

# Appendix IV:

## An experienced users introduction to the CPC464

***The CPC464 is a low cost colour personal computer*** with a generous, effective and thorough implementation of established technologies, presented in format designed ***to offer*** exceptionally attractive value for money coupled with substantial capacity for expansion, and thus be attractive to both first time and ***experienced users.***

The hardware and ROM software have been designed to provide newcomers and experienced programmers with a friendly environment in which existing software may be tailored, and new software written to take advantage of the many features supported by the CPC464.

The major features of the system are :

### **Z80CPU**

The most widely used microprocessor found in home computers throughout the world, and with the best supported software base - especially since the CPC464 offers the potential for the implementation of CP/M. The unique interrupt handling structure has enabled the CPC464 to innovate with the BASIC features A F T E R and E V E R Y, and other 'real time' facilities controlling sound and timers.

## 64K RAM

A generous amount of RAM is supplied as standard, over 42K of which is actually available to the user, thanks to the implementation of ROM overlay techniques when implementing the BASIC.

## Screen

The CPC464 supports three basic screen handling modes, including 80 column text, a palette of 27 colours, and resolution up to 640x200 pixels.

## Real Keyboard

A full feature 'typewriter-style' keyboard, with a logical cursor key cluster and standard numeric entry keypad which doubles use for function key purposes.

## Built-in cassette

Local cassette storage is available as a built-in feature, thus providing operation with no additional user complications with hookup, level setting etc. Writing at either **1kBaud** or **2kBaud** (software selectable), with read speeds automatically established by software.

## BASIC

A 'written in England' industry standard BASIC, faster and more versatile than you have come to expect from such BASICs, with many extensions for graphics and sound, plus extensive support in firmware.

## Extended character set

A full **8-bit** character set including symbols and graphics is accessible largely via the keyboard, and using **C H R \$(n)** functions.

## Elapsed Time

Interrupts are generated by frame scans providing for elapsed time facilities.

## User Defined Keys

Up to 32 Keys may be user defined with up to 32 character strings. Redefinition capability includes the repeat parameters. A complete 255 character set (all ASCII plus over 100 more), optionally user re-definable.

## S u b r o u t i n e s

Many assembler sub-routines are available to be called from BASIC.

## SCREEN MODES

There are three modes of screen operation:

a) Normal

Mode 1: 40 columns x 25 lines, 4 'ink' text  
320x200 pixels, individually addressable in 4 colours

## b) Multicolour mode

20 columns x 25 lines, 16 'ink' text

160x200 pixels, individually addressable in 16 colours

## c) High Resolution mode

80 columns x 25 lines, 2 ink text

640x200 pixels, individually addressable in 2 colours

## Colour Selection

(NB Throughout this guide, 'black' ie nil luminance is considered as a colour for the purposes of the following descriptions)

The border can be set to a ANY pair of colours regardless of the screen mode: ie flashing; or a single colour ie steady.

The number of available I N Ks depends on the screen modes selected. Each I N K can be set to a pair of colours ie flashing; or a single colour ie steady. The number of usable inks at any time depends on the screen mode as previously defined. The text P A P E R, text P E N, and graphics P E N can then be set to an available ink.

The text **writing can** be set to be translucent or opaque: ie it will either ignore the paper colour and overwrite the graphics, or completely overwrite the background.

## Windows

The user can select up to eight text windows into which characters are written, and also a graphics window into which plotting may be performed.

Windows are reset to defaults when the screen mode is set.

NB: If the text window is equivalent to the entire screen (default), then rapid rolling is achieved by hardware. If the text window is less than the available screen, then rolling is achieved by software, which is correspondingly slower.

## Cursor

The cursor is disabled during periods when the CPU is not requiring keyboard input, thus acting as an automatic prompt. The cursor is represented by an inverse square of colour.

## Polyphonic Sound

The sound facilities of the CPC464 are generated using the industry standard sound generator device from General Instrument's AY8910 family. The device operates with 3 channels (voices), each of which can be independently set for tone and amplitude. White noise may be added as required.

The three channels appear as left, right and centre (using the stereo extension jack). The internal loudspeaker produces a mixed monaural output.

The software provides envelope control facilities for amplitude and tone. The sound generator device's internal amplitude enveloping is normally not used.

## Printer Port

An industry standard Centronics compatible parallel printer port is provided, using the 'Busy' signal line for performing handshake operations.

