"Arnold V" Specification

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1 PRODUCT RANGE OVERVIEW

This project provides a more sophisticated and stylish replacement for the existing CPC464 and CPC6128 computers. This has been achieved by:

- Redesigning the ASIC and main PCB to incorporate a number of new features
- Restyling the casework to provide a more modern appearance.

1.1 Common Features

The casework consists of a new two piece set of plastic mouldings. This contains a horizontally mounted, double-sided PCB assembly on which are mounted most of the electronics for the computer.

A small, vertically mounted, daughter PCB provides the connector for a ROM cartridge. Any size ROM cartridge from 16k x 8 up to 512k x 8 can be installed. The firmware, fitted to the main PCB on earlier CPC computers, is supplied instead in a ROM cartridge.

All expansion and peripheral device connectors are mounted on the main PCB. In addition to the connectors used on the existing CPC range, there are:

- Separate connectors for two joysticks, replacing the old daisy-chain arrangement. However, the daisy chain system can still be used on the Joystick 1 connector if required.
- An additional 15-way female D-type connector will provide four analogue input channels and access to the four existing "fire" buttons. This is pin compatible with the games control port on the PC200 (PC-8) computer.
- All PCB edge connectors have been replaced by types that are easier to screen against spurious RF emission. The printer connector is a 25-way female D type, as used on the PC1640 etc, and the expansion connector is a 50-way Delta (Centronics style) type, as used for the earlier CPC range in Germany.
- The 6128's TAPE socket will be replaced by a 6 pin RJ-11 type for the light gun.

The computer provides stereo sound via additional pins on the monitor connector, as well as from the stereo sound socket.

All existing CPC electrical features are provided, plus some new features. There is complete backward compatibility except that:

- The border colour is undefined at power-on reset
- The new 6128 version has no tape socket

The following new features become available once a software "lock" has been opened, thus preventing existing CPC software from accidentally invoking them:

- 16 Sprites, each consisting of 16x16 high resolution pixels, in fifteen colours separate from the main screen colours. Each sprite can be magnified in X or Y, moved around the screen, and turned on or off independent of the main screen. Sprite pixels can be transparent, and sprites have a fixed order of priority (i.e. "depth"), so that they can pass in front of each other, in front of the main

screen, and behind the border.

- The colour palette has been extended to allow simultaneous display of up to 32 colours (16 main + 15 sprite + border) from a palette of 4096, rather than the previous 17 from 27.
- Additional screen controls have been added, to allow split-screen operation and smooth scrolling to be used.
- An automated sound generation process allows generation of more complex sound effects with greatly reduced software overhead.
- Some other internal features to ease implementation of better games software, described in the technical specification section.

The functions of display monitor and power supply are provided by either:

- A restyled range of monitors, consisting of a white tube monochrome monitor MM12 and an improved colour monitor CM14.
- An MP2-style modulator/power supply unit.
- A Peritel adaptor/power supply unit.

The old CPC6128 keyboard is used, except that the colour scheme has been changed and the connecting cable exits in a different location.

1.2 Amstrad 464 Plus

This variant has an integral cassette tape drive, and 64k bytes of dynamic RAM. It is supplied with a ROM cartridge containing the system firmware plus the BASIC language, disk firmware and a game, although it is not possible to select the disk firmware.

1.3 Amstrad 6128 Plus

This variant has an integral 3" floppy disk drive (5V) plus a 36-way Delta (Centronics style) expansion socket allowing a second 3" drive to be added. The 6128 Plus is to be supplied with a ROM cartridge containing the system firmware plus the BASIC language, disk firmware and a game. 128k bytes of dynamic RAM are fitted to the main PCB.

1.4 Further Variants

Unlike the existing CPC range, the size of dynamic RAM and whether or not a disk drive is installed are separately configurable options. It is therefore possible to produce a "4128" (128k diskless) or "664" (64k with disk) variant. Also, it is possible to increase the number of analogue input channels to eight.

2 TECHNICAL SPECIFICATION

The technical specification is essentially similar to the earlier CPC 464/6128 range, with some enhancements. This specification should therefore be read in conjunction the "Amstrad CPC 6128 Software Interface Spec" Issue 2, 17th February 1985. New features have been added by changes to the ASIC and main PCB circuitry.

The overriding concern in the specification of this new product range has been the need for total backward compatibility with the existing CPC range. Many of the new features within the ASIC employ new registers, which can be mapped to replace the page of RAM from 4000 to 7FFFh in the CPU memory map, by setting a bit pattern in an I/O port. Before this port is allowed to "exist", a deliberately obscure I/O sequence is needed. This mechanism protects existing CPC range software from accidents such as killing its own RAM page.

