IMAGINARY EARLY COMPUTERS

VX02

PERSONAL COLOR
COMPUTER SYSTEM

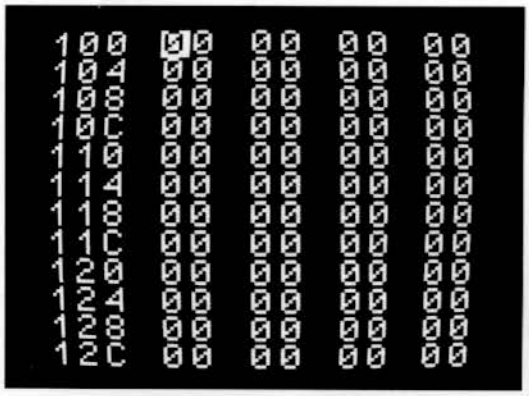
OPERATION MANUAL

1. SPECIFICATIONS

- Modern, and powerful (8-bit) MOS 6502 microprocessor
- 1 MHz processor clock (effectively 0.73 MHz when display enabled)
- 0.5 KB (512 bytes) of Random Access Memory (RAM)
- 256 bytes of Read-Only Memory (ROM)
- 16x12 characters display matrix
- 32x24 block graphics
- ROM character generator, 64 alpha-numerical characters and symbols
- Inverse function
- 6 colors (or 4 shades of grey on a black&white TV)
- Up to three colors or shades can be displayed simultaneously
- Software synchronization to TV vertical refresh
- Compatible with PAL (50 Hz) and NTSC (60 Hz) TV standard
- Controller stick (purchased separately, 9-pin D-connector)

2. HEX MONITOR

Vx02 does not require a keyboard. Also, there is no need for a peripheral mass storage device of any type: You can easily re-enter the program code every time you power up the computer, just by using the advanced Hex Monitor (which comes in system ROM and starts automatically, for your convenience) and the Controller Stick - it's really easy, fast and fun!



Tilt the Controller Stick left and right to move the cursor on screen. Pull back or push forward to edit the hexadecimal value under cursor.

When you have entered the entire program, just push down the Controller Stick button and your Vx02 will execute the program starting at memory address 0x100 (hexadecimal). See the appendices for example programs or start writing your own. Who knows, in the future you could even make a lucrative career as a professional programmer!

TIP: If you accidentally start an unfinished program your computer may crash. It's good practice to keep the value at 0x100 zero until the rest of the program is entered. MOS 6502 sees zero as the opcode BRK, which stops program execution and jumps back to Hex Monitor.

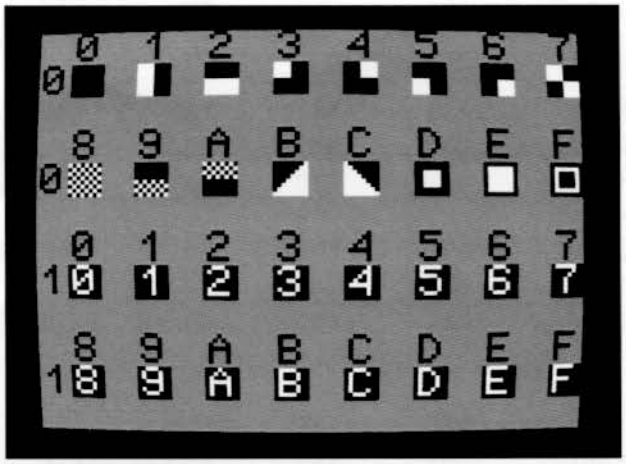
3. MEMORY MAP

0x00-0x01	Reserved for future expansion / Peripheral I/O
0x02	Hardware Control Register (CTRL)
	bit 7: Vertical synchronization - flipped between 0 / 1 when display rendering has finished and the microprocessor becomes available
	bits 6-5: Accent color selection: 00 = Blue, 01 = Red, 10 = Green, 11 = Yellow
	bit 4: Control Stick button (1 = button down)
	bits 3-0: Control Stick directions: 3 = Left, 2 = Down, 1 = Up, 0 = Right
0x03-0x3F	Zeropage available for user program and variables (Hex Monitor uses 0x03-0x07 when active)
0x40-0xFF	16x12 Display Matrix (0x10 bytes per line)
	0x40 Line 1 (Top of display)
	0x50 Line 2
	.
	.
	0xF0 Line 12 (Bottom of display)
	Bits 5-0 of each byte defines the character (0-63), bit 6: Inverse mode, bit 7: Use accent color
0x100-0x1EF	Program memory area
0x1F0-0x1FF	Stack memory area
0x200-0x2FF	Read-Only Memory (ROM)
	0x200 Reset (Clears decimal flag, enables display, clears the screen, resets Stack Pointer to 0x1FF and jumps to 0x100)
	0x20C Hex Monitor (BRK instruction entry point)

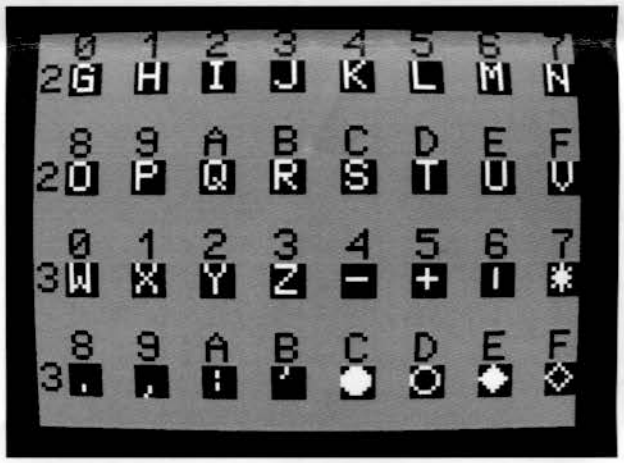
4. ROM CHARACTER GENERATOR

Vx02 has a complete alpha-numerical and symbol set of 64 beautifully crafted characters stored in Character Generator ROM. And Vx02 is not limited to just black and white! You can choose from 4 different accent colors and create stunning, colorful graphical experiences and immersive action games.

