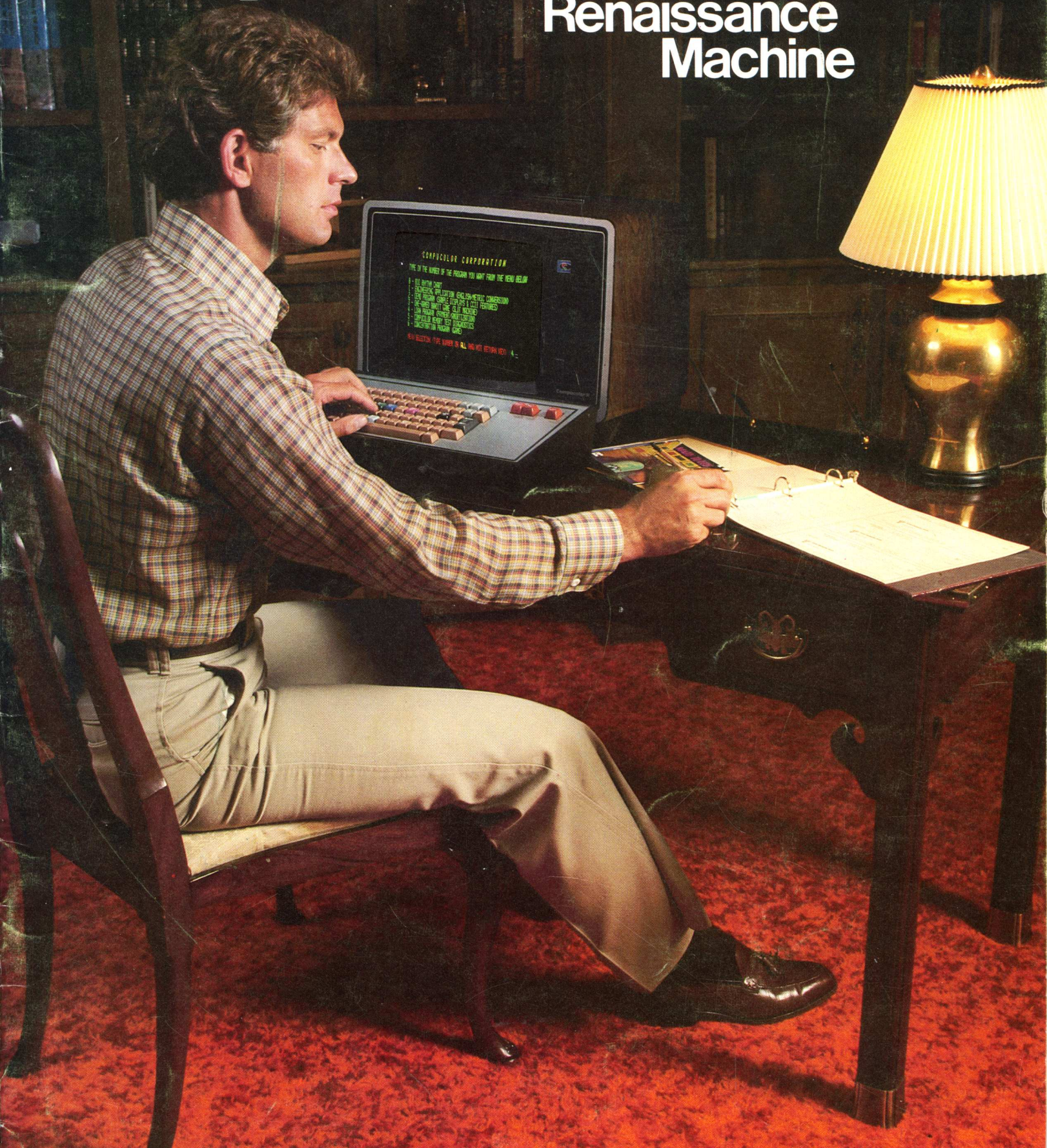


# Compucolor II The Renaissance Machine



Instruction Manual

\$300

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NOTE: Good data processing procedure dictates that the user test the program, run and test sample sets of data, and run the system in parallel with the system previously in use for a period of time adequate to insure that results of operation of the computer or program are satisfactory.

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# Compucolor<sup>®</sup> II

## Instruction Manual

The Compucolor Corporation thanks you for purchasing a Compucolor II. Although many precautions have been taken to assure that this material is received in good condition, we ask that you take a few minutes to read the following material so that you may derive maximum enjoyment and use from your Compucolor II.

The handbook has been divided into six sections. Section One gives directions for operating the Compucolor II and describes a step by step procedure for loading a program into the Compucolor II from a diskette. Section

Two describes the keyboard and tells you how to write and expand a simple program. Section Three summarizes BASIC and various FCS and CRT commands. Section Four concerns handling and care of diskettes as well as other precautions. Section Five lists a variety of books on the market that deal with computers and programming. Section Six provides lists of port assignments, memory locations, the fifty pin bus and RS232C Interface, as well as a complete character set.

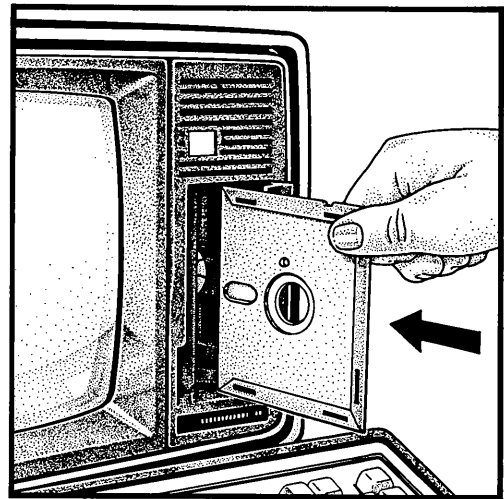
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# Section I

## How to operate the Compucolor II

1. Place the Compucolor II in a convenient location remembering that you will probably enjoy sitting and playing games on the computer for hours at a time. Be careful not to obstruct the air flow through the vent on the back of the unit.
2. Now connect the keyboard cable to the socket labeled "Keyboard" on the back of the Compucolor II. This connector will only fit one way, so if it doesn't fit, turn it over and try pushing in without forcing it. Find the CAPS LOCK key to the left of the space bar on the keyboard. Make sure this key is in the down position (see page 4).
3. Next plug the power cord into the back of the computer much like you would plug in an electric frying pan. Then plug the other end of the power cord into the wall socket. You may need an adapter if your socket cannot take a three-prong insert.
4. It's now time to turn on the Compucolor II by pushing to one side the "Power" (white) button on the back of the unit, just above the cord.
5. The Compucolor II will require 60 seconds for the tube to warm up before the message "DISK BASIC 8001 V6.78 COPYRIGHT © BY COMPUCOLOR" will appear.
6. If it does not appear then hold the SHIFT and CONTROL keys down and press the CPU RESET key. (Note: leave the SHIFT and CONTROL keys down for at least 5 seconds after pressing CPU RESET key.)
7. Take the diskette that came with your Compucolor II and slip it into the right side of the computer. Make sure the diskette is inserted correctly and then close the door. See illustration.
8. Push AUTO (brown key in upper left hand corner).
9. You will see a list or "MENU" of programs on the screen. Select the program by the number at left. Type in the number and press the ENTER key.
10. The program you selected will be loaded into the Compucolor II and you will see directions on the screen on how to proceed with the program you selected. Have fun.
11. If nothing appears on the screen after pressing AUTO key try turning the diskette over and follow the instructions starting at step 6.
12. If it still doesn't work after trying it again, then simply press the CPU RESET key with no other keys held down. The display will now say, "COMPUCOLOR II CRT MODE V6.78." If this does not appear turn the unit off for 15 seconds and then try from step 4.
13. After the "COMPUCOLOR II CRT MODE" message appears, press the (ESC) key and the (BASIC) or letter W key. The following message should appear: "DISK BASIC 8001 V6.78 COPYRIGHT © BY COMPUCOLOR." "MAXIMUM RAM AVAILABLE?" Now type "8192" and press the ENTER key. (If your Compucolor II is a Model 4 type "16384," then ENTER. If a Model 5, type "32768" then ENTER.) The unit will come back with the amount of free RAM memory available and the "READY" message. Now go to step 7. NOTE: if the ENTER key is pressed without entering a number the unit will search for the maximum RAM in your Compucolor II.
14. If the above does not provide the required results contact your local dealer for assistance, or call Compucolor Corporation's toll-free HOT LINE: (800) 241-4310.