The following new features are provided by changes to the ASIC and the main PCB electronics:

2.1 Hardware Sprites

Sixteen hardware sprites are to be provided by the ASIC.

Each consists of an array of 16x16 pixels of four bits per pixel. A sprite pixel will be "transparent" when it has a value of zero, thus allowing 15 sprite colours. The sprite pixel data exists in memory mapped registers within the ASIC, from address 4000h. The lower four bits of each byte will contain the data for a single pixel. The first 16 bytes contain the data for the upper scan line, starting at the top left hand corner of the sprite. 15 more similar scan lines of 16 pixels each follow, thus each 256 (0100h) byte block of register space contains one sprite. When the data for a sprite is read or written, that sprite is removed from the display for the duration of the access. Thus sprite data should only be accessed during retraced time or while the raster is scanning somewhere else, otherwise there is a risk of disruption of the display.

The position on screen of the upper left corner of each sprite, and the X and Y magnification, are defined by five registers for each sprite:

A2	A1	A0	
0	0	0	X position LSB
0	0	1	X position MSB
0	1	0	Y position (scan line) LSB
0	1	1	Y position MSB
1	0	0	bits 3,2 = X magnification, bits 1,0 = Y magnification

The position registers are read/write, and accept numbers in two's complement form. They should only be changed during retrace or when a sprite is off. Data written to these registers should be between +767 and -256 for X, and between +255 and -256 for Y, otherwise the sprites will appear in strange positions. With standard 6845 timing (64us scan lines, 200 visible lines), "on screen" positions at maximum sprite magnification are -64 to +639 in x and -63 to +199 in y. A sprite will not be displayed if either the vertical or the horizontal positions outside the on screen range. The magnification registers are cleared to zero at reset, and are write only. They are coded as:

0	0	Sprite not displayed
0	1	Magnification x1
1	0	Magnification x2
1	1	Magnification x4

The sprite control registers exist on 8-byte boundaries from addresses 6000 to 607Fh for sprites 0 to 15 respectively.

All sprite characteristics are independent of the main screen mode, the unmagnified pixel size being as for screen mode 2 (640x200). Sprite colours are defined by fifteen entries in the colour palette (see section 2.2 below). Thus sprites can be in different colours and resolutions from the rest of the screen. Sprites may overlay with each other or the border, and are prioritized so that the border has the highest priority, followed by sprites 0 to 15 in sequence, then the main screen data. Thus sprites always appear "in front

of" the main screen and "behind" the border.

2.2 Colour palette

The earlier colour palette within the ASIC, which selects 17 of 27 possible colours, has been replaced by a new palette which selects 32 of 4096 colours. This can be accessed through two ports. The primary port provides full access via 32 registers of 12 bits, i.e. 4 bits each for red, green and blue.

For compatibility with existing models a secondary port provides access to the first 17 registers only (i.e. main screen colours and border), via the existing 5 bit interface. A block of logic maps the five bit colour written to the palette at the address selected by the "palette pointer register".

The primary palette port is between addresses 6400 and 643Fh, each pair of bytes representing one entry in the palette. The most significant byte will contain the GREEN information in the lower nibble (D3-D0), and the other byte contains RED (D7-D4) and BLUE (D3-D0).

This ordering of colours has been selected to give the most consistent grey scale possible on a monochrome display (green is brighter than red, which is brighter than blue). However, because of the need to retain compatibility with the existing 27 level grey scale, the colours are summed with a 9:3:1 weighting rather than the 256:16:1 weighting which would be required to make the 12 bit word fully monotonic.

The primary palette registers appear in RAM low byte first, so that they can be loaded via a single 16-bit LD instruction, e.g. LD (6400h),0F00h would set the main colour zero to bright green. The palette is dual ported so that there are no restrictions on when it can be accessed.

The primary port palette registers are:

6400-641Fh	main screen colours 0 to 15
6420-6421h	border colour
6422-643Fh	sprite colours 1 to 15

The secondary port registers are:

00-0F	main screen colours 0 to 15
10-1F	border colour

2.3 Split Screen facility

Three new memory mapped registers have been added within the ASIC, to provided a horizontally split screen facility. One at address 6801h defines the scan line after which the screen split occurs. A value of zero (as at power on reset) will turn this feature off.

The other register pair at 6802h and 6803h define the start address in memory (similar to R12 and R13 respectively in the 6845, and therefore high byte first) which represents the location in memory from which to start displaying data for the lower screen. This allows the lower part of the picture to come from a separate memory area, and be separately scrolled. However, note that soft scrolling (Section 2.5 below) will act on the whole screen.