Characters 0x00-0x1F



Characters 0x20-0x3F



Characters 0x40-0x7F are same as 0x00-0x3F, but in inverse video. Full 32x24 block graphics can be displayed by employing both the characters 0x00-0x07 and their inverted versions 0x40-0x47.

Characters 0x80-0xBF are same as 0x00-0x3F, but displayed in accent color instead of white. Accent color can be changed by writing to bits 6-5 of Hardware Control Register (CTRL).

Similarly, characters 0xC0-0xFF are in accent color and same as 0x80-0xBF, but in inverse video.

APPENDIX 1: MOS 6502 MICROPROCESSOR INSTRUCTION SET

	0x00	0x20	0x40	0x60	0x80	0xA0	0xC0	0xE0	Mode
0x00	BRK	JSR	RTI	RTS	-	LDY	CPY	CPX	Impl./imm.
0x01	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	(Indir.,x)
0x02	-	-	-	-	-	LDX	-	-	Immediate
0x03	-	-	-	-	-	-	-	-	
0x04	-	BIT	-	-	STY	LDY	CPY	CPX	Zeropage
0x05	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	Zeropage
0x06	ASL	ROL	LSR	ROR	STX	LDX	DEC	INC	Zeropage
0x07	-	-	-	-	-	-	-	-	
0x08	PHP	PLP	PHA	PLA	DEY	TAY	INY	INX	Implied
0x09	ORA	AND	EOR	ADC	-	LDA	CMP	SBC	Immediate
0x0A	ASL	ROL	LSR	-	TXA	TAX	DEX	NOP	Accu/impl.
0x0B	-	-	-	-	-	-	-	-	
0x0C	-	BIT	JMP	JMP ()	STY	LDY	CPY	CPX	Absolute
0x0D	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	Absolute
0x0E	ASL	ROL	LSR	ROR	STX	LDX	DEC	INC	Absolute
0x0F	-	-	-	-	-	-	-	-	
0x10	BPL	BMI	BVC	BVS	BCC	BCS	BNE	BEQ	Relative
0x11	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	(Indir.),y
0x12	-	-	-	-	-	-	-	-	
0x13	-	-	-	-	-	-	-	-	
0x14	-	-	-	-	STY	LDY	-	-	Zeropage,x
0x15	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	Zeropage,x
0x16	ASL	ROL	LSR	ROR	STX·	LDX·	DEC	INC	Zeropage,x
0x17	-	-	-	-	-	-	-	-	
0x18	CLC	SEC	CLI	SEI	TYA	CLV	CLD	SED	Implied
0x19	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	Absolute,y
0x1A	-	-	-	-	TXS	TSX	-	-	Implied
0x1B	-	-	-	-	-	-	-	-	
0x1C	-	-	-	-	-	LDY	-	-	Absolute,x
0x1D	ORA	AND	EOR	ADC	STA	LDA	CMP	SBC	Absolute,x
0x1E	ASL	ROL	LSR	-	-	LDX·	DEC	INC	Absolute,x
0x1F	-	-	-	-	-	-	-	-	

· Indexed using Y instead of X
() Indirect instead of absolute

Complete MOS 6502 data sheet can be requested from MOS Technology, Inc., Valley Forge Corporate Center (215) 666-7950, 950 Rittenhouse Road, Norristown, PA. 19401

TIP: VxO2 doesn't support user interrupts. Instead, the IRQ is hard-wired to display refresh and Controller Stick detection, as these are partially handled by the microprocessor. You can, however, use the SEI instruction to disable IRQ and effectively blank the screen. Your program will run up to 36% faster, but you cannot read the Controller Stick or see anything until you restore the IRQ with CLI instruction.

APPENDIX 2: PROGRAMMING EXAMPLES

Hello World

```
100 A2 0A BD 0C
104 01 95 40 CA
108 10 F8 30 FE
10C 21 1E 25 25
110 28 00 30 28
114 2B 25 1D
```

The Wall

```
100 A2 0F A9 8F
104 95 40 95 F0
108 CA 10 F9 A2
10C 00 A0 0B A9
110 8F 95 40 95
114 4F 8A 18 69
118 10 AA 88 D0
11C F2 A9 93 85
120 03 A9 01 85
124 04 A9 40 85
128 02 A9 10 85
12C 06 85 07 85
130 40 20 A0 01
134 29 7F 69 20
138 AA B5 40 D0
13C F4 A9 BC 95
140 40 A5 02 C5
144 02 F0 FC A0
148 00 4A 90 02
14C A0 01 4A 90
150 02 A0 F0 4A
154 90 02 A0 10
158 4A 90 02 A0
15C FF C0 00 F0
160 02 84 04 20
164 A0 01 C6 07
168 D0 D7 A5 06
16C 85 07 A5 03
170 18 65 04 AA
174 B5 40 29 3F
178 C9 0F D0 06
17C 20 F6 02 4C
180 00 01 86 03
184 A0 4F 94 40
188 C9 3C F0 03
18C 4C 41 01 C6
190 06 C6 06 E6
194 40 A5 02 69
198 20 29 E0 85
19C 02 4C 31 01
1A0 A5 05 0A 0A
1A4 18 65 05 18
1A8 69 03 85 05
1AC 60
```


VxO2 - To boldly go
where no man has gone before!