# Section II

## Computer Basics

Compucolor II is a microcomputer. Housed within your Compucolor II is a single integrated circuit chip called a microprocessor. This is the very heart of your Compucolor II. The microprocessor is the computing device for storing programs and for performing logical operations. The microprocessor, called the Central Processing Unit, or CPU, controls all operations of the Compucolor II.

Compucolor II is capable of storing and filing information. Data is fed into the computer by means of typing on the keyboard. This process called INPUT uses the keyboard as its device. To view what has been fed into the computer, Compucolor II uses a display screen called a cathode-ray-tube or CRT display unit, to show OUTPUT.

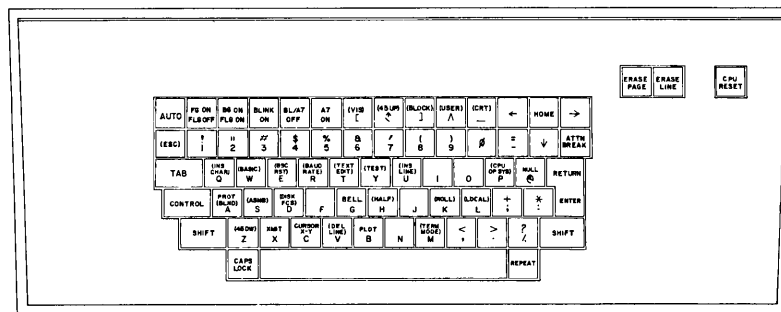
As soon as your Compucolor II is turned on, you are ready to play games, program, store and retrieve informa-

tion. You are in "DISK BASIC 8001." If you followed the instructions on page 2 of this manual you were able to load a diskette and run a program. Now we'd like to re-introduce you to your Compucolor II so that you can communicate with it effectively.

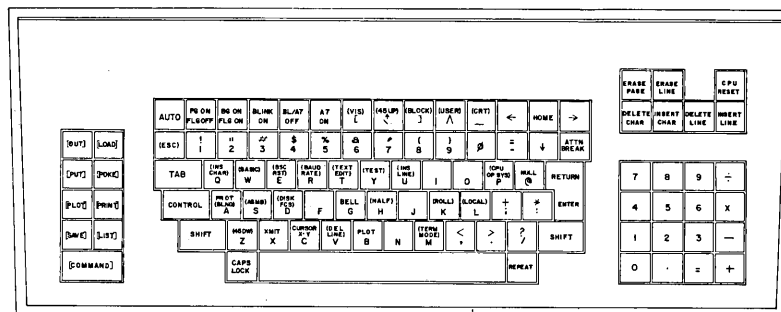
Compucolor II has within it a well defined set of rules for communicating with you. Your task is to learn what the computer already knows. Together, you and Compucolor II will communicate in such a way that Compucolor II will do as you say.

Communicating with Compucolor II means that you will be feeding data or information into your unit by means of a KEYBOARD. Let's take a few minutes to talk about some of the keyboard's features.

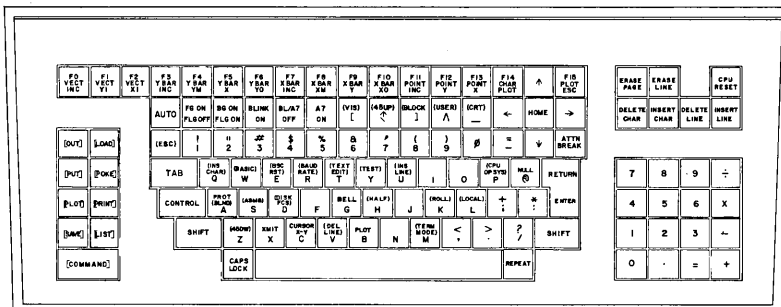
### STANDARD



### EXTENDED (Optional)



### DELUXE (Optional)



# Keyboard Operation

## CAPS LOCK

Typing words on the CompuColor II is only done in capital letters. To facilitate the use of capitals, a CAPS LOCK key is used. Located on the left next to the space bar, the CAPS LOCK key will stay depressed and all letters typed will be capitals. By using the SHIFT key, special characters can be printed while the CAPS LOCK key remains depressed. To unlock the CAPS LOCK key, depress it once. The key is now flush with the space bar and special characters are now typed when the SHIFT key is not depressed. With the SHIFT key depressed capital letters are typed. The numbers and punctuation keys work the same as a regular typewriter. SHIFT gives the top character on a key and unshift gives the bottom character on a key.

## SHIFT KEY

CompuColor II's keyboard is much like an ordinary keyboard with some additions. Like a regular typewriter, the SHIFT key is used to type upper case characters and in some cases, special characters. The SHIFT key must be depressed until the desired character is typed.

## AUTO

The AUTO key on the upper left has been specially programmed so that when you press the AUTO key a program called "MENU BAS" will be loaded from the diskette and caused to run. It will list on the screen all programs that can be run under the "MENU" system.

## RETURN ENTER

The RETURN-ENTER key is on the right side of the keyboard. By pressing this key when you are in DISK BASIC you command the CompuColor II to accept the most recent instruction entered. If you are in the "CRT MODE" then this will only cause a carriage return as on a typewriter.

*no line feed*

## DIRECTION ARROWS, HOME

Three direction arrows and a HOME key are located on the right side of the keyboard. The HOME key and the arrow keys control the cursor. Pressing HOME brings the cursor to the upper left hand of the screen. The direction arrows are used for correcting typing mistakes or to carry you to another spot on the screen.

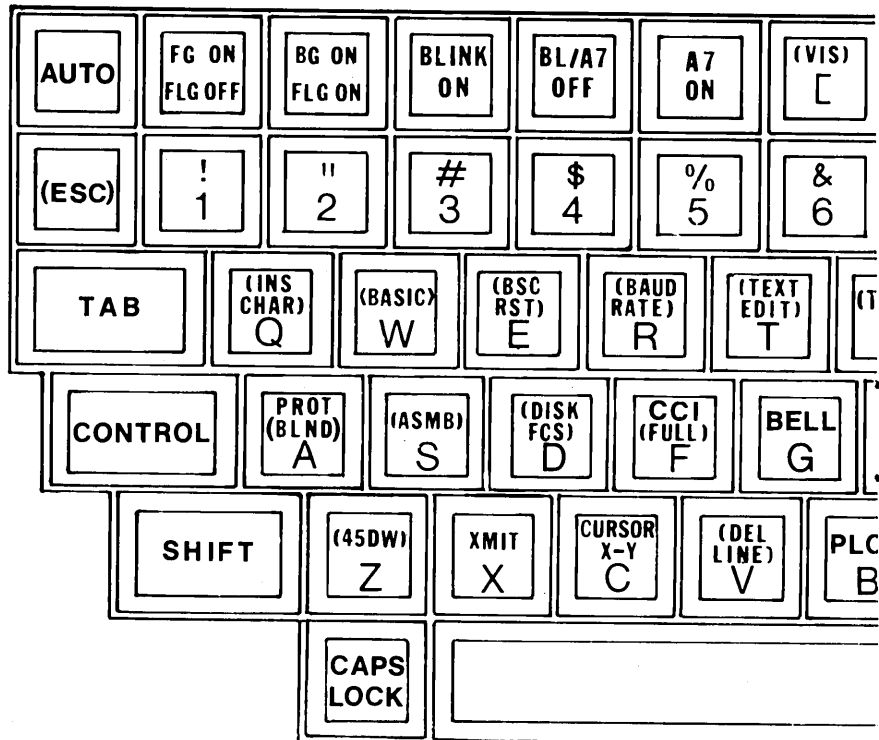
To correct a typing error in DISK BASIC press the ← arrow until you have erased the error. This backspace key erases all letters, one at a time, that it touches. For example, if you had typed "NOW IS THE TYME" ←←← retype "IME."

The following keys must be depressed while the desired key is being pressed:

CONTROL  
SHIFT  
REPEAT  
[COMMAND]

The following key need only be pressed and then followed by pressing the desired key:

(ESC)



### ERASE PAGE

To clear the screen press the ERASE PAGE key. This will return the cursor to its home position and you are ready to start again in the CRT mode. NOTE: in DISK BASIC mode it has erased the screen, but it did not erase your BASIC command internally.

### REPEAT

The REPEAT key next to the space bar allows you to type one letter again and again by typing a letter and holding the REPEAT key down at the same time.

