BasTo6809 User Manual

Introduction

BasTo6809 is a compiler that converts a BASIC program into 6809 Assembly Language, designed to run on the TRS-80 Color Computer. The assembly code generated by BasTo6809 is ready for use with **LWASM**, allowing you to assemble and execute machine language programs on your CoCo.

This tool is ideal for anyone looking to take their BASIC programs and convert them to a lower-level language for faster execution or to speed up development of assembly language code.

Version Information

BasTo6809 Version: 4.39

Author: Glen Hewlett

GitHub: BASIC-To-6809

Table of contents

Usage

Once installed you can use the IDE called SDECB to import your BASIC program and to edit it or create a new BASIC program. When your BASIC program is complete you can compile it from the IDE Compile menu. This will turn you program into a 6809 assembly language program ready to be assembled using LWASM into a CoCo binary file to be executed on a CoCo or and emulator.

You can also use any other editor and compile your program from the command line using the following commands.

```
BasTo6809 [options] program.bas
```

Where program.bas is the BASIC program you wish to convert to 6809 assembly language.

By default, the compiler will output a fully commented assembly language file (program.asm) that can be processed by LWASM to produce a machine code program for the Color Computer.

Command Line Options

BasTo6809 provides several command-line options to customize the behaviour of the compiler:

All these options can be set and will take precedence if the first line of your .bas file has a line starting with:
'CompileOptions: -fArcade_B0_F1 -o -s32 -b0

-coco

Use this option if your input is a tokenized Color Computer BASIC program.

-ascii

Use this option for a plain text BASIC program written in ASCII format, such as a program created with a text editor.

-bx

Optimizes the branch lengths, affecting how efficiently LWASM assembles the program.

-b0 (default): Some branches may be longer than necessary, resulting in larger/slower programs.

-b1 Ensures all branches are as short as possible, producing smaller & faster programs, but will slow down the assembly process (a lot).

-a

Makes the program autostart after it is loaded

-**v**

Displays the version number of BasTo6809.

-ox

Controls the optimization level during the compilation process:

-o0 disables optimizations (not recommended).

-o1 enables basic optimization.

-o2 (default) enables full optimization for the fastest and smallest possible code.

-pxxxx

Specifies the starting memory location for the program in hexadecimal. Useful if you need some extra space reserved for your own program. The default starting location for the compiled program is $0E00.

Example: -p4000 sets the starting address at $4000.

-sxxx

This option sets the maximum length to reserve for strings in an array. The default (and maximum) is 255 bytes. If your program uses smaller strings, setting this value can reduce the amount of RAM your program uses.

Example: -s128 reserves 128 bytes for each string.

-fxxxx

Where xxxx is the font name used for printing to the graphics screen (default is Arcade_B0_F1). Look in folder Basic_Includes/GraphicsMode/Graphic_Screen_Fonts to see font names available

-Vx

Sets the verbosity level of the compiler output.
-v0 (default) produces no output during compilation.
-v1 shows basic information while compiling.
-vx x=2,3 or 4 more info is displayed while compiling

-k

Keeps miscellaneous files generated during the compilation process.
By default, these files are deleted, leaving only the .asm file.

-h

Displays a help message with information on how to use BasTo6809.

Cool things the Compiler can do

– You can write the program on a CoCo or on a modern computer using any text Editor, but you're better off using the included IDE.

– New **GMODE** command allows you to choose every graphic mode the CoCo can produce, including semi graphics and if using a CoCo 3 all of the CoCo 3 graphics modes and Colour modes. Using these new screens you can use LINE (with B & BF), CIRCLE and PAINT commands.

– Can print directly to any graphic screen directly using PRINT #-3,

– Use of line numbers is optional

– You can use Labels for sections of code to jump to (case sensitive)

– Variable names can be 25 characters long (case sensitive)

– Doesn't use any ROM calls, possible to use all of the 64k of RAM on Coco 1 & 2

– The assembly language code generated is fully commented showing each BASIC line and how it's compiled. The assembly file generated can be used to help someone learn how to program in assembly language. Or allow an experienced assembly programmer to optimize the program by hand.

– Many new SDC related commands allow you to read and write directly to the SDC filesystem from your BASIC program

– A new SDC audio playback command to play RAW audio samples directly from the SD card in the CoCoSDC

– Easily add assembly code anywhere you want in your program and easily share values of variables between BASIC and your assembly code.

– Added sprite commands

– Added commands for the CoCo 3 to use scrollable playfields (backgrounds)

Changes to BASIC's Graphic features

PMODE has been replaced by the **GMODE** command
PCLS has been replaced by the **GCLS** command
PCOPY has been replace with the **GCOPY** command
LINE command format has been changed to include a colour value and no longer uses **PSET** and **PRESET**.

The commands **PSET, HSET, PRESET, HRESET, PPOINT** or **HPOINT** are not supported. Instead they are replaced with **SET** and **POINT** commands. The compiler will use whichever graphic mode is set using the GMODE command and will SET pixels to the requested colour the user wants that matches the GMODE requested.

You can now use SET,POINT,LINE,CIRCLE & PAINT commands on every screen, even the regular text screen, using GMODE 0,1

GMODE ModeNumber,GraphicsPage

Selects the graphics screen and the graphics page.
ModeNumber is the graphics mode you want to use
GraphicsPage is the Page you want to show/use for your graphics commands
To see a list of ModeNumbers and the resolutions **go here**

Special note the **ModeNumber** must be an actual number and cannot be a variable as the compiler needs to know exactly which graphic mode commands to be included at compile time.
GraphicsPage can be a variable.
If you are going to use Graphic pages, the compiler needs to know how many pages to reserve in RAM (for CoCo 1 & 2 graphics). So you must have a GMODE #,MaxPages entry at the beginning of your BASIC program. Where the value of MaxPages will be an actual number and not a variable.

GCLS #

Colour the graphics screen
is the colour value you want the screen to be coloured

GCOPY SourcePage,DestinationPage

Makes a copy the Source graphics page to the Destination graphics page.

SourcePage - Source graphics page

DestinationPage - Destination graphics page

SET(x,y,Colour)

Sets a pixel on the screen

x,y - Screen location of the pixel to be drawn

Colour - Colour Number of the pixel to be drawn

POINT(x,y)

Returns the colour value of the pixel selected

x,y - Screen location of the pixel value requested

LINE(x0,y0)-(x1,y1),Colour[,B][F]

x0,y0 - Starting location

x1,y1 - Ending location

Colour - Colour of the Line or Box to draw

B - Draw a Box

F - Fill the Box

PAINT(x,y),OldColour,FillColour

Fills the old colour value with the fill colour value which must also be the border colour of the section you are painting

x,y - Starting location

OldColour - Colour Number

FillColour - Colour Number

CIRCLE(x,y),Radius,Colour

Draws a circle on the screen

x,y - Origin of the circle

Radius - Size of the circle, to keep the aspect ratio close to round

Some of the graphics modes use scaling so the Radius isn't always a count of actual pixel values.

Colour - Colour Number of the circle to draw

PALETTE v,Colour

Sets the CoCo 3 Palette value

v -palette slot of 0 to 15

Colour - Colour value of 0 to 63

DRAW, GET & PUT commands are not yet available

New commands or features added to Color BASIC

– **IF/THEN/ELSE/ELSEIF/ENDIF**
– **SELECT/CASE**
– **WHILE/WEND**
– **DO/WHILE/LOOP**
– **DO/LOOP/UNTIL**

– SDC_PLAY Command that plays an audio sample or song directly off the SD card in the SDC Controller. See here for more info

– **SDC_PLAYORCL**, **SDC_PLAYORCR**, **SDC_PLAYORCS** these commands are similar to SDCPLAY except the audio is sent to the Orchestra 90 or COCOFLASH cartridge. See here for more info

– SDC file access commands that allow you to Read & Write files directly on the SD card's own filesystem. See here for more info

– Floating Point commands (special commands to handle floating point calculations and operations. See here for more info

– GETJOYD - Quickly get the joystick values of 0,31,63 of both joysticks both horizontally and vertically

- PRINT #-3, - Print to the graphics screen created with the GMODE command. Can also be used as ?#-3,"Hello World!". The default font is ArcadeArcade_B0_F1, but you can select others using the compiler command -fxxxx Where xxxx is the font name used for printing to the graphics screen (default is Arcade_B0_F1). Look in folder Basic_Includes/GraphicsMode/Graphic_Screen_Fonts to see font names available

- PLAYFIELD # - Used to set the Scrollable playfield mode. The # given must be an actual number and not a variable.

