TRS-80 Color Computer Emulator v1.20

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Last updated March, 14 2001

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Introduction:

This program emulates the TRS-80 Color Computer popular in the 1980s.

The emulators are written in 80386 assembly language with a C++ front-end to provide a user friendly interface. All the COCO emulation runs in assembly language for maximum speed. The start-up, configuration and virtual disk selection screens are written in C++.

The Color Computer emulator currently supports a standard configuration including:

- MC6809E Micro-Processor running at .8948 MHZ
- 8k Standard & 8k Extended BASIC ROM memory
- 16k Cartridge memory
- 4k, 16k, 32k & 64k RAM memory options
- MC6847 VDG & MC6883 SAM controllers
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  The following graphic modes are supported:

  Text   32 x 16 Text

  SG4   64x32 Block graphics

  SG6   64 x 48 Block graphics (4 color)

SG8   64 x 64 Block graphics

SG8a   64x96 Block graphics (4 color)

SG12   64x96 Block graphics

SG12a   64x96 Block graphics (4 color)

SG24   64x192 Block graphics

SG24a   64x192 Block graphics (4 color)

G1C/R   64 x 64 graphics (2 & 4 color)

G2C/R   128 x 64 graphics (2 & 4 color)

G3C/R   128 x 96 graphics (2 & 4 color)

G6C   128 x 192 graphics (4 color)

G6R   256 x 192 graphics (2 color)

G6Ra   256 x 96 graphics (2 color)

- COCO 2 mode supports lowercase & inverse video
- 60hz & 63.5ns video interrupts
- Standard keyboard
- Standard joysticks (2)
- Built-in serial port
- Cassette port sound
  - Creation of real cassette tapes loadable on a COCO
- CCR-81 cassette recorders:
  - Virtual recorder saves & loads from virtual cassette files
  - Wave recorder saves & loads from Wave sound files
- Fully emulated Multi-Pak Interface

Hardware Cartridges Emulated
Disk BASIC & FDC Cartridge • 100% compatible WD1793 floppy disk controller • NMI & HALT supported

Orchestra-90 Music Synthesizer Cartridge

- Sound output to PC speaker, SoundBlaster or Wave file

RS-232 Cartridge (coming soon)

In addition to the standard Color Computer configuration the emulator also supports:

- A point & shoot configuration screen with:
  - Unlimited configurations selectable at start-up
  - All system options and virtual disks saved on exit
- A point & shoot virtual floppy disk selection screen with:
  - Ability to create and open new virtual disks
  - New & powerful virtual disk format able to do everything a real floppy disk can do
  - Able to read & write other emulators JV1 & JV3 disks
  - Ability to boot, read, write & format REAL COCO floppy disks in a compatible PC drive
- A virtual cassette control screen with:
  - Ability to open and create new virtual cassettes
  - Controls just like a real cassette recorder
  - Feature to force cassette motor on
- An Audio/Wave cassette control screen with:
  - Ability to open and create new audio Wave files
  - Controls just like a real cassette recorder
  - Ability to load real COCO tapes using SB line input
  - Ability to save cassette port output to Wave file
  - Ability to load Wave file recordings of tape programs
  - Feature to force cassette motor on
- Multi-Pak Interface allows loading of up to 4 ROM/Hardware cartridges.
  A .CAR file is automatically created when a new cartridge ROM is loaded and is user modifiable.
  The .CAR file contains:
  - Title & description of cartridge
  - Label & text color
  - Length of ROM image

- o Hardware options for cartridge
- Serial port I/O can be sent to a PC printer, PC file or PC serial port.
- 2 user selectable fonts (Standard & Lowercase)
  - o Fonts are files which can be user modidied
- 2 user selectable keyboard layouts (PC & COCO)
  - o Keyboard layouts are files which can be user modified to create custom keyboard layouts
- The color palette is a file enabling the COCO's colors to be user modified
- Computer Type
  - o COCO Standard BASIC or Extended BASIC
  - o COCO2 Standard BASIC or Extended BASIC
- Ability to save & load system snapshots
- Ability to load .BIN files directly from a PC directory
- Ability to load .PAK format cartridge files
- Ability to drop to a DOS prompt
- Emulator speeds are accurate to .01% of a real COCO's for true sound and game play, plus:
  - o Hot-key speed selection of .447, .895, 1.79, 3.58 MHZ & Turbo
  - o Turbo speed is limited only by your PC's speed
  - o An override speed can be set & locked so the COCO runs at user selected speeds transparent to COCO OS.
- Color artifacting option for graphics mode G6R. This option closely emulates colors created on a color TV when in the 256 x 192 graphics mode.
  - o Option can be disabled or set for Red/Blue, Blue/Red colors
- PC mouse, PC joystick & arrow keys emulate COCO's 2 joysticks
- Hardware clock (memory mapped)
- PC mouse support (memory mapped)
- PC to COCO file I/O (memory mapped)
- Enhanced instruction set including instructions to:
  - o Open/close/read/write PC files
  - o Read, change & display the PC directory
  - o Execute DOS commands
  - o 8, 16 & 32 bit multiply and divide functions
  - o Ability to read and write to PC I/O ports & memory
- Amplifier for cassette & Orchestra-90 sound:
  - o PC speaker
  - o SoundBlaster 16/32 ISA