### CPU RESET

The CPU RESET key, on the far right of the keyboard, when pressed, takes you out of the DISK BASIC mode and puts you into the CRT mode.

The ESCAPE key (ESC), located directly below the AUTO key (top left) permits you to go into various special modes by pressing (ESC) and the desired code key. The keys with a name enclosed within ( ) are standard escape codes. A detailed listing of these codes can be found in Section III.

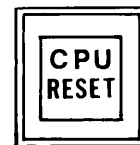
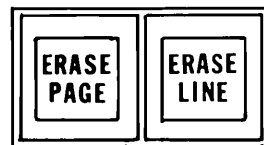
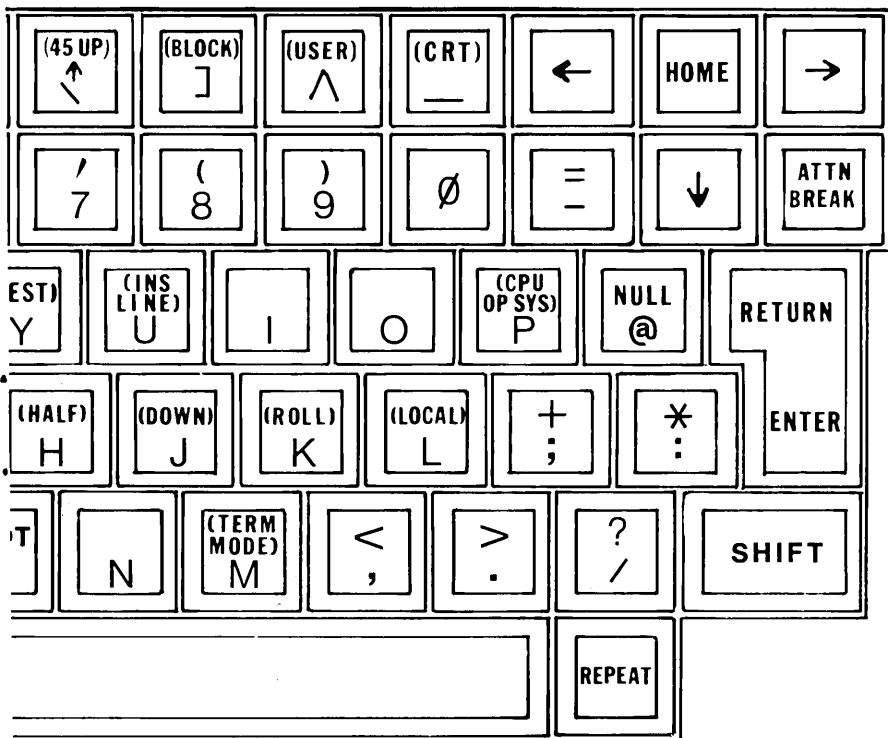
### ATTN/BREAK (Attention/Break) KEY

To temporarily suspend operation when running or listing a BASIC program, press the BREAK key.

To continue, press RETURN or any other character except ↓.

The ↓ or line feed will cause BASIC to break and halt operation.

Use ↓ followed by RETURN to break out of an INPUT statement in BASIC.



NOTE: There is a difference between the number Ø and the letter O, and between the number 1 and the letter L on all computer keyboards.

# What is a Program?

A series of instructions, stored by the computer is called a program.

Programs are written in a simple language called BASIC. The computer already knows this language and with the help of this pamphlet, you will learn some of the BASIC language in order to communicate with CompuColor II.

Let's begin.

You're about to write a simple program.

First: Press CPU RESET key while holding down the SHIFT key and the CONTROL key.

Screen display will look like this:

```
DISK BASIC 8001 V6.78 COPYRIGHT © BY COMPUCOLOR
MAXIMUM RAM AVAILABLE?
7473 (or 15665, or 32049)
READY
```

Now type:

```
10 PRINT "HI! THIS IS THE START OF SOMETHING WONDERFUL!"
```

Recheck your typed statement.

1. If wrong, use ← key (backspace) to retype.
2. If correct, press ENTER key.
3. Type RUN and then press the ENTER key.
4. If you get an ERROR message, retype the whole line, beginning with 10.
5. Press the ENTER key.
6. Type RUN and then press the ENTER key.

Did CompuColor follow your instructions?

Congratulations! You have just written your first program!

True, it's only a one-liner, but it is the start of something wonderful!

## HIGHLIGHTS

In writing a program every line must have a number. The program is listed on the screen in numerical order, from the smallest to the largest number.

Always use the *numeral 0* to type your program numbers. The *letter O* cannot be substituted for a number.

Type PRINT: The computer will print everything that is included within the quotation marks.

Press ENTER: This is a command that tells CompuColor II to remember the most recent instruction entered.

Type RUN: Any time you want CompuColor II to follow your instructions, you must type RUN and then press the ENTER key. This causes the CompuColor II to execute the RUN command.



# Programs can be expanded.

In the last section you wrote a one-line program. By adding a second or third line, your program can be expanded.

Type  
20 PRINT "CAN YOU BELIEVE THAT I CAN WRITE A PROGRAM?"

Check your work for errors.

Press ENTER.

Type RUN and then press the ENTER key.

If all systems worked, the screen display should read:

THIS IS THE START OF SOMETHING WONDERFUL!  
CAN YOU BELIEVE THAT I CAN WRITE A PROGRAM?

Let us assume that you want to answer the above question—

Type YES.

Hit ENTER.

Screen display now reads:

SN ERROR.

SN ERROR is the computer's way of telling you that it is not programmed to understand your message. Unless the computer gives you a choice between YES and NO, you cannot enter YES. Sometimes SN ERROR appears even if you do not intentionally enter misinformation.

Type LIST, press ENTER. Behold! The computer has followed your command and has listed everything that you have written.

## IF YOUR LISTING HAS A MISTAKE

When you find a mistake, type the number of the line that has the mistake in it. Then retype it correctly and press ENTER. The computer will now incorporate this new line into the program and the original line will be taken out automatically.

## SN ERROR

The computer's way of telling you that it cannot understand your message.

## LIST

This allows you to see what you have written up to this point.

## REMEMBER

Do not press SHIFT key. Letters are printed in capitals. Hold SHIFT key down to get special symbols.

Usually the line numbers in a program are written 10 numbers apart. This numbering system permits you to add new information to your program. Sometimes it is easier to read a program output when there is a space between the lines. To put a space between your program lines—

Type 15 PRINT

Press ENTER

Type RUN

When you type PRINT and write nothing after it, the computer will do just that—it will print a blank line. Pretty neat!

By adding additional numbers and statements, you can expand your program further. Just type in the number and the computer will automatically put it in the correct numerical sequence.

Now that you have taken part in the excitement of programming, you might want to find out more about it. Section 5 of this handbook lists some books on programming and games that might interest you.