# Max Resolution	Min Resolution	Size Multiple
1 - 256 x 7872	256 x 192	not applicable x 64
2 - 512 x 3840	512 x 192	not applicable x 192
3 - 1024 x 512	1024 x 256	not applicable x 256
4 - 2048 x 256	512 x 256	256 x not applicable
5 - 2560 x 192	512 x 192	256 x not applicable

- VIEW x,y - Command to select where in the scrollable playfield you want to see. The x & y co-ordinates are the top left corner of a viewable window of the playfield.

SPRITE_LOAD “SpriteName.asm”, #[,f] — Load a Sprite
The SPRITE_LOAD command loads a sprite into your program.

- "SpriteName.asm" is the name of your sprite file (must be in assembly format). Generated by the command line tool called **PNGtoCCSprite**
- **#** is the sprite number — a numeric ID used to reference this sprite in your program when using actual SPRITE commands.
- **f** is the number of frames this sprite has can be left blank if the sprite has only one frame.

This command associates the loaded sprite with the given number, so you can easily manage multiple sprites in your game.

SPRITE Command — Control Sprites on the Screen
The SPRITE command, along with various options, allows you to control the appearance and behaviour of sprites in your program.

Command Reference:
SPRITE OFF [#]
Turns off sprite number **#**.
If no number is provided, all sprites are turned off.

SPRITE LOCATE #, x, y
Moves sprite **#** to a new position on the screen.
x and **y** are the playfield coordinates.

SPRITE SHOW #[, f]
Displays sprite **#** using frame **f**.
If the sprite is not animated (i.e. it has only one frame) use of ,f is optional.

SPRITE BACKUP #
Saves the background behind sprite **#**.
This allows the sprite to be cleanly erased later.

SPRITE ERASE #
Erases sprite **#** and restores the background previously saved with SPRITE BACK.

SPRITE #,x,y[,f]
Draws sprite number **#** at **x**,**y** co-ordinates using frame **f**.
f is optional, a value of 0 (single frame sprite) is used if not given.

WAIT VBL - Wait for Vertical Blank then update the sprites on screen

CPUSPEED #
The compiler will detect and run the CPU at the maximum speed it can on the hardware it is running. If you want to change the speed use this command to set the CPU speed to value x
#=1 then set the CPU in Emulation mode and set the speed at .895 Mhz
#=2 then set the CPU in Emulation mode and set the speed at 1.79 Mhz
#=3 then set the CPU in Emulation mode and set the speed at 2.864 MHz
If **#** is anything else then the CPU will be set in Native mode and run at it's max speed

COPYBLOCKS source,destination,#
This is a CoCo 3 specific command which copies 8k blocks to other 8k blocks very fast. Useful for double buffering CoCo 3 background screens
source - First source block to be copied from
destination - First Destination block number to be copied to
# - Number of blocks to copy

TRIM$(string)
Removes spaces from both ends of a string
string - String variable

LTRIM$(string)
Removes spaces from the beginning of a string
string - String variable

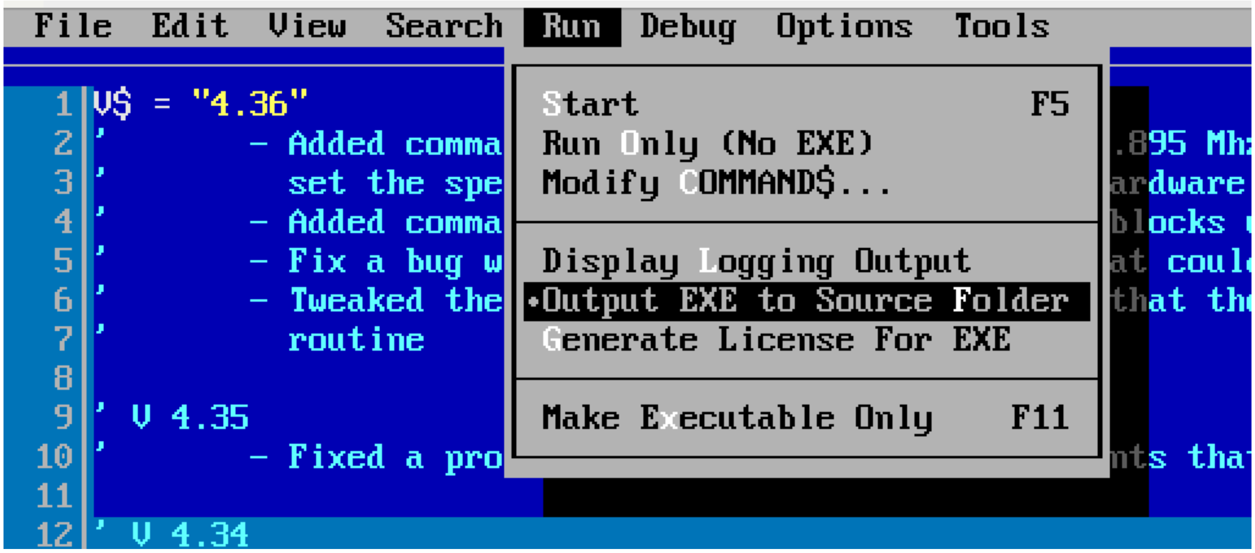
RTRIM$(string)
Removes spaces from the end of a string
string - String variable

How to Install

The compiler is called BasTo6809 and is written in BASIC specifically QB64pe (Phenix Edition). QB64pe is multi-platform so this BASIC to 6809 compiler can be used on a Mac, Linux or Windows machine.

Using QB64pe click on the Run menu option then click option "Output EXE to Source Folder"

There should now be a dot on the left of "Output EXE to Source Folder". This means this option is selected and the files that are compiled will be in the same folder as the source .bas files.