Note that care should be taken with programming this facility such that the screen split does not alter the function of address bits A1-A8 and the dynamic memory refresh is not upset. This can be accomplished by setting the start of the second screen to lie on a 16k boundary. The value in register pair 6802h/6803h is the first displayed line, and not the start address of the 16k block.

Also, during vertical retrace, the value in register 6801h should not be set to 257 less the total number of scan lines on the screen. With a normal screen of 312 scan lines, the value 312 - 257 = 55, or 37h should not be programmed unless (1) the vertical total adjust register is set to 1 while 6801h contains 37h, or (2) the raster interrupt (see 2.4 below) should be used such that 6801h contains 0 during vertical retrace.

2.4 Programmable raster interrupt

A new 8 bit memory mapped register (PRI) has been added within the ASIC at address 6800h, which is cleared at power up. If zero, the normal raster interrupt mechanism functions as before. Otherwise, an interrupt occurs instead at the end of the scan line specified. The PRI can be reprogrammed as required to produce multiple interrupts per frame. See section 2.7 below for general information on interrupts.

2.5 Soft scroll facility

A memory mapped 8 bit soft scroll control register (SSCR) has been added within the ASIC at 6804h, to allow scrolling of the screen by pixels rather than just by characters as at present. It is cleared at reset.

This soft scrolling mechanism affects the whole of the main screen, regardless of the split screen facility, but it does not affect sprites.

The lower four bits (D3-D0) of the SSCR define a horizontal delay of between 0 and 15 bits i.e. high resolution (mode 2) pixels. This shifts the screen image to the right by the value programmed, "losing" pixels behind the right border and instead displaying random data on the left. It is left to the programmer to ensure that the delay value is always a multiple of the number of bits per pixel.

The next three bits (D6-D4) will be added to the least significant three bits of the scan line address, thus determining which of the eight 2k blocks contains the data for the first scan line on the screen. The effect of this is to shift the display up by the number of scan lines programmed, "losing" what would otherwise be the first lines to be displayed, and instead appending extra lines to the bottom of the screen.

The most significant bit (D7), when set, causes the border to extend over the first two bytes (16 high resolution pixels) of each scan line, masking out the bad data caused by the horizontal soft scroll. Software which intends to use horizontal soft scroll should have this bit always set, so that the screen width does not keep changing.

Setting the SSCR to zero, as at reset, (i.e. no offsets, normal border), will of course effectively disable the soft scroll.

2.6 Automatic feeding of sound generator

An automated process has been added to feed data to the sound generator from three instruction streams in main RAM without CPU intervention. Three separate channels each fetch one 16-bit instruction during horizontal retrace time. These instructions must be in usual Z-80 format, i.e. least significant bit first, and must be aligned to word boundaries (i.e. address of first byte must be even). Once the three instructions have been captured, they are then executed sequentially. The maximum achievable update rate to the PSG is thus equal to the horizontal scan rate of 15.625 kHz per channel.

The available commands are:

0RDDh	LOAD R,D	Load 8 bit data D to PSG register R (0<=R<=15)
1NNNh	PAUSE N	Pause for N prescaled ticks (0<N<=4095)
2NNNh	REPEAT N	Set loop counter to N for this stream (0<N<=4095), and mark next instruction as loop start.
3xxxh	(reserved)	Do not use
4000h	NOP	No operation (64us idle)
4001h	LOOP	If loop counter non zero, loop back to the first instruction after REPEAT instruction and decrement loop counter.
4010h	INT	Interrupt the CPU (see section 2.7 below)
4020h	STOP	Stop processing the sound list.

Note that:

1. REPEAT Loops cannot be nested. Only one is allowed to be active per instruction stream at any time.
2. REPEAT 0 and PAUSE 0 instructions will have no effect, i.e. they are equivalent to NOP.
3. Control group (4xxxh) instructions can be logically ORed to produce more complex instructions, e.g. INT|STOP = 4030h = Interrupt and stop.
4. The STOP instruction will leave the source address register pointing to the next instruction, so that the instruction stream can be continued after CPU intervention.
5. The argument field (N) of the REPEAT instruction is actually the number of times the loop is taken. The block of code between REPEAT and LOOP instructions is therefore executed N+1 times.

A DMA control and status register (DCSR) controls which channels are currently enabled, and also tell the CPU which channel is interrupting.

The channel enable bits in this register enable each "DMA" channel separately, and can be set by the CPU, and cleared by either the CPU, a STOP instruction, or power on reset. The interrupt bits are set when a channel is requesting an interrupt, and cleared when the CPU writes a "1" to the appropriate bit.