## HIGHLIGHTS

- 1) Order
- 2) RUN
- 3) SN ERROR
- 4) LIST
- 5) SHIFT key

# Section III

## Summary of Commands

### 1. CRT COMMANDS

#### CONTROL CODES

CODE	EXPLANATION
0—NULL (control @)	Has no effect.
1—AUTO (control A)	Loads and runs a BASIC program named "MENU," from the disk drive.
2—PLOT (control B)	Enters graphic plot mode (see plot submodes), not allowed as a BASIC input character.
3—CURSOR XY (control C)	Enters X-Y cursor address mode for either visible cursor or blind cursor, used to go from BASIC to CRT MODE when typed as a BASIC input character.
4—(control D)	Not used.
5—(control E)	Not used.
6—CCI (control F)	The next character which follows provides the 8 bit visible status word. Specifies Foreground, Background, Blink, and Plot. (See status word format, page 9.)
7—BELL (control G)	Not used.
8—HOME (control H)	Moves the cursor to top left corner of display.
9—TAB (control I)	Causes cursor to advance to next column—the tab columns are every 8 characters.
10—↓ (control J) or LINEFEED	Causes a break in BASIC execution of a program, causes the cursor to move down one line.
11—ERASE LINE (control K)	Causes the cursor to return to beginning of line and causes the complete line to be erased. Also causes the BASIC input line to be ignored.
12—ERASE PAGE (control L)	Causes the complete screen to be erased and the cursor moves to the home position. BASIC input ignores this character.
13—RETURN (control M)	Causes the cursor to move to the beginning of the line it presently is on. Causes BASIC input to accept the typed line and process as a statement or input data.
14—A7 ON (control N)	Turns the A7 flag on. (2x character height and also 1 stop bit.)
15—BLINK/A7 OFF (control O)	Turns the blink bit and A7 flag off.
16—BLACK KEY (control P)	Sets foreground color black if flag is off and background black if flag is on.
17—RED KEY (control Q)	Same as above with color red.
18—GREEN KEY (control R)	Same as above with color green.
19—YELLOW KEY (control S)	Same as above with color yellow.
20—BLUE KEY (control T)	Same as above with color blue.
21—MAGENTA KEY (control U)	Same as above with color magenta.
22—CYAN KEY (control V)	Same as above with color cyan.
23—WHITE KEY (control W)	Same as above with color white.
24—XMIT (control X)	Causes data to be transmitted from the visible cursor to the end of the page or until FF, 00 sequence is found in refresh RAM. Sends text characters with a linefeed and carriage return at end of each line. NOTE: color status is not sent.
25—CURSOR RIGHT (control Y)	Causes the cursor to move right 1 position. On BASIC input displays previous character inputted.
26—CURSOR LEFT (control Z)	Causes the cursor to move left 1 position. On BASIC input deletes previous character from input buffer.
27—ESC (control [)	Provides an entry to the escape code table—must be followed by one or more codes for proper operation.
28—CURSOR UP (control \)	Causes the cursor to move up one line.
29—FG ON/FLAG OFF (control ])	Sets the flag bit off. If followed by one of the color keys it will set the foreground to that color. In plot mode OR's "ON" bits.
30—BG ON/FLAG ON (control ^)	Sets the flag bit on. If followed by one of the color keys, it will set the background to that color. In plot mode XOR's "ON" bits.
31—BLINK ON (control —)	Sets the blink bit on which will blink the foreground color against the background color.

## ESCAPE CODES

5 BIT CODE	LETTER	FUNCTION
0	@	Used for terminal control—not available for any other use.
1	A	Blind cursor mode.
2	B	Plot via color pad.
3	C	Transmit cursor X, Y position to RS232 PORT.
4	D	Enters Disk File Control System (FCS) with CRT as output.
5	E	Re-entry to DISK BASIC.
6	F	Sets full duplex mode, not functional when in BASIC.
7	G	Enters Disk File Control System (FCS) with RS232 PORT as output.
8	H	Sets half duplex mode.
9	I	Causes a program jump to location 36864.
10	J	Sets write vertical mode.
11	K	Sets roll up and write left to right mode.
12	L	Sets local mode.
13	M	Sets all output to the RS232 PORT.
14	N	Sets to ignore all inputs.
15	O	Not used.
16	P	Not used.
17	Q	Not used.
18	R	Baud rate selection mode. A7 on = 1 stop bit, A7 off = 2 stop bits. (See baud rate table.)
19	S	Causes a program jump to location 40960.
20	T	Causes a program jump to location 33280.
21	U	Not used.
22	V	Not used.
23	W	Initializes and transfers control to DISK BASIC 8001.
24	X	Sets terminal to page mode and write left to right mode.
25	Y	Test mode—fill page with next character.
26	Z	Not used.
27	[	Visible cursor mode.
28	\	Not used.
29	]	Not used.
30	^	Causes a program jump to location 33275.
31	_	Transfer control to the CRT mode.

## BAUD RATE SELECTION

Number	1	2	3	4	5	6	7
Baud rate	110	150	300	1200	2400	4800	9600

## STATUS WORD FORMAT

A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>
Plot	Blink	Background Color			Foreground Color		
		Blue	Green	Red	Blue	Green	Red

## INCREMENTAL DIRECTION CODES

	$\Delta X1$		$\Delta Y1$		$\Delta X2$		$\Delta Y2$	
If BIT = 1	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>
Direction	+	-	+	-	+	-	+	-
Value (Hex)	80	40	20	10	8	4	2	1

## GRAPHIC PLOT SUBMODES

DISK BASIC plot value or RS-232 INPUT CODE	PLOT SUBMODE	OPTIONAL FUNCTION KEYBOARD CODE
255	Plot Mode Escape	F 15
254	Character Plot	F 14
(253)	X Point Plot	F 13
(252)	Y Point Plot	F 12
251	X-Y Incremental Point Plot	F 11
250	X <sub>0</sub> of X Bar Graph	F 10
(249)	Y of X Bar Graph	F 9
(248)	X max of X Bar Graph	F 8
247	Incremental X Bar Graph	F 7
246	Y <sub>0</sub> of Y Bar Graph	F 6
(245)	X of Y Bar Graph	F 5
(244)	Y max of Y Bar Graph	F 4
243	Incremental Y Bar Graph	F 3
(242)	X <sub>0</sub> Vector Plot	F 2
(241)	Y <sub>0</sub> Vector Plot	F 1
240	Incremental Vector Plot	F 0

For incremental plot submodes see the format of the incremental direction codes (page 9).

## 2. DISK BASIC

### BASIC Statements

The following summary of BASIC statements defines the general format for the statement and gives a brief explanation of its use.

COMMAND	EXPLANATION
✓CLEAR	Sets the array and string buffers to nulls and zeroes.
✓CLEAR X	Sets space for string variable to X characters (normally 50 characters).
✓CONT	Continues execution after CTRL/J, or ↓.
✓DATA value list	Used in conjunction with READ to input data into an executing program.
✓DEF FN X (argument) = expression	Defines a user function to be used in the program.
✓DIM variable (n), variable (n,m), variable \$(n), variable \$(n,m)	Reserves space for lists and tables according to subscripts specified after variable name. Up to 255 dimensions.
✓END	Terminates program execution.
FILE "N", "filename", records, rec. size, blocking factor	Creates a new random file with the specified number of records (1-32767), record size (1-32767 bytes), and blocking factor (1-255). File name is a string expression containing a valid FCS file name.
FILE "R", file number, "filename", buffers	Opens a random file with the specified file number (1-127) and number of buffers (1-255).
FILE "A", file, current rec., records, rec. size, blocking factor	Finds the specified attributes for the currently open file: current record accessed, number of records, record size, and blocking factor.
FILE "C", file 1, ---, file N	Closes the specified files and releases the buffer space.
FILE "D", file 1, ---, file N	Writes any modified buffers immediately for the specified files.
FILE "T", line number	Causes file errors to trap to the specified line number. No line number turns the error trapping off.
FILE "E", file, error, line number	Lets the user determine the disk error number and location of the file error.
✓FOR variable = expression 1 TO expression 2 STEP expression 3	Sets up a loop to be executed the specified number of times.
✓GET file N, record, first byte; numeric variable, string variable [byte count]	Reads from the record in the file N starting at the specified first byte (1-255) into the variables in the list. String variables must have a byte count (1-255).

## BASIC Statements (Cont.)

COMMAND	EXPLANATION
✓GOSUB line number	Used to transfer control to the first line of a subroutine.
✓GOTO line number	Used to unconditionally transfer control to other than the next sequential line in the program.
✓IF expression GOTO line number	Used to conditionally transfer control to the specified line of the program.
✓IF expression THEN statement	Used to execute BASIC statements only when expression is true.
✓INPUT list	Used to input data from the terminal keyboard, prompts with "?".
✓INPUT "string"; list	Used to input data with the quoted string as the prompt.
✓LIST	Prints the user program currently in memory on the CRT display.
✓LIST line number	Prints the program from the line specified to the end.
LOAD "PRGRM1"	Loads a BASIC Program named "PRGRM1" from disk into memory. Names cannot exceed six characters (letters and/or numbers).
LOAD "name.ARY"	Loads the numeric array specified by name from disk. First two characters are the array's name.
✓NEXT variable	Placed at the end of a FOR loop to return control to the FOR statement.
✓ON X GOSUB line number list	Multiple GOSUB statement. Will transfer control to subroutine on stated line. However, the RETURN statement placed at the end of each subroutine will cause the next statement following ON GOSUB to be executed.
✓ON X GOTO line number list	Multiple GOTO statement, will transfer control to stated line number, depending on value of variable.
✓OUT I,X	Causes the byte X to be output to port I (the range of I is 0 to 255).
✓PLOT expression	Sends the one byte result of the expression to the terminal. The result must be between 0 and 255.
✓PLOT list	Sends the list of data to the CRT. Example: PLOT 2, 242, 0, 0, 255.
✓POKE I,X	Causes the byte X to be placed in memory location I, the range of I is 0 to 65535.
✓PRINT list	Used to output data to the terminal.
✓PRINT expression	Prints results of expression.
✓PRINT expression, expression;	The ; causes the carriage return and line feed to be suppressed. Use , for normal spacing and ; for compressed spacing.
✓PRINT "string"	Prints a character string.
✓?	Equivalent to the word PRINT.
✓PRINT SPC (X)	Prints the specified number of spaces.
✓PRINT TAB (X)	Used to space to the specified column.
✓PUT file N, record, first byte; numeric expr., string expr. [byte count]	Writes the expressions in the list to the record in file N starting at the specified first byte. String expressions must have a byte count.
✓READ variable list	Used to assign the values listed in a DATA statement to the specified variables.
✓REM comment	Used to insert explanatory comments into a BASIC program.
✓RESTORE	Used to reset the data block pointer so the same data can be used again.
✓RESTORE line number	Used to reset the data block pointer to a specified line number.
✓RETURN	Used to return program control to the statement following last executed GOSUB statement.
✓RUN	Executes the program in memory.
✓RUN line number	Executes the program starting at line number specified.
SAVE "PRGRM1"	Saves the BASIC program or data from memory into the disk and names it "PRGRM1."
SAVE "name. ARY"	Saves the numeric array specified by name on disk. First two characters are the array's name.
✓WAIT X,I,J	Causes the input port X to be read, exclusive OR'ed with byte J, and then AND'ed with byte I. The program will wait until the result is zero before continuing.
:	A colon is used to separate multiple statements per line. Example 10 A = 1: B = 10: C = 111