Version 1.xx of the emulator is the result of hundreds of hours of programming and there are still updates to be made and COCO hardware to add support for. You are welcome to download a full working copy of the emulator without cost or obligation to experience the 1980's again. I'm trusting you to decide if the program is worthwhile and that if you continue to use the emulator beyond an introductory period that you will send $10 US to:

David Keil
P.O. Box 143
Alma Center, WI 54611

Failure to contribute to a program you find worthwhile and make use of will result in two things happening. 1) You will have nothing but restless nights until you contribute. 2) Continued upgrades and hardware support for the emulator will never be written.

Enjoy the emulator,

David Keil
dmkeil@discover-net.net
../../~dmkeil/

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Installation:

Unzip the Color Computer emulator program distribution zip into a directory. You should also download and unzip the support distribution zip into the same directory. Included in the zip is a Disk BASIC cartridge which will need to be inserted into a multi-pak slot before COCO disk can be accessed.

To start the Color Computer emulator type:

    COCO

To access a virtual disk push F9 to select a virtual disk, select disk #0 and push ENTER to select a virtual disk file, then highlight and push ENTER to select a virtual disk, then push F9 to return to the enulation screen and type:

DIR

The directory of the disk you inserted should be displayed. If a syntax error was reported or the boot-up message didn't show 'DISK BASIC' you will need to insert the Disk BASIC cartridge into the Multi-Pak Interface, set the select switch to the correct slot and reboot the emulator.

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Command line options:

The emulator has only one command line option. The option is to select a configuration file to use. This option is in the form:

COCO /@filename

replace filename with the name of the configuration file you wish to use. If the config file doesn't already exist it will be created. If you don't enter a /@ option then the filename defaults to COCO.CFG. All configuration changes, virtual disks, cartridges & cassettes you have selected are saved in this file when you exit the emulator. When you restart the emulator again using the same configuration name the emulator's configuration is loaded from this file.

Operation:

Once you have started the emulator operation is for the most part exactly like operating a real Color Computer. However, because there are no physical drives, floppies, reset & power switches and the need for configuration options and other enhancements beyond a normal COCO there is additional operation information the user will need to understand in order to use the emulator effectively.

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Operation - ROM Images:

The emulators come with various Color Computer ROM images. The ROM image loaded at emulator startup depends on which "Computer Type" is configured in the "Configuration Screen".

The emulator uses:

- BASIC.ROM (Standard Color BASIC)

- EXTBASIC.ROM (Extended Color BASIC)
- DSKBASIC.ROM (Disk BASIC)

The last ROM listed is actually a cartridge and will need to be inserted into the Multi-Pak Interface to be used.

The emulator also support cartridge ROM images. These images are raw dumps of an actual cartridge ROM. The load address is assumed to be $C000 and the length is assumed to be the actual file length with a maximum length of $3F00.

The emulator creates and maintains .CAR files which contains other important information about a cartridge ROM. This file is created when a cartridge ROM is first loaded and some of its information can be changed by the user. Check the section on the Multi-Pak Interface and the .CAR file technical information for more info about these files.

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Operation - The emulator keyboard:

The emulator has two keyboard layouts. Layout one is the PC layout where each PC key is translated and send to the emulator as labeled on the PC. Layout two is the COCO layout where each PC key sent according to the relative position on a real COCO keyboard. The best way to understand the difference is. In the PC layout a shift-2 will cause an '@' to be entered in the emulator. In the COCO layout a shift-2 will cause a double quote to be entered. Most of the time the user will want to run the emulator in the PC layout since the values labeled on the PC key is what is sent to the emulator. However, some COCO programs require key combinations using the few keys that get re-mapped and will not work with the translated layout. This is when the user would use the COCO layout.

ESCAPE	COCO break key
F1, F2	Mapped to keys of the same name on the COCO 3
CTRL	Works like Shift-Down arrow in the COCO emulator and as CTRL in the COCO 3 emulator. Right joystick button when keyboard joystick emulation is enabled.
ALT	Mapped to key of the same name on the COCO 3 Left joystick button when keyboard joystick emulation is enabled.
'	The `/~ key pushed un-shifted is the same as shift-@ on real COCO keyboard
F3 & Page-Down	COCO clear key