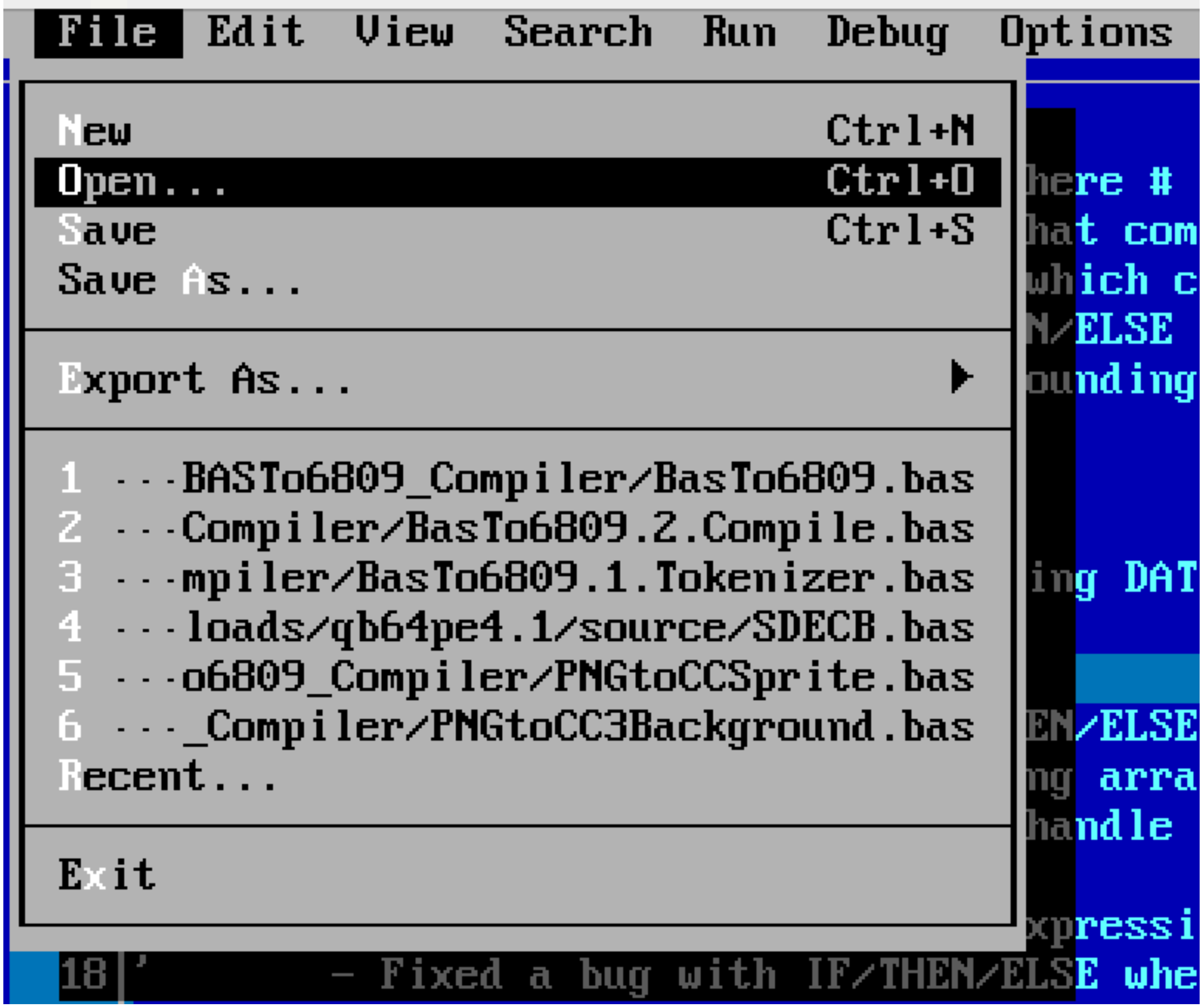


```
V$ = "4.36"
'       - Added comma                            .895 Mh
'         set the spe                            ardware
'       - Added comma                            blocks
'       - Fix a bug w                            at coul
'       - Tweaked the                            that th
'         routine

' V 4.35
'       - Fixed a pro                            nts tha

' V 4.34
```

Next you will need to load the .bas files for the compiler. Use Menu option File | Open (Ctrl+O)


File
Edit
View
Search
Run
Debug
Options
New Ctrl+N
Open... Ctrl+O
Save Ctrl+S
Save As...
Export As...
1 ...BASTo6809_Compiler/BasTo6809.bas
2 ...Compiler/BasTo6809.2.Compile.bas
3 ...mpiler/BasTo6809.1.Tokenizer.bas
4 ...loads/qb64pe4.1/source/SDECB.bas
5 ...o6809_Compiler/PNGtoCCSprite.bas
6 ..._Compiler/PNGtoCC3Background.bas
Recent...
Exit
' - Fixed a bug with IF/THEN/ELSE whe

1) Find the file BasTo6809.bas and choose/load it. Then press F11 which will compile it and save the executable version in the same folder it was opened/loaded from.
2) Open the file BasTo6809.1.Tokenizer.bas and once loaded press F11, again this will compile it and save the executable version in the same folder it was opened/loaded from.
3) Open the file BasTo6809.2.Compile.bas and once loaded press F11, again this will compile it and save the executable version in the same folder it was opened/loaded from. (This will take awhile to compile)
4) Open the file cc1sl.bas and once loaded press F11, again this will compile it and save the executable version in the same folder it was opened/loaded from.

Compile the Integrated Development Environment - IDE

The IDE's name is SDECB (Super Duper Extended Color Basic)

Similar to the other .bas programs you have just compiled you can now also compile the IDE. Once again File | Open this time go into the IDE folder and select/load SDECB.bas, once loaded press F11 to compile it. This may also take awhile. Once finished you will have the executable version in the IDE folder.

For **Mac and Linux users** the executable files that have just been created won't have extensions. For **Windows users** the executable files that have just been created will have the extension .exe

Now that you have all the files compiled into executable files you can copy them all to a new working folder of your choice. From the IDE folder you must copy the executable file SDECB.exe and also the folder "internal" to your new working folder.
- If you're using **Windows** machine you should also copy the file "**compile.bat**" from this folder to your working folder.
- If you're using **Mac or Linux** machines you should also copy the file called "**makefile**" from this folder to your working folder.
****** the compile.bat and makefile are used by the IDE to compile your BASIC programs and gives you flexibility on what to do once you compile your BASIC program. These files can be edited so you can add functionality to your development environment.

From the main folder (one folder up from the IDE folder) you need to copy the executable files, BasTo6809.exe, BasTo6809.1.Tokenizer.exe, BasTo6809.2.Compile.exe and cc1sl.exe (again on Mac and linux there won't be any extensions on the executable filenames) to your new working folder

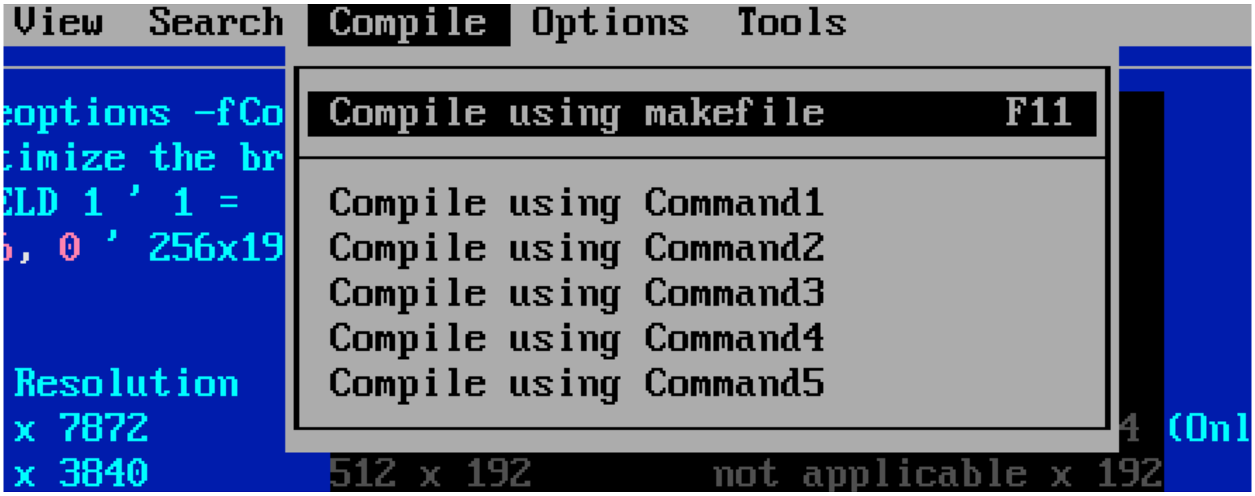
You also must copy two folders "Basic_Includes" & "Basic_Commands" you may wish to copy the "Sample_Programs" folder if you want but it isn't necessary.

One last thing you will need to do is install lwasm on your computer as this is the assembler that is needed to turn the assembly output from the compiler into the final machine language program.

Make sure lwasm is either installed in your working folder or it is in your path. The compile.bat and makefile do expect lwasm to be in the working folder.

Once you're working folder is setup you can use the IDE called SDECB.exe to write your BASIC program. The IDE will give you warnings if there are any commands it doesn't understand or there is a syntax error in your code that you can find and fix before you even try to compile your program.

Once you're ready to compile your program you can Press F11 or goto Menu Compile and select the command you want to follow.



These Commands run commands in your compile.bat/makefile which you can edit to suite your needs. For example you could have Command5 compile the program, assemble it with lwasm then copy it to a floppy disk image and start your emulator of choice. If you look at the compile.bat or makefile you should be able to follow along the structure of the file to figure out how to add actions to the various commands.

You can also compile your BASIC programs to machine language from the command line using the following commands:

Using **MacOS** or **Linux**:

```
./BasTo6809 -ascii BASIC.bas
lwasm -9bl -p cd -o./ML.bin BASIC.asm > ./Assembly_Listing.txt
```

Using **Windows**:

```
.\BasTo6809.exe -ascii BASIC.bas
lwasm -9bl -p cd -o./ML.bin BASIC.asm > ./Assembly_Listing.txt
```

At this point you'll have an EXECutable program called ML.bin in the folder that you can use on a real CoCo or an emulator.