### BASIC Operators

SYMBOL	FUNCTION
=	Assignment, or equality test (DISK BASIC 8001 does not allow the LET statement)
-	Negation or subtraction
+	Addition or string concatenation
*	Multiplication
/	Division
^	Exponentiation
NOT	Logical or One's complement (2 byte integer)
AND	Logical or Bitwise AND (2 byte integer)
OR	Logical or Bitwise OR (2 byte integer)
=, <, >	Relational tests (result is TRUE = - 1 or FALSE = 0)
<=, = <	
>=, = >	
< >	

### The precedence of operators is:

- (1) Expressions in parentheses
- (2) Exponentiation ( $A \wedge B$ )
- (3) Negation ( $-X$ )
- (4) \*, /
- (5) +, -
- (6) Relational operators ( $=, <, >, <=, >=$ )
- (7) NOT
- (8) AND
- (9) OR

### Standard Mathematical Functions

The Mathematical functions are of the following form:  $10y = ABS(x)$ .

NAME	EXPLANATION
√ABS(x)	Returns the absolute value of X.
√ATN(x)	Returns the arctangent of x as an angle in radians in the range + or - pi/2. Where pi = 3.14159.
√CALL(x)	Call the user machine language routine at location 33282. D,E registers have value of X and A,B registers must have Y on return from machine language routine.
√COS(x)	Returns the cosine of x radians.
√EXP(x)	Returns the value of $e^x$ where $e = 2.71828$ .
√FNx(y)	Returns the value of the user defined function x with argument y.
√FRE(x)	Returns number of free bytes not in use.
√INT(x)	Returns the greatest integer less than or equal to x.
√INP(x)	Returns a byte from input port x. The range for x is 0 to 255.
√LOG(x)	Returns the natural logarithm of x.
√PEEK(x)	Returns a byte from memory address x. The range for x is 0 to 65535.
√POS(x)	Returns a value 0 to 63 of the print command column.
√RND(x)	Returns a random number between 0 and 1.
√SGN(x)	Returns a value indicating the sign of x.
√SIN(x)	Returns the sine of x radians.
√SQR(x)	Returns the square root of x.
√TAN(x)	Returns the tangent of x radians.

### Standard String Functions

The string functions are of the following form  $A\$ = CHR\$(x)$  or  $A = ASC(x\$)$

NAME	EXPLANATION
√ASC(x\$)	Returns as a decimal number the eight-bit internal code for the first character of string (x\$).
√CHR\$(x)	Generates a one-character string having the ASCII value of x.
√FRE(x\$)	Returns number of free string bytes.
√LEFT\$(x\$,I)	Returns left most I characters of string (x\$).
√LEN(x\$)	Returns the number of characters in the string (x\$).
√MID\$(x\$,I,J)	Returns J characters of string (x\$) starting at position I.
√RIGHT\$(x\$,I)	Returns right most I characters of string (x\$).
√STR\$(x)	Returns the string which represents the numeric value of x.
√VAL(x\$)	Returns the number represented by the string (x\$).

## BASIC and FILE Error Codes

After an error occurs, BASIC returns to command level and types READY. Variable values and the program text remain intact, but the program cannot be continued and all GOSUB and FOR context is lost.

When an error occurs in a direct statement, no line number is printed.

Format of error messages:

Direct Statement        XX ERROR  
Indirect Statement    XX ERROR IN YYYYY

In both of the above examples, "XX" will be the error code. The "YYYYY" will be the line number where the error occurred for the indirect statement.

The following are the possible error codes and their meanings:

ERROR CODE	MEANING
BS	Bad Subscript. An attempt was made to reference a matrix element which is outside the dimension of the matrix. This error can occur if the wrong number of dimensions are used in a matrix reference. For instance, $A(1,1,1) = Z$ when A has been dimensioned DIM A(2,2).
DD	Double Dimension. After a matrix was dimensioned, another dimension statement for the same matrix was encountered. This error often occurs if a matrix has been given the default dimension 10 because a statement like $A(I) = 3$ is encountered and then later in the program a DIM A(100) is found.
CF	Call Function error. The parameter passed to a math or string function was out of range. CF errors can occur due to: a) A negative matrix subscript ( $A(-1)=0$ ). b) An unreasonably large matrix subscript ( $>32767$ ). c) LOG-negative or zero argument. d) SQR-negative argument. e) $A \uparrow B$ with A negative and B not an integer. f) A CALL (X) before the address of the machine language subroutine has been patched in. g) Calls to MID\$, LEFT\$, RIGHT\$, INP, OUT, WAIT, PEEK, POKE, TAB, SPC or ON...GOTO/GOSUB with an improper argument.
ID	Illegal Direct. You cannot use an INPUT or DEF statement as a direct command.
NF	NEXT without FOR. The variable in a NEXT statement corresponds to no previously executed FOR statement.
OD	Out of Data. A READ statement was executed but all of the DATA statements in the program have already been read. The program tried to read too much data or insufficient data was included in the program.
OM	Out of Memory. Program too large, too many variables, too many FOR loops, too many GOSUB's, too complicated an expression or any combination of the above.
OV	Overflow. The result of a calculation was too large to be represented in BASIC's number format. If an underflow occurs, zero is given as the result and execution continues without any error message being printed.
SN	Syntax error. Missing parenthesis in an expression, illegal character in a line, incorrect punctuation, etc.
RG	RETURN without GOSUB. A RETURN statement was encountered without a previous GOSUB statement being executed.
US	Undefined Statement. An attempt was made to GOTO, GOSUB or THEN to a statement which does not exist.
/0	Division by Zero.
CN	Continue error. Attempt to continue a program when none exists, an error occurred, or after a new line was typed into the program.
LS	Long String. Attempt was made by use of the concatenation operator to create a string more than 255 characters long.
OS	Out of String Space. Use the CLEAR X statement to allocate more string space or use smaller strings or fewer string variables.
ST	String Temporaries. A string expression was too complex. Break it into two or more shorter ones.
SL	SAVE/LOAD error. (From disk operation.) Other error messages may also appear from the FILE CONTROL SYSTEM (FCS).
TM	Type Mismatch. The left hand side of an assignment statement was a numeric variable and the right hand side was a string, or vice versa; or, a function which expected a string argument was given a numeric one or vice versa.
UF	Undefined Function. Reference was made to a user defined function which had never been defined.

**BASIC and FILE Error Codes (Cont.)**

ERROR CODE	ERROR NUMBER	MEANING
EV		No error vector.
BF	2	Bad file name.
NO	4	File not open.
AO	6	File already open.
FS	8	File size error.
RO	10	Record overflow.
EF	12	End of file.
CO	14	Can't open file (usually nonexistent file).
CC	16	Can't close file (usually hardware problem).
RE	18	FCS READ error (usually hardware problem).
WE	20	FCS WRITE error (usually hardware problem).