The control and status register bits are:

D7	R	Raster interrupt (see 2.7 below)
D6	R/W	Channel 0 interrupt
D5	R/W	Channel 1 interrupt
D4	R/W	Channel 2 interrupt
D3		Unused (write 0)
D2	R/W	Channel 2 enable
D1	R/W	Channel 1 enable
D0	R/W	Channel 0 enable

Each channel has a 16 bit source address register (SAR) and an 8 bit pause prescaler register (PPR). These are memory mapped, from address 6C00h, as follows:

6C00h	Channel 0 address, LSB
6C01h	Channel 0 address, MSB
6C02h	Channel 0 prescaler
6C03h	unused
6C04-6C07h	Channel 1, as above
6C08-6C0Bh	Channel 2, as above
6C0Fh	Control and Status register

The SAR must be loaded by the CPU with a physical RAM address between 0000h and FFFEh. This means that the most significant two bits select which pages 0 to 3 of the DRAM is used, and the remaining bits are the address relative to the page start. The DMA process is not affected by the RAM or ROM mapping registers, and will always fetch data from RAM and not ROM. Note that the least significant bit of the address is ignored, and the instructions are always fetched from word boundaries.

The pause prescaler counts N+1 scan lines (where N is the value written by the CPU), giving a minimum tick of 64us, and a maximum of 16.384ms. When set nonzero by a PAUSE instruction, the pause counter for a particular channel is decremented every tick until it reaches zero. Therefore, if the PPR is set to a value N and a PAUSE M instruction is executed, the total delay time between the instruction before the PAUSE and that following the PAUSE will be M * (N+1) * 64us. Pauses of between 64us and 67s may thus be generated.

The ASIC arbitrates accesses to the parallel interface device between the "DMA" channels and the CPU, allowing only one to access it at a time. CPU accesses to the 8255 could be held off by means of wait states for up to a 8 microseconds if the "DMA" channel is currently executing a LOAD instruction. After a LOAD is executed, the ASIC must put the PSG address register back as it was before. To achieve this the 8255 parallel peripheral interface and the 74LS145 decoder have been integrated into the ASIC.

The exact timing is based on 1us cycles as follows. After the leading edge of HSYNC from the 6845, there is one dead cycle followed by an instruction fetch cycle for each channel which is active (i.e. enabled and not paused). The execute cycles then follow for each active channel. All instructions execute in one cycle, except that LOAD requires at least 8 cycles. An extra cycle is added to a LOAD if the CPU is accessing the 8255, or two extra cycles if the CPU access was itself a PSG register write.

2.7 Interrupt Service

The ASIC will produce interrupts from four sources: the raster interrupt and the three sound generator "DMA" channels.

Bit D7 is set if the last interrupt acknowledge cycle was for a raster interrupt. Bits D6-D4 of the DCSR are set if interrupts from sound channels 0 to 2 respectively are active. For compatibility with earlier models, the raster interrupt is reset either by a CPU interrupt acknowledge cycle, or by writing a 1 to bit D4 of the mode and ROM enable register. The sound channel interrupts are cleared by writing a 1 to the relevant bit in the DCSR.

Thus interrupt service software in an environment where DMA interrupts are used must inspect these bits, giving highest priority to the raster interrupt, because this interrupt is always cleared automatically.

Failure to observe this requirement may result in raster interrupts being missed. DMA interrupts must be acknowledged by writing a "1" to the relevant DCSR bit.

2.8 Enhanced ROM cartridge support

Previously, 32k of firmware ROM existed in two 16k blocks. The low block was at addresses 0000 to 3FFFh, and the high block at C000 to FFFFh. Expansion ROMs were mapped into C000 to FFFFh by writing a code to I/O address DFxxh. The disk ROM was code 0 or 7, depending on the state of an expansion signal.

The new Arnold V range has no on board ROM, but instead has a cartridge slot which can support ROM cartridges of up to 4Mbits (512k bytes, or 32 pages of 16k bytes). This means that cartridge games cannot be copied, because there is no firmware available when the game is installed. However, any software house producing a game where the intermediate state of play or high score table can be saved must produce their own driver software.

The upper 5 ROM cartridge address lines are controlled by the ASIC via the existing ROM mapping port (at DFxxh), and hence define which of the 32 pages are mapped to the upper ROM block (C000 to FFFFh). The machine is supplied with a ROM cartridge containing the firmware and BASIC, and, where applicable, the disk ROM.

For values less than 128 written to the mapping port, the "BASIC" page of the cartridge is always selected at the high ROM block address, unless the value last written to the mapping port matches the current disk ROM code (i.e. either 0 or 7), in which case the "Disk" page is selected. For values greater than 127, the lower 5 bits set the cartridge ROM page number directly, so that the cartridge may be addressed at pages 128-159 (80-9Fh).