Optimizing

To generate the fastest and smallest version of your program use the compiler option -b1. LWASM will take awhile to assemble so be patient, could be a minutes or many and **it may seem like nothing is happening**:

For MacOS and Linux:

```
./BasTo6809 -b1 HELLO.BAS
```

For Windows:

```
.\BasTo6809 -b1 HELLO.BAS
```

The only other thing you might need to do if you have a program that is very big is use the cc1sl program. The steps for compiling a big program are:

For MacOS and Linux:

```
./BasTo6809 -b1 HELLO.BAS
lwasm -9bl -p cd -o./HELLO.BIN HELLO.asm > ./NEW_Assembly_Listing.txt
./cc1sl -l HELLO.BIN -oBIGFILE.BIN
```

For Windows:

```
.\BasTo6809 -b1 HELLO.BAS
lwasm -9bl -p cd -o./HELLO.BIN HELLO.asm > ./NEW_Assembly_Listing.txt
.\cc1sl -l HELLO.BIN -oBIGFILE.BIN
```

In this case your final program to execute on the CoCo is called BIGFILE.BIN, you can of course call it whatever you want. Remember to only use cc1sl if your file is fairly big. I remember testing it with small programs and it seemed to not work. I never did look into why at least as of yet. But it works perfect if you do have a large program that does require more than 32k.

The latest version of the compiler can be found on my GitHub site.
For support, ask for help on the CoCo Nation basic-to-6809 Discord channel

64k programs

If your program requires more than 32k you must use the cc1sl program (CoCo 1 Super Loader). This program enables the loading of an ML program no matter where it will be loaded into RAM including where the BASIC ROM addresses are.

```
cc1sl - CoCo 1 Super Loader v1.03 by Glen Hewlett
Usage: cc1sl [-l] [-vx] FILENAME.BIN -oOUTNAME.BIN
[.scn] or [.csv]…
Turns a CoCo 1 Machine Language program into a loadable
program no matter if it over writes BASIC ROM locations
and more
Where:
-l Will add the word LOADING at the bottom of the
screen while the program
loads
-vx Amount of info to display while generating the new
file x can be 0, 1 or 2. Default x=0 where no info is
shown
FILENAME.BIN is the name of your big CoCo 1 program, it
must end with .BIN
OUTNAME.BIN is the name of the output file to be
created otherwise it defaults to GO.BIN
*.scn A binary file that must end with .scn will be
shown on the CoCo text screen while loading
*.csv A csv text file that must end with .csv will be
shown on the CoCo text screen while loading
For more info see the cc1sl_help.txt file
```

cc1sl.bas is also a QB64pe program cc1sl.bas that you must compile with QB64pe before using.

Supported BASIC commands

AUDIO ON/OFF - Pass audio from the cassette input to the computer audio output

CASE - used with SELECT CASE/END SELECT

CIRCLE - CIRCLE (x, y), radius, color

CLEAR - Clears all the variables and arrays to zero

CLS [#] - Colour the screen

COPYBLOCKS source,destination,#

CPUSPEED # (1,2,3 Mhz(ish) any other number program will run hardware as fast as it can including a 6309 will go into native mode

DATA- DATA “MYDATA”,2,4,5

DEF FN - Define a function

DIM - DIM array1(100),array$(10)

DO (WHILE/UNTIL)

ELSE

ELSEIF

END - End program, the compiler will try to exit back to Color Basic but might crash the computer.

END IF

END SELECT - Part of SELECT CASE

EVERYCASE - Part of SELECT CASE

EXEC # - EXECute code at a given address

EXIT (DO,FOR,WHILE) - jump out of a loop

FOR

GCLS # - Colour the graphics screen #

GETJOYD - New command which allows you to quickly get the joystick values of 0,31,63 of both joysticks both horizontally and vertically
Results are stored same place BASIC normally has the Joystick readings:

```
LEFT LEFT RIGHT RIGHT
VERT HORIZ VERT HORIZ
$15A $15B $15C $15D
```

GMODE [Mode],Page - Set the graphics mode and graphics page

GOSUB

GOTO

GCOPY Source,dest - Copy graphics page to another graphics page

IF

INPUT

LET

LINE

LOADM

LOCATE - Set the position on the graphics screen to print text from

LOOP (WHILE/UNTIL)

MOTOR ON/OFF - Turn the cassette relay on or off

NEXT

NTSC_FONTCOLOURS b,f - Only used for GMODE 160 to 165. This sets the background and foreground colours of the NTSC composite output fonts.

ON GOSUB

ON GOTO

PAINT

PALETTE v,colour

PLAY

PLAYFIELD # - Tells the compiler which playfield (scrolling) mode to use

POINT

POKE

PRINT – Can’t do PRINT USING

READ

RESET

RESTORE

RETURN

RUN - Will ReRun the program as if it was just loaded

SCREEN

SDC_BIGLOADM"FILENAME.BIN",#

SDC_CLOSE(#)

SDC_DELETE(A$)

SDC_DIRPAGE A$,B$,x

SDC_FILEINFO$(#)

SDC_GETBYTE(#)

SDC_GETCURDIR()

SDC_INITDIR(A$)

SDC_LOADM"FILENAME.BIN",#[,Offset]

SDC_MKDIR(A$)

SDC_OPEN”FILENAME.EXT”,”X”,#

SDC_PLAY"FILENAME.BIN",#

SDC_PLAYORCL"FILENAME.BIN",#

SDC_PLAYORCR"FILENAME.BIN",#

SDC_PLAYORCS"FILENAME.BIN",#

SDC_PUT0 x

SDC_PUT1 x

SDC_SAVEM"FILENAME.BIN",#,Start,End,Exec
SDC_SETDIR(A$)
SDC_SETPOS(#,a,b,c,d)
SELECT - SELECT CASE/END SELECT
SET
SPRITE
STEP
STOP
SOUND
TAB()
TIMER
UNTIL
VIEW x,y - View location for a scrollable playfield
WAIT VBL
WHILE/WEND - loop control
WPOKE location,word - POKE a 16 bit word value in memory location

Numeric Commands it can handle

ABS()
ASC()
BUTTON(#) - Get the status of one of the joystick buttons
CMPGT(FP_A,FP_B) - Floating Point Compare if Greater Than
CMPGE(FP_A,FP_B) - Floating Point Compare if Greater Than or Equal
CMPEQ(FP_A,FP_B) - Floating Point Compare if Equal
CMPNE(FP_A,FP_B) - Floating Point Compare if Not Equal
CMPLE(FP_A,FP_B) - Floating Point Compare if Less Than or Equal
CMPLT(FP_A,FP_B) - Floating Point Compare if Less Than
FLOATADD(FP_X,FP_Y) - Floating Point ADD
FLOATATAN(FP_X,FP_Y) - Floating Point ATAN
FLOATCOS(FP_X,FP_Y) - Floating Point COS
FLOATDIV(FP_X,FP_Y) - Floating Point DIV
FLOATEXP(FP_X,FP_Y) - Floating Point EXP
FLOATLOG(FP_X,FP_Y) - Floating Point LOG
FLOATMUL(FP_X,FP_Y) - Floating Point MUL
FLOATSIN(FP_X,FP_Y) - Floating Point SIN
FLOATSQR(FP_X,FP_Y) - Floating Point SQR
FLOATSUB(FP_X,FP_Y) - Floating Point SUB
FLOATTAN(FP_X,FP_Y) - Floating Point TAN
FLOATTOSTR$(FP_A) - Floating Point number to a string
FN()
INSTR([start],Basestring,SearchString)
INT()
JOYSTK()
LEN()
PEEK()
POINT()
RND(x) - Fast random number generator, will generate a value between
1 and x, where x can have a max value of 255
RNDZ(x) - Fast random number generator, will generate a value between
0 and x, where x can have a max value of 255
RNDL(x) - Large random number generator, will generate a value between
1 and x, where x can have a max value of 32767
SGN()
STRTOFLOAT(A$) - Convert a string to a Floating Point variable
SQR()
VAL()

WPEEK(location) - Returns with 16 bit word value stored in location

String Commands it can handle

CHR$()
HEX$()
INKEY$
LEFT$()
LTRIM$()
MID$()
RIGHT$()
RTRIM$()
STR$()
STRING$()
TRIM$()

Logical operators it can handle

AND
OR
XOR
NOT

Math operators

+,-,*,/,^, MOD = remainder, DIVR same as / except the result is rounded to the nearest value. For compatibility it accepts \ as integer division (which is the same as /)

Command Descriptions: (work in progress)

PALETTE - Palette v,colour where v is the palette slot of 0 to 15 and colour is the colour value of 0 to 63

PLAYFIELD # — Scrollable Playfield Mode Selection

The PLAYFIELD # command sets the scrollable playfield mode in your BASIC program. The # must be a literal number, not a variable.