## Expansion Support

Many hardware interfaces are available via jump blocks or indirection to provide software expansion facilities. AMSTRAD will be introducing, amongst other items, disc drives, serial interfaces with driver software in ROM etc.

## Coordinates

The text origin is the top left hand corner of the screen, and physical positions on the screen change with the screen mode.

The graphics origin is the bottom left hand corner, and assumes the screen is in High Resolution mode at all times -although calculations for inks will be performed correctly in all screen modes.

### NB

In normal screen mode, each pixel has TWO horizontal addresses, and either may be used. In **multicolour** mode, each pixel has FOUR horizontal addresses, and any of the four can be used to define the pixel position.

The vertical axis has co-ordinates from 0....**399** which are divided by two and truncated to give a physical position in the range 0....**199**. This ensures that expected aspect ratios are preserved on screen.

## Expansion ROMS

All ROMs occupy the top 16K of memory (where the the BASIC lives) and there are facilities in the firmware to call up to 240 additional 16K add-on ROMs (a certain amount of address decoding hardware must be employed externally to the base machine as part of the ROM expansion hardware.)

## Overview:

A brief summary of the main features of the hardware and firmware of the CPC464.

### 1) Hardware

1.1) Inside the main CPC464 case.

Computer, keyboard, cassette datacorder and loudspeaker. RGB and luminance outputs.

#### 1.1.1) LSI chips

**Z80A** processor running at **4MHz**.

64K bytes of 64K x 1 dynamic RAM refreshed by accesses to the screen memory.

32K bytes of ROM containing BASIC and the operating system (OS).

A custom logic array incorporates nearly all logic not already inside LSI chips; particularly timing, colour generation and DMA circuitry.

The 6845 CRT controller device generates scanning signals for the video RAM.

### NB

The mapping is intricate and changes with the screen mode. The CRTC can be used to perform scrolling (sideways by 1140 screen width) and rolling (up and down by 8 scan lines) if the software requires. Parameters within the CRTC select the number of lines, the frame rate, width and positioning of the borders.

GI sound generator chip AY-3-8912: 3 voices. Sound is taken from the three channels and mixed equally to produce a mono output on the integral loudspeaker, controlled by a volume control. There is also an external stereo output where . . . . .

Left = Channel A + 1/2 Channel C. Right = Channel B + 1/2 Channel C.

This chip also receives keyboard and joystick port scan information.

An 8255 parallel I/O device interfaces the bus to the GI sound chip. It also scans the keyboard, joystick port, option links and controls the cassette.

### 1.1.2) External sockets.

PCB edge connectors for general purpose expansion (12) and an external printer (12) (parallel, Centronics). Sockets for joystick (14) (9 pin D-Type), stereo sound output (15), video output (10) (RGB and sync or composite video or luminance and sync).

### 1.2) Outside the case.

The CPC464 system comes with a choice of two types of direct input video monitor, each includes a 5v power supply for the computer, designed to suit local mains voltage standards in the country of sale. In addition, there is an optional PSU and UHF TV modulator, the MP1.

Cables will be required to connect to a Centronics compatible printer and Hi-fi unit.

### 1.3) Display specification.

The screen operates from 16K of memory. The machine has a set of 27 colours which can be freely selected to form a palette. The number of inks on the palette depends on the screen mode. A number of inks can be set to the same colour if required. Pixels on the screen are defined as dots of a particular ink. (Note that the background, or paper, requires one ink from the available palette). There is a B0 R D E R surrounding the active picture area which can be independantly set to any of the 27 colours.

Mode	Number of Inks	Vert dots	Horiz dots	Horiz chars
Normal	4	200	320	40
High Res	2	200	640	80
Multi Colour	16	200	160	20

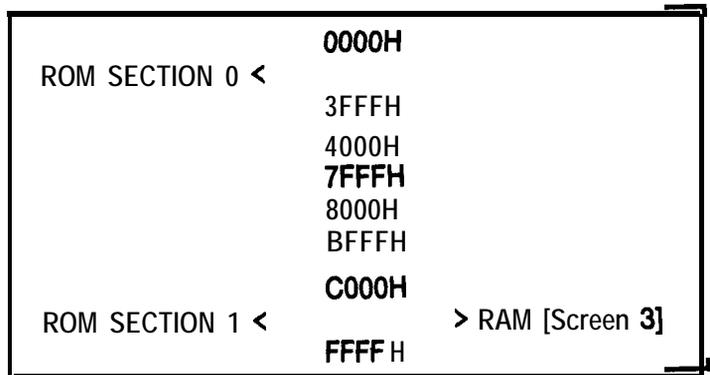
NB :The computer will produce a grey scale effect if viewed on a monochrome monitor. The order of colours in increasing brightness is as follows:-