The earlier expansion ROM mapping scheme uses port DFxxh and ROMDIS on the expansion bus, still functions. The only change is that ROMDIS can now disable the disk ROM, and selecting the disk ROM does not cause ROMDIS to be activated. An expansion card ROM mapped at any page takes priority over the same page number in the cartridge.

In addition, new bits are defined in the mode and ROM enable (MRER) register at I/O address 7Fxxh. Previously, D7 = 1 and D6 = 0 to select this register, and D5 should be 0. This has been modified such that, if this register is written with D5 = 1, the bottom five bits are redefined. This new register is known as the secondary ROM mapping register (RMR2). D4 and D3 control the address of the low bank, and also whether the memory mapped register page is enabled at 4000 to 7FFFh.

D4	D3	
0	0	Low bank ROM = 0000 to 3FFFh, register page off
0	1	Low bank ROM = 4000 to 7FFFh, register page off
1	0	Low bank ROM = 8000 to BFFFh, register page off
1	1	Low bank ROM = 0000 to 3FFFh, register page on

D2 to D0 determine which of the lower 8 pages of the cartridge ROM appear at the low bank address. The default is page 0.

The logical (as seen by the CPU) to physical (as appears on the upper five cartridge address lines) page translation scheme is thus:

Low bank:	Logical page (RMR2)	Physical page

	0-7	0-7

	Logical page (DFxxh)	Physical page
High Bank:	0-127 (not disc page)	1
	0 or 7 (disc page)	3
	128-255	0-31

This means that any of the first eight pages of cartridge ROM can be pages to either 0000, 4000, or 8000h, while any of the 32 cartridge pages can simultaneously appear at C000h.

The two ROM disable bits in the existing mode and ROM enable register disable the ROM as before, wherever it is mapped, as will the ROMDIS signal from the expansion bus.

The "write through" mechanism, whereby writes to an area which is currently mapped as ROM actually write to the underlying RAM, still functions, wherever the ROM is mapped. However, the write through mechanism cannot be used to access the register page. Write through also does not operate to the RAM from the register page.

2.9 Analogue paddle ports

The ASIC includes the logic for an octal A/D converter, in conjunction with an external R-2R network, comparator and analogue multiplexer. Eight analogue input channels are thus available on the PCB, of which only four have connectors. This allows support for four paddles or two joysticks, with capacity for twice this many without redesigning the ASIC. The A/D is 6 bits wide, to give sufficient resolution after calibrating joysticks. It appears to the software as a bank of eight, 6 bit, read-only registers from 6808h to 680Fh, known as ADC0-7. They are updated approximately 200 times per second. The A/D inputs have an input range of 0V (data = 00) to 2.5V (data = 3Fh), and an input impedance of 180k to Vcc.

2.10 PAL subcarrier locking

The main oscillator for the ASIC is 40MHz. A divide by 9 output at 4.444MHz is provided with a 5:4 mark/space ratio. It is possible to change the main crystal to 9 x 4.33619MHz = 39.902571 MHz, slowing the whole system by 0.25%. This may or may not upset the disk drives, but even if this is the case, a diskless unit could provide PAL subcarrier frequency locked to the master oscillator, thus improving the picture quality.

2.11 Locking of enhanced features

The ASIC contains a locking mechanism, whereby the enhanced features are not available until the software has performed an obscure sequence of I/O instructions to the ASIC. This prevents any existing software from having nasty accidents on the new hardware.

The lock is operated by writing a series of bytes to the 6845 address register at address BCxxh. The lock must first be synchronised by writing first a non zero byte value then a zero. The following sequence must then be written:

FF,77,B3,51,A8,D4,62,39,9C,46,2B,15,8A,CD,EE

The lock will then be picked. If it required to lock it again, the same sequence must be followed but without the terminating "EE".

However, it should be noted that unauthorised use of this mechanism may infringe Amstrad's patent .

When the lock is "locked", the secondary ROM mapping register does not exist (see Section 2.6). It is therefore impossible to select (or to deselect) the memory mapped register page.

2.12 Eight bit printer support

The ASIC can provide support for eight bit printers. If a link on the PCB is made, the most significant printer port bit will be controlled by bit 3 in register 12 (decimal) of the 6845, i.e. bit 11 of the start address register. If the link is not made, the most significant printer port bit will always be low.

2.13 Floppy disc data separator

Because of timescale pressures, the data separator design in the ASIC has been deleted rather than improved . Thus all models with a disk drive use an external SED9420 data separator.