To create playfield graphics, use the command-line tool PGNtoCC3Playfield to convert a PNG into a file (or files). These can then be loaded into memory using one of the following commands in BASIC:

- LOADM
- SDC_LOADM
- SDC_BIGLOADM

Once loaded, the background playfield becomes scrollable according to the selected mode.

# Max Resolution	Min Resolution	Size Multiple
1 - 256 x 7872	256 x 192	not applicable x 64
2 - 512 x 3840	512 x 192	not applicable x 192
3 - 1024 x 512	1024 x 256	not applicable x 256
4 - 2048 x 256	512 x 256	256 x not applicable
5 - 2560 x 192	512 x 192	256 x not applicable

VIEW x,y - Command to select where in the scrollable playfield you want to view. The x & y co-ordinates are the top left corner of a viewable window of the playfield.

New SDC Commands

Besides using the new SDC_LOADM and SDC_SAVEM commands you can read and write to files and folders on the SD card installed in your CoCoSDC directly.

SDC_LOADM"FILENAME.BIN",#[,Offset]

Loads a machine language binary file into the computer from the SDC directly.
is the file number 0 or 1
Offset is optional, if it's included this amount will be added to the original LOADM address.

SDC_SAVEM"FILENAME.BIN",#,Start,End,Exec

Saves a section of memory to the SDC directly
is the file number 0 or 1
Start Address in memory to start copying from
End Address in memory to sop copying from
Exec Address where the program should start execution
Saves a section of memory to the SDC directly

SDC_BIGLOADM"FILENAME.BIN",#

Loads CoCo 3 Memory Blocks very fast. Useful for loading in background screens for games or other large amounts of data.
is the file number 0 or 1
See the end of this document for the specs of this file format

SDC_OPEN"FILENAME.EXT","X",#

Opens file for Reading from or Writing to the SD card directly.
FILENAME.EXT - can be any 8 character filename with a 3 character extension
X - is either an **R** for Read or **W** for Write
- is the file number to open. This must be either a 0 or a 1

SDC_CLOSE(#)

Closes the open file where **#** is 0 or 1

SDC_PUTBYTE0 x

Writes a single byte variable x to the open file 0

SDC_PUTBYTE1 x

Writes a single byte variable x to the open file 1

x=SDC_GETBYTE(#)

Reads a single byte from the open file number (0 or 1) and stores the value in variable x, auto increments so the next read will be the next byte in the file. Optionally use the SDC_SETPOS() command to set the starting location in the file.

- is the file number. This must be either a 0 or a 1

SDC_SETPOS(#,a,b,c,d)

Sets the position in the file to read.

- is the file number (0 or 1)

a,b,c are the Logical sector number
(24 bit number of the 256 byte sectors)
a Most significant byte
b Mid significant byte
c Least significant byte

d The byte in the selected sector (zero based)

So if you wanted to get the byte 300 in the open file #1 you would use: **SDC_SETPOS(1,0,0,1,43)**

Points at the 300th byte

n=SDC_GET(1)

n now has the value of the 300th byte, the next SDCGET(1) command will get the 301st byte and so on.

A$=SDC_FILEINFO$(#)

This will copy the 32 bytes of file info to a string variable such as A$ the info can be useful for calculating the file size.

is the file number either 0 or 1.

This is the layout of the bytes in the string:

1-8	File Name
9-11	Extension
12	Attr. bits: $10=Directory, $04=SDF Format, $02=Hidden, $01=Locked
29-32	File Size in bytes (LSB first)

x=SDC_DELETE(A$)

Delete a file or empty directory on the SDC
A$ = variable with the full path to the empty directory or file you want delete.
Result in x where x is:
0 No Error
1 SDC busy too long
3 Path name is invalid
4 Miscellaneous hardware error
5 Target file or directory not found
6 Target directory is not empty

The next section are commands related to SD card directories

x=SDC_MKDIR(A$)

Make a directory on the SDC

A$ = variable with the full path to the directory you wish to make

Result in x where x is:

0 No Error

1 SDC busy too long

3 Path is invalid

4 Miscellaneous hardware error

5 Parent directory not found

6 Name already in use

x=SDC_SETDIR(A$)

Sets the directory on the SDC

A$ = variable with the full path to the directory you change to

Result in x where x is:

0 No Error

1 SDC busy too long

3 Path is invalid

4 Miscellaneous hardware error

5 Target directory not found

GET CURRENT DIRECTORY
A$=SDC_GETCURDIR(0)

Retrieves information about the Current Directory for the SD card

String variable A$=Directory info string where the following bytes are:

1-8	Filename
9-11	Extension
12-31	Private

x=SDC_INITDIR(A$)

First step to getting a directory listing. To get a directory you must first use this command to setup where and what to list on the directory.

A$ = variable to the full path name of the target directory. The final component of the path name should be a wildcard pattern that will be used to filter the list of returned items.

Example:

A$="MYDIR/*.*" - will list everything in MYDIR
A$="MYDIR/*.TXT" - will list files ending with .TXT

Result in **x** where **x** is:

0 No Error
1 SDC busy too long
3 Path is invalid
4 Miscellaneous hardware error
5 Target directory not found

SDC_DIRPAGE A$,B$,x

Second step to getting a directory listing.

This command returns a 256 byte data block which is divided into 16 records of 16 bytes each. Each record describes one item. If there are not enough items to fill the entire page then unused records are filled with zeroes. You may continue to send commands for additional pages until a page containing at least one unused record is returned. Since the directory listing is 256 bytes and the max size of a string is 255 bytes. The listing is split into two string variables with 128 bytes of the directory each. The first variable **A$** will get the the first 128 bytes and the second variable **B$** will get the second 128 bytes of the directory listing.

Each entry is:

1-8	File Name
9-11	Extension
12	Attribute bits $10=Directory, $02 Hidden, $01 Locked
13-16	Size in bytes (MSB first)

Result in **x** where **x** is:

0 No Error
1 SDC busy too long
4 Listing has not been initiated or already reached the end of a listing

SDC Audio Playback Commands

SDC_PLAY	- Playback mono audio samples at 44.75 kHz
SDC_PLAYORCL	- Playback mono audio samples at 44.75 kHz
SDC_PLAYORCR	- Playback mono audio samples at 44.75 kHz
SDC_PLAYORCS	- Playback stereo audio samples at 22.375 kHz

SDC_PLAY - Playback an audio file directly stored on the SDC output through the CoCo directly.
Usage: SDC_PLAY”MYAUDIO.RAW”, **#**
is the file number 0 or 1

While the sample is playing you can press the BREAK key to stop it.

In order for you to get your audio sample in the correct format to be played back you’ll need to prepare your audio samples and put them on the SD card. The format for the raw audio file that will be played is mono 8 bits unsigned. To convert any sound file or even the audio from a video file to the correct format used with the SDCPLAY command use FFMPEG and the following command:

```
ffmpeg -i source_audio.mp3 -acodec pcm_u8 -f u8 -ac 1 -ar 44750 -af aresample=44750:filter_size=256:cutoff=1.0 MYAUDIO.RAW
```

You can also use an audio tool like Audacity to Export an audio sample to an uncompressed Mono 44750 Hz, RAW (header-less) unsigned 8-bit PCM sample.