F4	Hot-key to bring up Multi-Pak Interface screen
Shift-F4	Hot-key to do a Power-Up reset of the COCO. Use this reset when changing cartridges and when the normal reset doesn't reset the COCO system.
F5	Hot-key to bring up system configuration screen
Shift-F5	Suspend emulator and drop to a DOS prompt.
F6	Hot-key to force a change in the emulator CPU speed.
Shift-F6	Lock the CPU speed. Locking the CPU speed prevents the COCO operating systems from changing the CPU speed.
F7	Hot-key to save a snapshot of the COCO program currently running
Shift-F7	Hot-key to: • load a snapshot of a saved COCO program • load a .BIN file from a PC directory • load a .PAK cartridge ROM image file from a PC directory This function will load the ROM image into cartridge slot #1 Use the F1 key to toggle the type of file that is loaded.
F8	Hot-key to stop Wave file recording, start or re-start playing recorded Orchestra 90 music
Shift-F8	Hot-key to stop playing recorded Orchestra 90 music
F9	Hot-key to bring up the virtual floppy drive status screen
Shift-F9	Hot-key to bring up the virtual hard drive status screen
F10	COCO reset key
Shift-F10	Exit the emulator (like the COCO power switch)
F11	Hot-key to bring up the virtual cassette control screen
Shift-F11	Hot-key to bring up the Audio/Wave cassette control screen
F12	Stop the MC6809 CPU and display MC6809 registers on status line. Each time F12 is pushed the CPU executes one MC6809 instruction (single step mode).
Shift F12	Stop the MC6809 CPU and display MC6809 registers on status line.

	Pushing when the CPU is stopped will re-start the CPU (ends single step mode).
Insert / Home / Page-Up / Delete / End	The [0],[: *], [- =], [; +] & [@] These COCO keys are re-mapped on these PC keys to eliminate some of the problems with translating the PC layout. For example, for programs that don't recognize caps-lock and use shift-0 as cap-lock instead, the user can use shift-Insert to enter the shift-0 key combination.
Caps-Lock	Works like Shift-0 in the COCO emulator and as Caps-Lock in the COCO 3 emulator.
Num-Lock	When keyboard emulation of COCO joysticks is enabled pushing Num-Lock toggles the joystick keys between joystick and keyboard input.
Arrow keys	Changes COCO joystick values when keyboard joystick emulation is enabled.

When the keyboard is in 'PC' mode the keys not defined above send keystrokes to the emulator corresponding to the character labeled on the PC's keyboard. The following are a few exceptions.

- The [~ ^ _ { | }] do not send keystrokes to the emulator.

When the keyboard is in 'COCO' mode the keys not defined above send keystrokes to the emulator corresponding to its relative location on a COCO keyboard. In most cases this is the same character labeled on the PC's keyboard. The following are some of the major differences.

- The '[{', '] } & '\ |' keys send '@', 'left arrow & 'right arrow' instead.
- The 'tab' & 'caps lock' keys send 'up arrow' & 'down arrow' instead.
- The [' "] key is not mapped.
- The [` ~] key is not mapped except in COCO 3 mode where it is 'caps lock'.

The following conditions apply to both keyboard modes.

- NumLock does not effect the number pad, it always sends numbers.
- The num-lock light does not reflect the state of the keyboard joystick emulation.
- The cap-lock light does not reflect the actual cap-lock state within the emulator.
- Don't use the PC's pause key to stop the emulator. This key will stop the emulator but doesn't stop interrupt functions and will cause COCO I/O errors. For programs that can't be paused use the F12, Shift-F12 key instead.

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Operation - The emulator display screen:

The emulator operates in 640x480x16 VGA mode. The, up to 8, colors the COCO uses are defined in a palette file (COCO.PAL).

At the bottom of the display screen is a status line. The four boxes on the left represent the 4 floppy drive select lights. Between drive lights 1 and 2 is the track number of the currently selected drive.

Following the drives lights is where is cassette counter is displayed. The same counter is used for the Virtual & Audio/Wave recorders.

Approximately in the center of the screen is the CPU speed. The available speeds are .447, .895, 1.79, 3.58 and turbo. The turbo speed is represented by question marks. If the speed message is in reverse-video then the speed is locked.

If a RS-232 or Modem pak is installed then the RS-232/Modem status indicators are displayed following the CPU speed. The 7 lights correspond to RX, TX, DTR, RTS, CTS, DSR & CD. The 8th light is unused. The first set of lights, closest to the CPU speed, are for the RS-232 pak and the second set is for the Modem Pak.

The four boxes on the left represent the 4 hard drive access lights. Between drive lights 1 and 2 is the cylinder number the hard drive is currently accessing.

When the CPU is in single step mode the section of the status line following the speed is the MC6809 register display. The MC6809 registers PC AB X Y U S DP CC are displayed here.

The Status line can be turned off in the configuration screen.

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Operation - The virtual floppy disk selection screens:

Since the emulator doesn't have actual floppy drives a way to remove, insert and create new virtual floppies from within the emulator is needed. The virtual disk selection screens are for that purpose.

To bring up the first of the selection screens push the F9 key. The emulator display screen will be replaced by the virtual drive status screen. This screen displays