2.14 Power requirements

The Arnold V range is a 5V only design. Power requirements are:

Amstrad 464 Plus:	MIN	MAX	UNIT
Main PCB	700	1300	mA
Cassette unit	TBD	TBD	mA
Total consumption	TBD	TBD	mA

Amstrad 6128 Plus:	MIN	MAX	UNIT
Main PCB	700	1300	mA
Disk Drive Unit	500	1100	mA
Total consumption	1200	2400	mA

3 SOFTWARE SPECIFICATION

The computers are shipped with a cartridge fitted in the cartridge slot. Disk based software is supplied with the 6128 Plus by Amstrad. There will be no welcome tape or disk.

3.1 6128

1M ROM cartridge (i.e. 128k x 8) Combined firmware, BASIC and Disk ROM, incorporating free game:

Page 0:	Firmware
Page 1:	BASIC
Page 2:	Game

One 3" disk with CP/M Plus and utilities only.

3.2 464

1M ROM cartridge as for 6128.

4 MECHANICAL SPECIFICATION

Both models in the new Arnold V range will share a common plastic cabinet. This will be a two-piece design, i.e. upper and lower cabinet halves. The name Amstrad will be moulded in to the top cabinet.

The different variants will be handled by breakout sections or tool inserts as necessary. The 464 version will have the model name "464 Plus" moulded into the cassette door, and the "6128" version will have the model name "6128 Plus" moulded into the upper casework above the disk drive, in the area of plastic which does not exist for the 464 version.

The monitors will have international symbols for brightness, contrast, volume and vertical hold. Apart from these items, there will be no moulded lettering, and moving cores must be kept to a minimum. The casework will provide both aesthetic and structural functions. Other moulded parts will be needed for the ROM cartridge, cartridge slot, cassette door, and the power switch. These should be in the same material and the same colour as the main casework mouldings.

The power switch will be connected to a "bolt" which engages in the side of the ROM cartridge when the power is on, so that the cartridge cannot be inserted or withdrawn while power is applied to the machine.

The main PCB, disk drive (6128) and cassette mechanism (464) will be mounted to the lower cabinet.

Ideally, the keyboard should be similarly mounted on the lower cabinet, to improve serviceability, as should as many minor components as possible. A slimmer cassette mechanism must be used, to keep the height of the computer low. The cassette mechanism electronics will be mounted below the cassette deck, as with the old version.

5 DISPLAY DEVICES

With the CPC range, the display device, i.e. Monitor, Modulator/power supply, or peritel adaptor also supplies power to the computer. In view of the fact that RFI prevention will be important in Europe after 1992, all display devices should be to Class 1 construction, i.e. earthed, so that it is easier to prevent the computer radiating, and should themselves be designed to meet the RFI standard EN55022 (CISPR 22).

The monitors should operate off both 220V and 240V supplies without modification.

The relevant safety standard for this product is BS415 (IEC65).

5.1 Monitors

The new Arnold V range will always be sold with a monitor.

The existing GTM65 and CTM640 monitors have been restyled in the same colour as the main cabinet.

The monitor rear cabinet material must be to BS415 Clause 20.2

The MM12 monochrome incorporates a 12" paper white tube, similar to that used on the PCW9512.

The input will be the same as the earlier GTM65 versions, i.e. impedance 470 ohms to 0V, analogue voltage input which is linear between 0.8V (Black) and 1.75V (Peak white).

The CM14 colour monitor needs to handle a sixteen level input on each of RGB. The new monitor must present an input impedance of 100 ohms to 0V, and accept an analogue input current of 0-10mA for each gun. The levels shall be defined such that 0mA is black and 10mA is full on. The response must be linear between these limits.

The monitors also incorporate stereo speakers, amplifiers, and a volume control. There is no 12V D.C. output.

5.2 Modulator/Power Supply units

The existing MP2 can be used with the new Arnold V range. However, it would be better to produce a new version following the RFI guidelines at the start of this section, and preferably including a sound modulator.

The input circuit of the Peritel adaptor will probably need to be redesigned to handle the new analogue video signals. It should also have the sound channels added.

6 NATIONAL VARIANTS

The existing national variants of the ROM (i.e. UK, France, Spain) will continue to be supported, but no others will be added. Steps should be taken to limit the amount of national variation to that which really is necessary. There should be no need to make any changes for approvals reasons, except to power supply input voltages and mains connectors.

There will be different versions of the keyboard, instruction book, and disk, as well as the ROM cartridge. It is thus possible to change between, variants without dismantling the computer.