SDC_PLAYORCL & **SDC_PLAYORCR** use the same audio format as the regular SDC_PLAY command except the output is sent to the Orchestra90/ **COCOFLASH** Left or Right speaker.

If you want to stream 8 bit stereo sound from your CoCo to the **COCOFLASH**/Orchestra90 use the command:
SDC_PLAYORCS”MYSAMPLE.RAW” where the sample MYSAMPLE.RAW is stored on the SD card in your SDC Controller. It can be created with the FFMPEG command below:

```
ffmpeg -i source_audio.mp3 -acodec pcm_u8 -f u8 -ac 2 -ar 22375 -af aresample=22375:filter_size=256:cutoff=1.0 MYSAMPLE.RAW
```

You can also use an audio tool like Audacity to Export an audio sample to an uncompressed Stereo 22375 Hz, RAW (header-less) unsigned 8-bit PCM sample.

New Floating Point Commands

One of the things that makes a compiler so fast is that it uses integer math. If you must use floating point math and you don't mind the slowdown in speed you can use the following commands.

FLOATADD(FP_X,FP_Y)	- Floating Point **ADD**
FLOATATAN(FP_Y)	- Floating Point **ATAN**
FLOATCOS(FP_Y)	- Floating Point **COS**
FLOATDIV(FP_X,FP_Y)	- Floating Point **DIV**
FLOATEXP(FP_X)	- Floating Point **EXP**
FLOATLOG(FP_X)	- Floating Point **LOG**
FLOATMUL(FP_X,FP_Y)	- Floating Point **MUL**
FLOATSIN(FP_X)	- Floating Point **SIN**
FLOATSQR(FP_Y)	- Floating Point **SQR**
FLOATSUB(FP_X,FP_Y)	- Floating Point **SUB**
FLOATTAN(FP_X)	- Floating Point **TAN**

New Floating Point String conversion commands:

FLOATTOSTR$(FP_A)	- Floating Point number to a string
STRTOFLOAT(A$)	- Convert a string to a Floating Point variable

New Floating Point Comparison commands:

CMPGT(FP_A,FP_B)	- Floating Point Compare if Greater Than
CMPGE(FP_A,FP_B)	- Floating Point Compare if Greater Than or Equal
CMPEQ(FP_A,FP_B)	- Floating Point Compare if Equal
CMPNE(FP_A,FP_B)	- Floating Point Compare if Not Equal
CMPLE(FP_A,FP_B)	- Floating Point Compare if Less Than or Equal
CMPLT(FP_A,FP_B)	- Floating Point Compare if Less Than

In order to use floating point variables you must prefix the variable name with "**FP_**" for example:

```
FP_X=FLOATSQR(12.33452)
```

FP_X will now equal 3.51205353

```
FP_Var5=100.12345
```

FP_X and a variable named X are different variables. X will be a signed 16 bit integer and FP_X is a floating point number.

Variable conversions can only be done directly as a single command
You cannot do FP functions assigned directly to a signed integer variable:

```
X=FLOATMUL(100,0.100912345)
```

You must do it in two steps, first use a floating point variable with the the math function as

```
FP_Var5=FLOATMUL(100,0.100912345)
```

Results FP_Var5 = 100.912345
Then copy the floating point number to the signed integer variable as

```
X=FP_Var5
```

Now X will equal 101 (rounding is done)

You can assign a FP number directly to a signed int as:
`X=100.912345` then X will equal 101 (rounding is done)
`X=FP_Var1` then X will equal the signed integer value of the floating point variable FP_Var1
`C(3,6)=FP_Var2` then the array C(3,6) will equal the signed integer value of the floating point variable FP_Var2

Conversion from signed integers to FP variables can be done directly as

```
FP_Var1=X
```

If you want to assign an equation of signed ints to a floating point variable it must be done with the `INT()` command

```
FP_Var1=INT(X*32+Y/5)
```

Input values of the commands can be any of the following:

- A floating point variable such as FP_MyFloatVariable1 as

```
     FP_Var2=FLOATADD(FP_MyFloatVariable1,FP_Var1)
```

- A floating point number such as 100.352 as:

```
     FP_Var2=FLOATADD(FP_Var1,100.352)
```

- A regular 16 bit signed variable, must use INT() as:

```
     FP_Var2=FLOATADD(FP_Var1,INT(X))
```

- A regular 16 bit signed expression, must use INT() as:

```
     FP_Var2=FLOATADD(INT(X*23+F),FP_Var1)
```

You can not do complicated equations with floating point math directly. You must do the equation in steps.

Example, if you wanted to do FP_Var1=FP_Var2*55.234+63.56*X

You would need to do this as:

```
FP_Temp1=FLOATMUL(FP_Var2,55.234)
FP_Temp2=FLOATMUL(63.56,INT(X))
FP_Var1=FLOATADD(FP_Temp1,FP_Temp2)
```

To convert user input to a floating point number it must be in a string variable and converted to a floating point number with the command **STRTOFLOAT(A$)** useful for converting user input into float values.

```
INPUT”ENTER A NUMBER”;N$
FP_Var1=STRTOFLOAT(N$)
```

To do comparisons with Floating point numbers you must use one of:
CMPGT(FP_A,FP_B) - Floating Point Compare if Greater Than
CMPGE(FP_A,FP_B) - Floating Point Compare if Greater Than or Equal
CMPEQ(FP_A,FP_B) - Floating Point Compare if Equal
CMPNE(FP_A,FP_B) - Floating Point Compare if Not Equal
CMPLE(FP_A,FP_B) - Floating Point Compare if Less Than or Equal
CMPLT(FP_A,FP_B) - Floating Point Compare if Less Than
Example:

```
IF CMPGT(FP_Var1,VP_Var6) THEN ?”VP_Var1 is > VP_Var6”
```

These special comparisons must be done on their own after the IF statement. Anything after the first CMPxx(,) will be ignored.
If you wanted to do:

```
IF CMPGT(FP_Var1,VP_Var6) AND A=B THEN ….
```

You must break it down to:

```
IF CMPGT(FP_Var1,VP_Var6) THEN IF A=B THEN …
```

Another example:

```
IF CMPGT(FP_Var1,VP_Var6) OR A=B THEN ….
```

You must break it down to:

```
IF CMPGT(FP_Var1,VP_Var6) THEN IF A=B THEN … ELSE IF
A=B THEN …
```