**3. FCS (File Control System) COMMANDS**

File Control System is entered by pressing (ESC), then D from the keyboard, or PLOT 27,4 from BASIC. (Only the first three letters of the command need to be typed in.) If (ESC), D is from the keyboard then BASIC is terminated and must be re-entered by (ESC),E key sequence.

**Statement Definitions**

The following definitions will be used to describe the FCS commands:

( ) Means mandatory part.

[ ] Means optional part and if not specified, will result in the default type.

(Device name:) = [Device type] [Number] (:)

Device types are CD, MD, and FD for Compucolor Disk, Mini-Disk, and 8" Floppy Disk and number is either 0 or 1.

(Memory spec) = (Load address) (Byte count) or (-End address) all memory addresses are in HEX format.

(File spec) = (File name) [.Type] [:Version]

File name is any 6 characters. Type can be any three characters and PRG is default type. Version is 0 to FF HEX number.

NOTE: After a default device type has been selected only the number of the device is required. COMPUTECOLOR II defaults to CD0.

**COMMANDS**

<b>COPY</b> [Device Name:] (File Spec) TO [Device Name:] (File Spec)	Will copy one file from one location to another location.
<b>DELETE</b> [Device Name:] (File Spec)	All file spec options are required. Allows the user to delete any file.
<b>DEVICE</b> [Device Name:]	Sets and displays the current default device name.
<b>DIRECTORY</b> [Device Name:]	Lists directory of the default or specified device.
<b>DUPLICATE</b> (Device Name:) TO (Device Name:)	Will duplicate all the files on the original diskette onto another diskette. (Requires two disk drives.)
<b>EXIT "FCS"</b>	(ESC) and (ESC) again or (ESC) and E to return to BASIC.
<b>INITIALIZE</b> [Device Name:] (Volume Name) No. OF DIR BLOCKS	Number of directory blocks will default to a normally adequate no.; NOTE: device name requires all options.
<b>LOAD</b> [Device Name:] (File Spec), Load Address	Loads memory with a program. Defaults to LDA type files written by Compucolor II assembler.
<b>READ</b> [Device Name:] (Start Block No.) (Memory Spec)	Will read into memory from anywhere on the diskette starting at any block and ending where specified, without regard to program boundaries.
<b>RENAME</b> [Device Name:] (File Spec) TO (File Spec)	Allows the user to rename any file to any other name.
<b>RUN</b> [Device Name:] (File Spec)	Loads and executes program by name; normally a PRG type file.
<b>SAVE</b> [Device Name:] (File Spec) (Memory Spec), Start Address, Actual Address	Start address defaults to LOAD address and actual address defaults to load address. Saves memory as a PRG type default file.
<b>WRITE</b> [Device Name:] (Start Block No.) (Memory Spec)	Same as READ but writes memory to diskette. WARNING: it is possible to destroy the FCS directory and file information on a diskette with this command.



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**FCS Error Codes**

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<b>EBLF</b>	BAD LOAD FILE SPEC, 2	<b>EIVU</b>	INVALID UNIT, 2
<b>EBLK</b>	INVALID BLOCK NUMBER, 2	<b>EKBA</b>	KEYBOARD ABORT, 4
<b>ECOP</b>	ERROR DURING COPY, 1 & 3	<b>EMDV</b>	MISSING DEVICE NAME, 2
<b>ECFB</b>	CAN'T FIND BLOCK, 3	<b>EMEM</b>	MEMORY ERROR DURING READ, 4
<b>EDCS</b>	DATA CRC ERROR, 3	<b>EMFN</b>	MISSING FILE NAME, 2
<b>EDEL</b>	DELETE ERROR, 1 & 3	<b>EMVN</b>	MISSING VOLUME NAME, 2
<b>EDFN</b>	DUPLICATE FILE NAME, 2	<b>EMVR</b>	MISSING VERSION, 2
<b>EDIR</b>	DIRECTORY ERROR, 1 & 2	<b>ENSA</b>	NO START ADDRESS, 2
<b>EDRF</b>	DIRECTORY FULL, 4	<b>ENVE</b>	NO VOLUME ENTRY IN DIRECTORY, 5
<b>EDSY</b>	DATA SYNC CHAR ERROR, 1 & 3	<b>ERSZ</b>	FILE TOO LARGE TO READ INTO ALLOCATED MEMORY, 2 & 4
<b>EDUP</b>	ERROR DURING DUPLICATE, 1 & 3	<b>ESIZ</b>	DEVICE SIZES NOT SAME, 1
<b>EFNF</b>	FILE NOT FOUND, 2	<b>ESKF</b>	SEEK FAILURE, 1
<b>EFRD</b>	FILE READ ERROR, 3	<b>ESYN</b>	SYNTAX ERROR, 2
<b>EFWR</b>	FILE WRITE ERROR, 3	<b>EVFY</b>	VERIFY FAILURE DURING WRITE, 3
<b>EHCS</b>	HEADER CRC ERROR, 3	<b>EVOV</b>	VERSION NUMBER OVERFLOW, 4
<b>EIVC</b>	INVALID COMMAND, 2	<b>EWRP</b>	WRITE FAILURE, 3
<b>EIVF</b>	INVALID FUNCTION, 2	<b>EWSF</b>	FILE TOO LARGE TO WRITE ON DISKETTE, 2 & 4
<b>EIVD</b>	INVALID DEVICE, 2		
<b>EIVP</b>	INVALID PARAMETERS, 2		

**Descriptions of Solutions to FCS Errors**

- 1.) Mechanical Problem—Jammed READ/WRITE head, loose disk drive internal I/O connectors. Refer to CompuColor Maintenance Manual.
- 2.) Invalid User Input—Incorrect entry from user. Refer to FCS Commands, page 14.
- 3.) Diskette Failure—Try a different diskette.
- 4.) Error Message is self-explanatory.
- 5.) Diskette Not Initialized—You need to initialize the diskette and possibly purchase a formatted CompuColor blank diskette.

## Section IV Software

**Available Software**

CompuColor II has an ever growing library of software designed to challenge, stimulate, educate, and facilitate. Check your dealer for the latest available program diskettes.

**Precautions/storage**

Each 5¼" diskette comes in a folder. For extended media life of your diskette, we suggest the following procedures.

- 1.) Do not put fingers on the precision surface.
- 2.) Insert the diskette carefully into the disk drive.
- 3.) Keep the diskette far from magnetic fields which will erase the diskette.
- 4.) Store the diskette in the jacket when not in use.
- 5.) Handle the diskette with care. Bending and folding will damage it.
- 6.) Diskettes are best stored at temperatures ranging from 10° to 52° C or 50° to 125° F.
- 7.) Do not leave diskette in disk drive while turning your CompuColor II on or off.

Availability of Preformatted Diskettes—Diskettes are available at the rate of 2 diskettes for \$19.95 and may be obtained from CompuColor Corporation or your local dealer.

**Precautions/Power Outages**

Your CompuColor II should not be operated during an electrical storm. Storms can cause power outages to your CompuColor II. If your machine has a power failure, all data and programs will be lost. If the disk drive is being used during power failure, the diskette may be damaged.

Do not leave diskette in disk drive while turning your CompuColor II on or off.

# Section V

## Bibliography

Some introductory books on computers and programming available through your CompuColor dealer:

### COMPUCOLOR BASIC Manual

#### AN INTRODUCTION TO MICROCOMPUTERS,

Adam Osborne

Volume 0: The Beginner's Book

Volume 1: Basic Concepts

#### Basic BASIC,

James S. Coan

#### A Guided Tour of Computer Programming in BASIC,

Thomas A. Dwyer and Michael S. Kaufman

#### BASIC (New 2nd Edition),

Bob Albrecht

#### A Quick Look at BASIC,

Donald D. Spencer

#### My Computer Likes Me...When I Speak BASIC

#### What to do After You Hit RETURN

#### Fun with Computers and BASIC,

Donald D. Spencer

Also check these home-computer oriented magazines, each with its own flavor.

**BYTE, Creative Computing, Interface Age, Kilobaud, People's Computers, Personal Computing**

# Section VI

## PORT ASSIGNMENTS

PORT #		I/O PORT ADDRESS
Hex	Dec	
0	F	TMS 5501
10	1F	TMS 5501 Duplicate Addresses
20	5F	Not assigned.
60	6F	SMC 5027
70	7F	SMC 5027 Duplicate Addresses
80	FF	Not assigned.