7 PACKING LIST

The following items should be included in the computer carton:

- Polystyrene foam packing pieces
- The Amstrad 464 Plus or 6128 Plus unit, with ROM cartridge installed.
- A PD-1 Games Paddle
- The instruction book

The following should be included in the monitor carton:

- Polystyrene foam packing pieces
- The MM12 or CM14 monitor

APPENDIX I

New Register Map

The new register page, from 4000h to 7FFFh appears as follows:

ADDR	SIZE	POR	TYPE	MNEM	USE
4000h	100H	N	R/W		Sprite 0 image data
4100h	100h	N	R/W		Sprite 1 image data
‖	‖	‖	‖	‖	‖
4F00h	100h	N	R/W		Sprite 15 image data
5000h					(unused)
6000h	2	N	R/W	X0	Sprite 0 X position
6002h	2	N	R/W	Y0	Sprite 0 Y position
6004h	1	Y	W	M0	Sprite 0 magnification
6005h	3				(unused)
6008h	2	N	R/W	X1	Sprite 1 X position
600Ah	2	N	R/W	Y1	Sprite 1 Y position
600Ch	1	Y	W	M1	Sprite 1 magnification
600Dh	3				(unused)
‖	‖	‖	‖	‖	‖
6078h	2	N	R/W	X15	Sprite 15 X position
607Ah	2	N	R/W	Y15	Sprite 15 Y position
607Ch	1	N	W	M15	Sprite 15 magnification
607Dh	3				(unused)
6080h					(unused)
6400h	2	N	R/W		Colour palette, pen 0
6402h	2	N	R/W		Colour palette, pen 1
‖	‖	‖	‖	‖	‖
641Eh	2	N	R/W		Colour palette, pen 15
6420h	2	N	R/W		Colour palette, border
6422h	2	N	R/W		Colour palette, sprite colour 1
6424h	2	N	R/W		Colour palette, sprite colour 2
‖	‖	‖	‖	‖	‖
643Eh	2	N	R/W		Colour palette, sprite colour 15
6440h					(unused)
6800h	1	Y	W	PRI	Programmable raster interrupt scan line
6801h	1	Y	W	SPLT	Screen split scan line
6802h	2	N	W	SSA	Screen split secondary start address
6804h	1	Y	W	SSCR	Soft scroll control register
6805h					(unused)
6806h					(unused)
6808h	1		R	ADC0	Analogue input channel 0
6809h	1		R	ADC1	Analogue input channel 1
680Ah	1		R	ADC2	Analogue input channel 2
680Bh	1		R	ADC3	Analogue input channel 3

680Ch	1		R	ADC4	Analogue input channel 4
680Dh	1		R	ADC5	Analogue input channel 5
680Eh	1		R	ADC6	Analogue input channel 6
680Fh	1		R	ADC7	Analogue input channel 7
6810h					(unused)
6C00h	2	N	W	SAR0	"DMA" channel 0 address pointer
6C02h	1	N	W	PPR0	"DMA" channel 0 pause prescaler
6C03h	1				(unused)
6C04h	2	N	W	SAR1	"DMA" channel 1 address pointer
6C06h	1	N	W	PPR1	"DMA" channel 1 pause prescaler
6C07h	1				(unused)
6C08h	2	N	W	SAR2	"DMA" channel 2 address pointer
6C0Ah	1	N	W	PPR2	"DMA" channel 2 pause prescaler
6C0Bh	4				(unused)
6C0Fh	1	Y	R/W	DCSR	"DMA" control/status register

Registers in I/O space are generally identical to earlier CPC464/6128 versions, except as follows:

ADDR	DATA	POR	TYPE	MNEM	USE
7Fxxh	00xxxxxx	N	W		Palette pointer register
7Fxxh	01xxxxxx	N	W		Palette memory
7Fxxh	100xxxxx	Y	W	MRER	Mode and ROM enable register
7Fxxh	101xxxxx	Y	W	RMR2	Secondary ROM mapping register
7Fxxh	11xxxxxx	Y	W		Memory mapping register (RAM)
DFxxh	xxxxxxxx	Y	W		Expansion/Cartridge ROM select

Note that RMR2 can only be accessed when the new feature lock (Section 2.11 above) has been "opened". Otherwise, MRER exists in its place.

POR column indicates whether a register has power on reset. A "N" indicates that the contents of a register will be undefined at power on.

APPENDIX II

Connector pinouts

From front of left hand side rearwards, then along the rear panel towards the right, the connectors will be:

SOUND:	3.5mm stereo jack
1 (Shield)	GND
2 (Tip)	L Sound

3 (Ring)	R Sound

JOYSTICK 1:	9 way male D. Joystick 2 can be daisy chained		
1	Up	6	Fire 2
2	Down	7	Fire 1
3	Left	8	Common
4	Right	9	Common (joystick 2)
5	N.C.		

JOYSTICK 2:	9 way male D.		
1	Up	6	Fire 2
2	Down	7	Fire 1
3	Left	8	Common
4	Right	9	N.C.
5	N.C.		