Other Floating Point info and a real world example

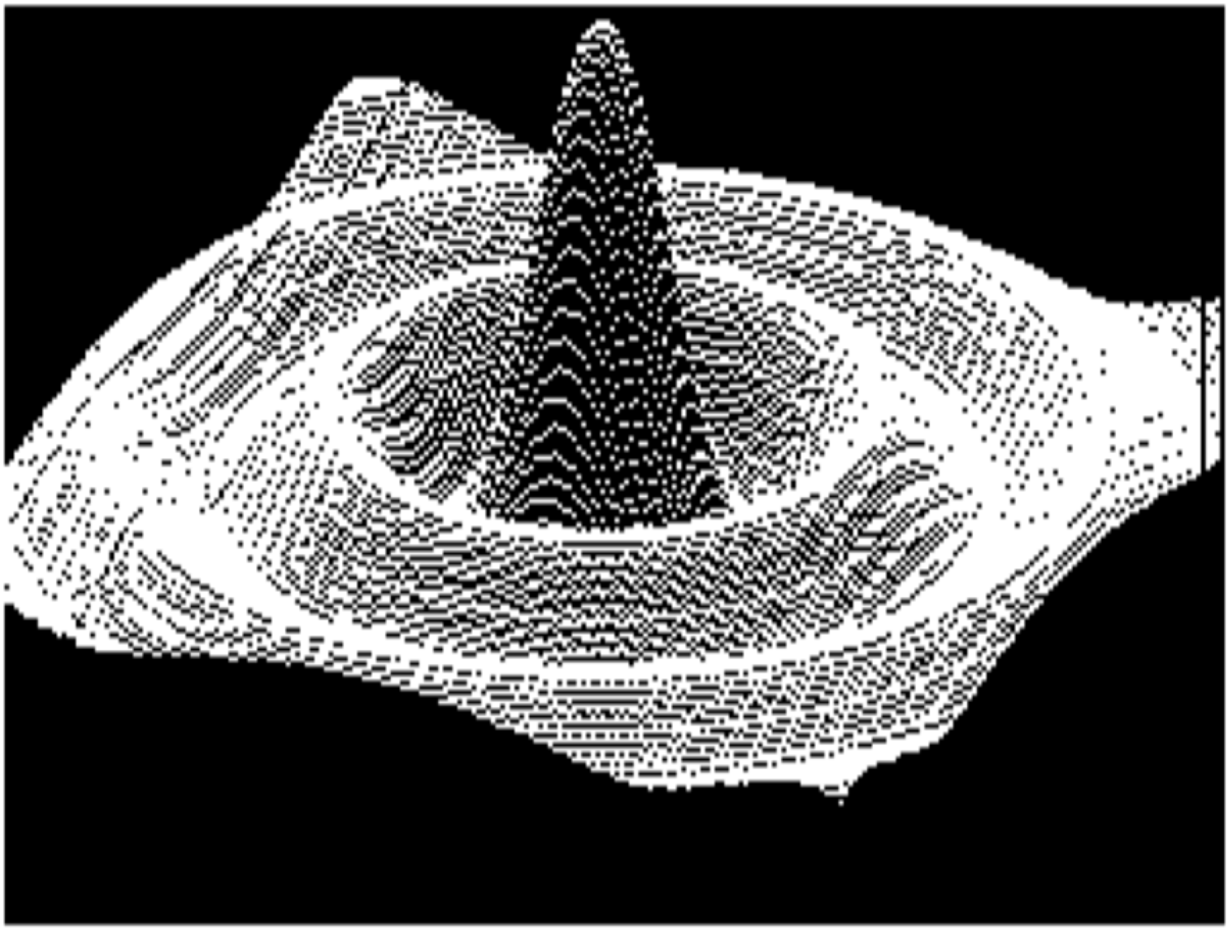
Printing of floating point numbers directly will display a kind of broken scientific version of the floating point number on screen. You can use the function **FLOATTOSTR$(FP_A)** Which cleanly formats a Floating Point number to a string which you can then print on screen. Although the number is still going to display in scientific notation.
You can use the code below to show floating point numbers formatted as normal numbers. The variable V$ can be manipulated as you want with regular string commands like MID$ to format the string as you want for your program.

```
FP_C=FLOATMUL(-234.54321,234.54321)
FP$=FLOATTOSTR$(FP_C)
' Get the sign of the number
S$=LEFT$(FP$,1)
' Get the numbers without the decimal
N$=MID$(FP$,2,1)+MID$(FP$,4,8)
' Get the Exponent + 1
E=VAL(RIGHT$(FP$,3))+1
SELECT CASE E
    CASE IS <1
        V$=S$+"0."+STRING$(-E,"0")+N$
    CASE 1 TO 8
        V$=S$+LEFT$(N$,E)+"."+RIGHT$(N$,9-E)
    CASE IS >8
        V$=S$+N$+STRING$(E-9,"0")
End Select
?"FP$=";FP$
?"V$=";V$
```

Output is:

```
FP$=-5.50105174E+04
V$=-55010.5174
```

This is a tweaked version of James Diffendaffer's 3D plot program that I converted from working on a CoCo 3 to work on a CoCo 1 & 2



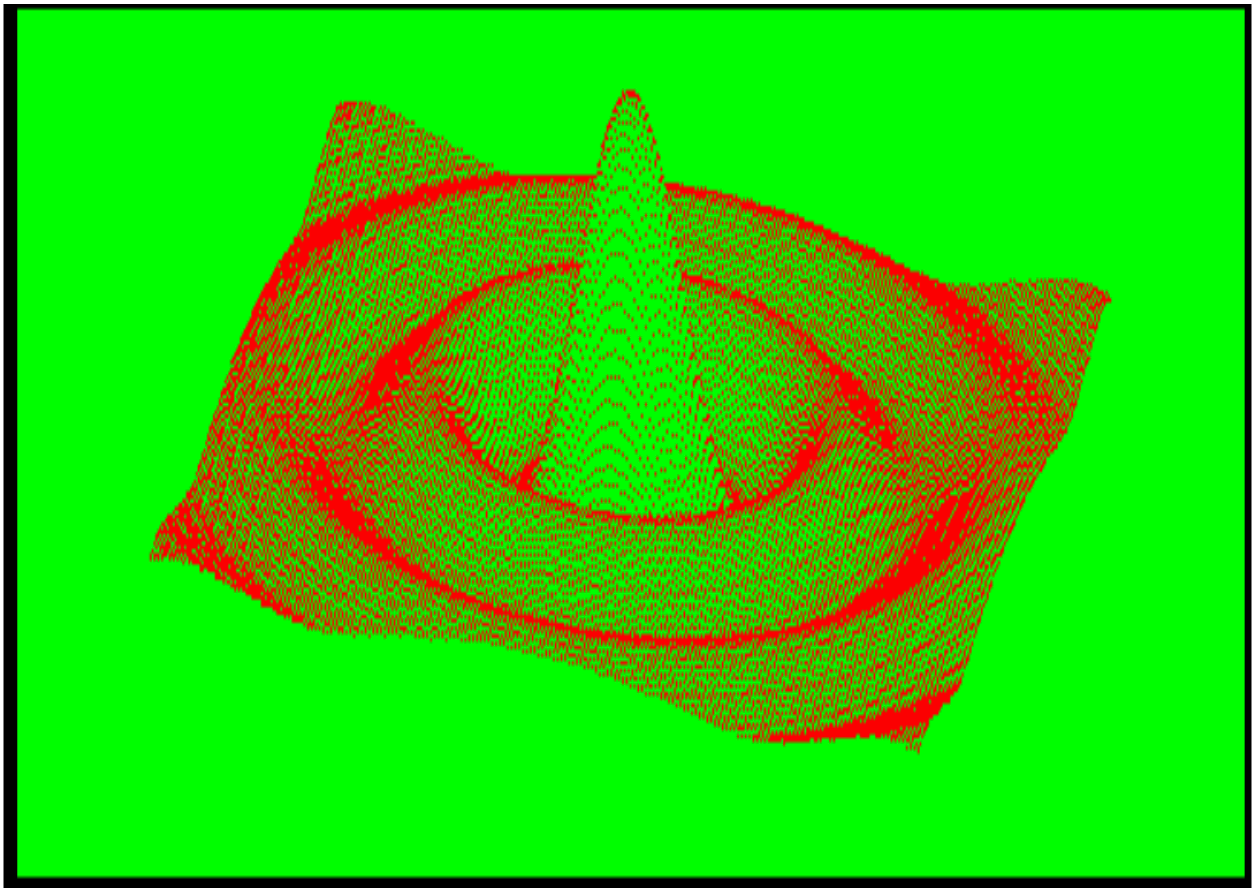
Original program:

```
0 CX=250:CY=192:PMODE 4,1:PCLS:SCREEN 1,1
1 DIM R(250):FOR I=0 TO CX:R(I)=CY:NEXT I:GOTO 10
2 R=SQR(X*X+Y*Y)*1.5: IF R=0 THEN F=90:GOTO 4
3 F=90*SIN(R)/R
4 A=10*X+125-5*Y:B=5*Y+2.5*X+93:RETURN
10 FOR Y=10 TO -10 STEP -0.1
70 FOR X=10 TO -10 STEP -0.1
80 GOSUB 2
82 IF A<0 THEN A=0
83 IF A>255 then A=255
84 IF R(A)>B-F THEN R(A)=B-F:PSET(A,B-F)
90 NEXT X,Y
101 GOTO 101
```