GREY LEVEL	COLOUR	GREY LEVEL	COLOUR
0	<b>BLACK</b>	13	WHITE
1	BLUE	14	PASTEL BLUE
3	BRIGHT RED BLUE	15 16	ORANGE PINK
<b>4</b>	MAGENTA	17	PASTEL MAGENTA
<b>5</b>	MAUVE	18	BRIGHT GREEN
6	BRIGHT RED	19	SEA GREEN
7	PURPLE	20	BRIGHT CYAN
8	BRIGHT MAGENTA	21	LIME GREEN
9	GREEN	22	PASTEL GREEN
10	CYAN	23	PASTEL <b>CYAN</b>
11	SKY BLUE	24	BRIGHT YELLOW
12	YELLOW	25	PASTEL YELLOW
		26	BRIGHT WHITE

## 1.4) Memory Map

The 64K of RAM is allocated as follows.

**Note** that part of the ROM overlays the screen RAM, thereby releasing the maximum possible area to user RAM during BASIC operations.



When there is both RAM and ROM at an address, then READING accesses the ROM and WRITING accesses the RAM. Either ROM section can be turned off, allowing read access to the RAM at the same address.

## 1.5) Add-on ability

### 1.5.1) Sideways ROMS

Provision is made for additional ROMS to be selected in place of any part of the on-board ROM. The address arbitration and bank selection logic will be contained in a module connected to the expansion bus, but all the signals required are brought to the expansion bus.

### 1.5.2) Additional RAM

Additional RAM can be switched in place of any part of the on-board RAM. The address arbitration and bank selection logic will be contained in a module connected to the expansion bus, but all the signals required are brought to the expansion bus. This memory will be read-only and a special scheme involving I/O mapping will be required to write to this additional RAM from the computer.

### 1.5.3) Additional I/O

Most I/O port addresses are reserved by the computer, in particular addresses below **7Fxx** should not be used at all. The following can be used by external hardware.

#### **F8xx, F9xx, FАxx, FBxx**

Expansion bus peripherals must decode addresses on **A0** to **A7** whilst address **A10** is low. Expansion bus I/O channels in the address range **F800** to **FBFF** are reserved as follows:-

Addresses AO-A7

<b>00</b>	- <b>7B</b>	** Do not use . *
<b>7c</b>	- <b>7F</b>	Reserved for disk interface
<b>80</b>	- <b>BB</b>	** Do not use **
<b>BC</b>	- <b>BF</b>	Reserved for future use
<b>C0</b>	- <b>DB</b>	** Do not use . *
<b>DC</b>	- <b>DF</b>	Resewed for communications interfaces
<b>E0</b>	- <b>FF</b>	Available for user peripherals

Note that **Z80** instructions which place the B register on the upper half of the address bus (A1 **5-A8**) must be used.

## 2) Keyboard.

A full reset is operated by **[CTRL][SHIFT][ESC]** pressed together. Keys causing printing characters or cursor movement will auto-repeat under firmware control, excluding all keys on the numeric keypad..

**[ESC]** Suspends program execution. Followed by a further **[ESC]** terminates execution. Followed by any other character resumes program execution.

**[CAPS LOCK]** is a toggle, operated by the caps lock key. Shift lock is a toggle operated by **[CTRL][CAPS LOCK]** pressed together.

The copy cursor is detached from the input cursor by operating **[SHIFT]** together with the cursor keys. Input can be obtained from the character beneath the copy cursor by pressing the **[COPY]** key.

The cursor keys are intended to allow editing of the input buffer, which may spread over a number of screen lines. The cursor keys may be used to position the start of keyboard input to any screen position prior to any keyboard input being received. Once any keyboard input has been received then the screen position is fixed. The new input text will overwrite any existing content on the screen at that position.

**[DEL]** is a backwards delete and **[CLR]** is a forward delete.