PORT #		SMC 5027 CRT CHIP
Hex	Dec	
60	96	Load Register 0—Don't Load
61	97	Load Register 1—Don't Load
62	98	Load Register 2—Don't Load
63	99	Load Register 3—Don't Load
64	100	Load Register 4—Don't Load
65	101	Load Register 5—Don't Load
66	102	Load Register 6—Roll Register #
67	103	Processor Load Command—Don't Use
68	104	Read Cursor X Register
69	105	Read Cursor Y Register
6A	106	Issue Reset Command—Don't Issue
6B	107	Scroll up 1 line
6C	108	Load Cursor X Register
6D	109	Load Cursor Y Register
6E	110	Load Start Timing—Don't Load
6F	111	Self Load Command—Don't Use.

PORT #		TMS 5501 I/O CHIP
Hex	Dec	
0	0	Read Serial Data in from J-2.
1	1	Read Parallel Data from Keyboard Connection J-1.
2	2	Read Interrupt Address on TMS 5501.
3	3	Read Status on TMS 5501.
4	4	Issue Discrete Command.
5	5	Set Baud Rate on J-2 Serial I/O.
6	6	Transmit Serial Data out to J-2.
7	7	Transmit Parallel Data on Connection J-1 (also controls Disk R/W).
8	8	Load Interrupt Mask Register.
9	9	Interval Timer #1.
A	10	Interval Timer #2.
B	11	Interval Timer #3.
C	12	Interval Timer #4.
D	13	Interval Timer #5.
E	14	No Function.
F	15	No Function.

# KEY MEMORY LOCATIONS

- 28672 to 32767 = Screen refresh RAM.
- 32940 = Points to maximum RAM used by BASIC.
- 32980 = Points to start of source.
- 32982 = Points to end of source and start of variables.
- 32984 = Points to end of variables and start of arrays.
- 32986 = Points to end of arrays.
- 33209 = 0 to 59 seconds of Real Time Clock.
- 33210 = 0 to 59 minutes of Real Time Clock.
- 33211 = 0 to 23 hours of Real Time Clock.
- 33215 = User ESCAPE ↑ jump vector.
- 33218 = User output FLAG jump vector.
- 33221 = User input FLAG jump vector.
- 33224 = User timer no. 2 jump vector.
- 33238 = External output port buffer.
- 33247 = Keyboard FLAG.
- 33249 = FCS output FLAG.
- 33251 = Input port FLAG.
- 33265 = BASIC output FLAG.
- 33272 = Output port FLAG.
- 33273 = LIST output FLAG.
- 33278 = Keyboard character.
- 33279 = Keyboard character ready FLAG.
- 33282 = Location of CALL(x) jump.
- 33285 = BASIC output vector location.
- 33289 = No. of characters on terminal output.
- 33433 = Start of BASIC source code.
- 65535 = Maximum amount of RAM.

# FIFTY PIN BUS

(Preliminary, subject to change.)

PIN	DESIGNATION	PIN	DESIGNATION
1	+12V	26	D2 BUS
2	MR	27	A2
3	MW	28	D3 BUS
4	I/O W	29	A3
5	Φ2 (+12V)	30	D7 BUS
6	Φ2 TTL	31	A4
7	Φ1 (+12V)	32	D6 BUS
8	17.9712MHz	33	D4 BUS
9	SYNC	34	D5 BUS
10	RESET	35	A6
11	-5V	36	D0 8080
12	+5V	37	A7
13	GND	38	D1 8080
14	I/O R	39	A8
15	A10	40	D2 8080
16	READY	41	A14
17	NO CONNECTION	42	D3 8080
18	NO CONNECTION	43	D4 8080
19	HOLD	44	A9
20	A5	45	A13
21	A11	46	D7 8080
22	D0 BUS	47	A12
23	A0	48	A15
24	D1 BUS	49	D5 8080
25	A1	50	D6 8080

# RS 232C INTERFACE

CPU EDGE CONNECTOR #	RS232C PIN #	SIGNAL NAME AND LINE
1	1	AA Protective Ground
3	2	BA Transmitted Data
5	3	BB Received Data
7	4	CA Request to Send
14	7	AB Signal Ground
15	20	CD Data Terminal Ready

# CHARACTER SET

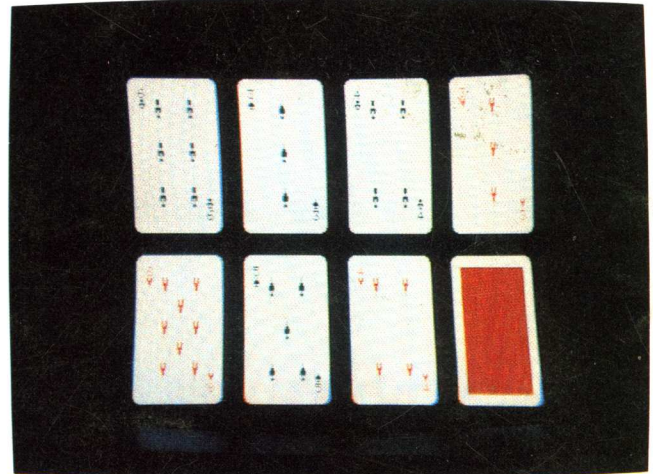
0									30,28		27,4		20,6		14,21		27,5		27,5		20,6		1,2		5,14		32,2			
1									98,8		1,32		16,17		16,2		20,21		27,4		20,21		27,4		3,6		5,14			
2									1,28		12,31		1,2		1,19		22,23		1,32		22,24		1,28		7,4		32,1			
3									1,2		1,2		1,2		28,30		28,30		5,26		0,21		39,1		8,4		5,26			
4									22,23		28,30		18,19		30,28		2,32		25,31		22,24		32,1		25,31		7,4			
5									30,1		27,5		20,6		5,26		3,4		3,25		32,10		2,2		43,43		3,4			
6									5,14		7,4		12,31		30		3,4		7,23		32,33				43,43		13,4			
7									79,30		3,4		32,30		20,32		32,21		19,25											
8									30,79		3,24		32,32		22,32		32,23		26,16											
9									20,21		27,4		20,6		98,8															
10									14,15		12,4		22,4		1,10															

ALTERNATE CHARACTER SHAPES

# Typical Graphic and Alphanumeric Displays



Each diskette presents a "menu" of programs from which to choose.



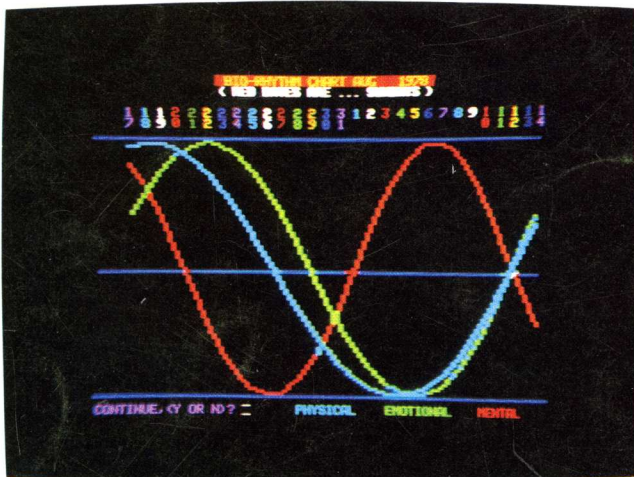
Card decks in two sizes can be generated on the Compucolor II.



Test your luck against the Compucolor II slot machine.



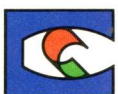
Colorful graphics add a new dimension to computer games.