ANALOGUE:	15 way female D		
1	GND (Pot common)	9	GND (Pot common)
2	Fire 1	10	Fire 1
3	X1	11	X2
4	COM1 (switches)	12	COM2 (switches)
5	+5V	13	Y2
6	Y1	14	Fire 2
7	Fire 2	15	GND (Pot common)
8	GND (Pot common)		

AUX:	6 pin RJ-11 type
1	+5V
2	Common

3	LPEN
4	Fire 2
5	Fire 1
6	GND

PRINTER:	25 way female D		
1	*Strobe	14	
2	D0	15	
3	D1	16	+5V
4	D2	17	GND
5	D3	18	GND
6	D4	19	GND
7	D5	20	GND
8	D6	21	GND
9	D7	22	GND
10		23	GND
11	BUSY	24	GND
12		25	GND
13			

EXPANSION:	50 way Delta range.		
1	Sound	2	GND
3	A15	4	A14
5	A13	6	A12
7	A11	8	A10
9	A9	10	A8
11	A7	12	A6
13	A5	14	A4
15	A3	16	A2
17	A1	18	A0
19	D7	20	D6
21	D5	22	D4
23	D3	24	D2
25	D1	26	D0
27	VCC	28	*MREQ

29	*M1	30	*RFSH
31	*IORQ	32	*RD
33	*WR	34	*HALT
35	*INT	36	*NMI
37	*BUSRQ	38	*BUSAK
39	READY	40	*BRST
41	*RSET	42	*ROMEN
43	ROMDIS	44	*RAMRD
45	RAMDIS	46	CURSOR
47	LPEN	48	*EXP
49	GND	50	CLK4

5 V DC:	6mm power
Centre	+5V
Outer	GND

MONITOR:	8 way DIN type A (45326)
1	*Sync
2	Green
3	Lum
4	Red
5	Blue
6	L Sound
7	R Sound
8	GND

SECOND DRIVE:	36 way Delta range (6128 only)		
1	N.C. (Disk change)	2	GND
3		4	GND
5		6	GND
7	Index	8	GND

9	N.C. (Drive 0 select)	10	GND
11	Drive 1 Select	12	GND
13		14	GND
15	Motor On	16	GND
17	Direction Select	18	GND
19	Step	20	GND
21	Write Data	22	GND
23	Write Gate	24	GND
25	Track 0	26	GND
27	Write Protect	28	GND
29	Read Data	30	GND
31	Side 1 Select	32	GND
33	Ready	34	GND
35	N.C.	36	GND

The internal connectors will be:

TAPE PORT:	8 way 0.1" pitch connector (464 only)
1	+5V
2	GND
3	+5V
4	Write Data
5	Read Data
6	+5V
7	Sound
8	*Motor on

DISK POWER:	4 x 0.1" pitch high current PCB header (6128 only)
1	+5V
2	GND
3	GND
4	N.C.

INTERNAL DRIVE:	26 way 0.1" pitch ribbon cable connector (6128 only)		
1	GND	2	Index
3	GND	4	Drive 0 Select
5	GND	6	N.C. (Drive 1 Select)
7	GND	8	Motor On
9	GND	10	Direction Select
11	GND	12	Step
13	GND	14	Write Data
15	GND	16	Write Gate
17	GND	18	Track 0
19	GND	20	Write Protect
21	GND	22	Read Data
23	GND	24	Side 1 Select
25	GND	26	Ready

KEYBOARD:	2 pcs 10 way 0.1" pitch socket for flexible PCB		
1	N.C.	1	Y1
2	X1	2	Y2
3	X2	3	Y3
4	X3	4	Y4
5	X4	5	Y5
6	X5	6	Y6
7	X6	7	Y7
8	X7	8	Y8
9	X8	9	Y9
10	N.C.	10	Y10

POWER SWITCH:	2 pin 0.1" pitch header
1	Input from PSU
2	+5V to Computer

POWER ON LED:	2 pin 0.1" pitch header
1	LED Anode
2	GND

ROM CARTRIDGE:	2 pcs 2 x 9 way 2.5mm pitch sockets.						
1a	A10	2a	A2	1b	+5V	2b	+5V
3a	*CE	4a	A1	3b	CLK	4b	CA18
5a	D7	6a	A0	5b	CA16	6b	CA17
7a	D6	8a	D0	7b	CA15	8b	CA14
9a	D5	10a	D1	9b	A12	10b	A13
11a	D4	12a	D2	11b	A7	12b	A8
13a	D3	14a	SIN	13b	A9	14b	A9
15a	CCLR	16a	GND	15b	A5	16b	A11
17a	GND	18a	GND	17b	A4	18b	A3

This document was originally transcribed by Rob Scott and Paul Fairman. It was converted into HTML by Kevin Thacker.