, with the Datasette recorder an additional \$99. Further information is available from Commodore Business Machines Pty Ltd, 5 Orion Road, Lane Cove, NSW, 2066. Phone 427 4888. ☺