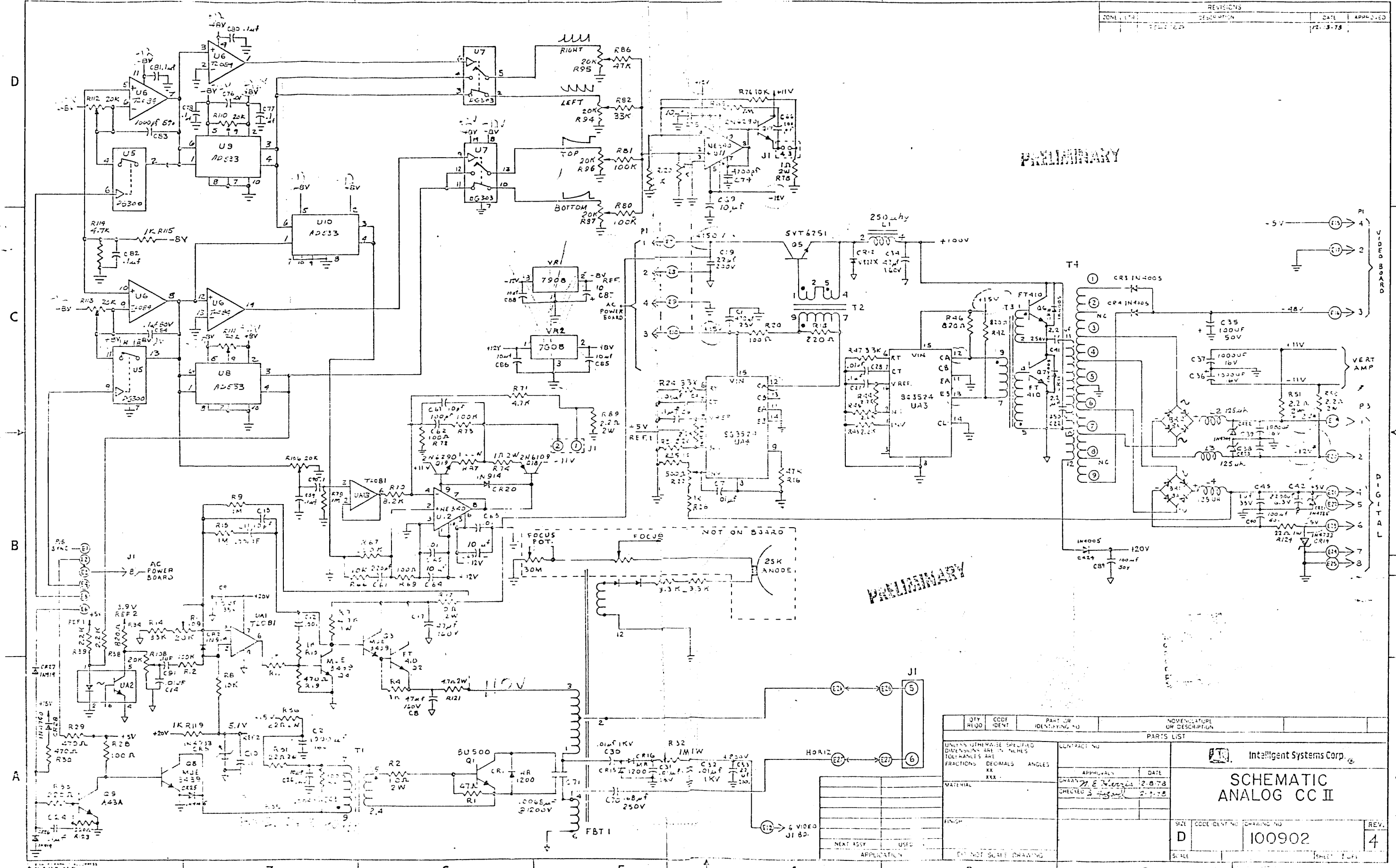
With plot mode and color, charts are easy to program and quickly understood.



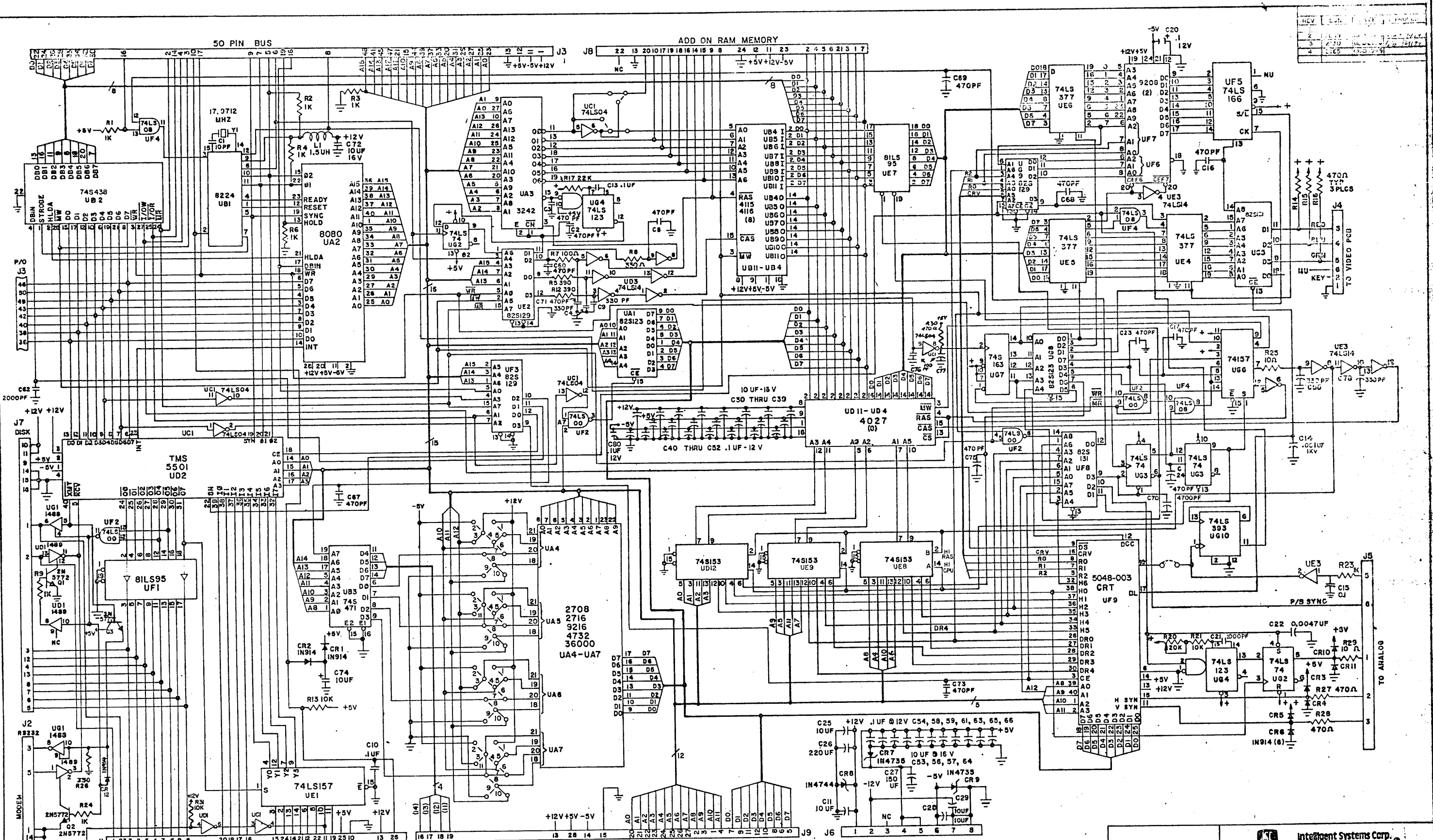
Converting to the metric system is a simple matter with Compucolor II.



REVISIONS			
ZONE	DESCRIPTION	DATE	APPROVED
1	REVISED	12-8-78	



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES XX XXX		CONTRACT NO	Intelligent Systems Corp.
MATERIAL		APPROVALS	DATE
FINISH		CHECKED	12-8-78
NEXT ASSY USED		SCALE	100902
APPLICATIONS		REV.	4



REV	DATE	BY
1	7-5-78	J.E. Harris
2	7-5-78	J.E. Harris
3	7-5-78	J.E. Harris
4	7-5-78	J.E. Harris

**PROPRIETARY**  
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INPUT	H2V	-5V	A12	A10	CS	GND	A11	C5			
PATCH NO.	1	2	3	4	5	6	7	8	9	10	11
ROM IC	2708	X	X	X	X	X	X	X	X	X	X
	2716	X	X	X	X	X	X	X	X	X	X
	4732	X	X	X	X	X	X	X	X	X	X
	9216	X	X	X	X	X	X	X	X	X	X
	36000	X	X	X	X	X	X	X	X	X	X

PATCH II IN FOR SOCKETS A5 & A7 ONLY

REF. DESIGNATIONS	DATE
LAST USED	7-5-78
C60	7-5-78
R3	7-5-78
CR2	7-5-78
Q3	7-5-78
L1	7-5-78
Y1	7-5-78

DRAWN: J.E. Harris  
 CHECKED: Jim Farris  
 DATE: 7-5-78  
 DATE: 9-11-78  
 FOR REV 4 PCB

**Intelligent Systems Corp.**

**SCHEMATIC LOGIC**

SIZE: CODE IDENT NO. DRAWING NO. **100961**

REV. **4**