Below is a version of the same program but ready to be compiled with the new floating point commands. Note that you can’t use floating point numbers with the FOR NEXT commands so this is a work around.

```
0 CX=250:CY=192:GMODE 16,1:GCLS:SCREEN 1,1
1 DIM R(250):FOR I=0 TO CX:R(I)=CY:NEXT I:GOTO 10
2 'R=SQR(X*X+Y*Y)*1.5: IF R=0 THEN F=90:GOTO 4
FP_Temp1=FLOATMUL(FP_X,FP_X)
FP_Temp2=FLOATMUL(FP_Y,FP_Y)
FP_Temp1=FLOATADD(FP_Temp1,FP_Temp2)
FP_R=FLOATSQR(FP_Temp1)
FP_R=FLOATMUL(FP_R,1.5)
IF CMPEQ(FP_R,0) THEN FP_F=90:GOTO 4
3 'F=90*SIN(R)/R
FP_Temp1=FLOATSIN(FP_R)
FP_Temp1=FLOATMUL(90,FP_Temp1)
FP_F=FLOATDIV(FP_Temp1,FP_R)
F=FP_F
4 'A=10*X+125-5*Y:B=5*Y+2.5*X+93:RETURN
FP_Temp1=FLOATMUL(10,FP_X)
FP_Temp2=FLOATMUL(5,FP_Y)
FP_A=FLOATADD(FP_Temp1,125)
FP_A=FLOATSUB(FP_A,FP_Temp2)
A=FP_A
FP_Temp1=FLOATMUL(5,FP_Y)
FP_Temp2=FLOATMUL(2.5,FP_X)
FP_B=FLOATADD(FP_Temp1,FP_Temp2)
FP_B=FLOATADD(FP_B,93)
B=FP_B
RETURN
10 FOR Y=100 TO -100 STEP -1
70 FOR X=100 TO -100 STEP -1
FP_Y=FLOATDIV(INT(Y),10)
FP_X=FLOATDIV(INT(X),10)
80 GOSUB 2
82 IF A<0 THEN A=0
83 IF A>255 then A=255
84 IF R(A)>B-F THEN R(A)=B-F:SET(A,B-F,1)
90 NEXT X,Y
101 GOTO 101
```

This is the same program scaled for the highest resolution screen a CoCo 3 can use.



```
0 CX=640:CY=224:GMODE 156,1:GCLS:SCREEN 1,1
1 DIM R(640):FOR I=0 TO CX:R(I)=CY:NEXT I:GOTO 10
2 'R=SQR(X*X+Y*Y)*1.5: IF R=0 THEN F=90:GOTO 4
FP_Temp1=FLOATMUL(FP_X,FP_X)
FP_Temp2=FLOATMUL(FP_Y,FP_Y)
FP_Temp1=FLOATADD(FP_Temp1,FP_Temp2)
FP_R=FLOATSQR(FP_Temp1)
FP_R=FLOATMUL(FP_R,1.5)
IF CMPEQ(FP_R,0) THEN FP_F=90:GOTO 4
3 'F=90*SIN(R)/R
FP_Temp1=FLOATSIN(FP_R)
FP_Temp1=FLOATMUL(90,FP_Temp1)
FP_F=FLOATDIV(FP_Temp1,FP_R)
F=FP_F
4 'A=10*X+125-5*Y:B=5*Y+2.5*X+93:RETURN
```

```
'A=20*X+319-5*Y:B=5.895*Y+2.5*X+111:RETURN
FP_Temp1=FLOATMUL(20,FP_X)
FP_Temp2=FLOATMUL(5,FP_Y)
FP_A=FLOATADD(FP_Temp1,319)
FP_A=FLOATSUB(FP_A,FP_Temp2)
A=FP_A
FP_Temp1=FLOATMUL(5.895,FP_Y)
FP_Temp2=FLOATMUL(2.5,FP_X)
FP_B=FLOATADD(FP_Temp1,FP_Temp2)
FP_B=FLOATADD(FP_B,111)
B=FP_B
RETURN
10 FOR Y=100 TO -100 STEP -1
70 FOR X=100 TO -100 STEP -1
FP_Y=FLOATDIV(INT(Y),10)
FP_X=FLOATDIV(INT(X),10)
80 GOSUB 2
82 IF A<0 THEN A=0
83 IF A>639 then A=639
84 IF R(A)>B-F THEN R(A)=B-F:SET(A,B-F,1)
90 NEXT X,Y
101 GOTO 101
```

New Graphics commands

GMODE ModeNumber,GraphicsPage

Selects the graphics screen and the graphics page.
ModeNumber is the graphics mode you want to use
GraphicsPage is the Page you want to show/use for your graphics commands

To see a list of ModeNumbers and the resolutions **go here**
Special note the **ModeNumber must be an actual number and cannot be a variable as the compiler needs to know exactly which graphic mode commands need to be included at compile time.

GraphicsPage can be a variable.
If you are going to use Graphic pages, the compiler needs to know how many pages to reserve in RAM (for CoCo 1 & 2 graphics). So you must have a GMODE #,MaxPages entry at the beginning of your BASIC program. Where the value of MaxPages will be an actual number and not a variable.

* Special note if you are going to use GMODE 160 to 165 (the special NTSC composite 256 colour modes). When the compiler comes across the first GMODE command with the values of 160 to 165 it will automatically set the palette to the following values:
Palette 0,0 ' xx000000
Palette 1,16 ' xx010000
Palette 2,32 ' xx100000
Palette 3,48 ' xx110000

GCLS #

Colour the graphics screen
is the colour value you want the screen to be coloured

GCOPY SourcePage,DestinationPage

Makes a copy the Source graphics page to the Destination graphics page.
SourcePage - Source graphics page

DestinationPage - Destination graphics page

SET(x,y,Colour)

Sets a pixel on the screen

x,y - Screen location of the pixel to be drawn

Colour - Colour Number of the pixel to be drawn

POINT(x,y)

Returns the colour value of the pixel selected

x,y - Screen location of the pixel value requested

LINE(x0,y0)-(x1,y1),Colour[,B][F]

x0,y0 - Starting location

x1,y1 - Ending location

Colour - Colour of the Line or Box to draw

B - Draw a Box

F - Fill the Box

PAINT(x,y),OldColour,FillColour

Fills the old colour value with the fill colour value which must also be the border colour of the section you are painting

x,y - Starting location

OldColour - Colour Number

FillColour - Colour Number

CIRCLE(x,y),Radius,Colour

Draws a circle on the screen

x,y - Origin of the circle

Radius - Size of the circle, to keep the aspect ratio close to round Some of the graphics modes use scaling so the Radius isn't always a count of actual pixel values.

Colour - Colour Number of the circle to draw

PALETTE v,Colour

Sets the CoCo 3 Palette value

v -palette slot of 0 to 15

Colour - Colour value of 0 to 63

DRAW, GET & PUT commands are not yet available

Sprite Handling - Overview

To use sprites in your BASIC programs you need to first prepare them with some external tools.
- A graphic editor like GIMP to make or convert/export your sprite image into a 32 bit RGBA (includes transparency) PNG file.
- The command line tool (included with this compiler) PNGtoCCSB to convert the PNG file into a Sprite to be used in your BASIC program.

Typically you'll use PNGtoCCSB to convert your PNG file into a sprite with a command similar to:

```
PNGtoCCSB -g15 -s0 MySprite.PNG
PNGtoCCSB -g15 -s0 MyOtherSprite.PNG
```

This command will convert the PNG files MySprite.PNG & MyOtherSprite.PNG into compiled sprites ready to be used -g15 tells the tool we are going to use this sprite with a GMODE 15 graphics screen in your BASIC program. When converting the PNG to a compiled sprite it will match the colours of the PNG to the available colours in the GMODE & Screen mode (-sx option) on the CoCo.

This will save the compiled sprites as MySprite.asm & MyOtherSprite.asm

In your BASIC program you will need to start your program with the following commands:

```
Sprite_Load "MySprite.asm", 0 ‘ Load sprite as #0
Sprite_Load "MyOtherSprite.asm", 1 ‘ Load sprite as #1

GMODE 15,1 ‘This will reserve graphics page 0 and graphics page 1
GMODE 15,0 ‘Set the current graphics page to use as 0
GCLS 0 ‘Colour the graphics screen colour 0
SCREEN 1,0 ‘Show the graphics screen (you could do this later)
```

Draw any background graphics for your program here…

Once your background graphics are drawn you need to copy screen 0 to screen 1 this is done with the GCOPY command. This is necessary as the sprite routines use double buffering where the screen is switched to show screen 1 the sprite updates are drawn on screen 0, once the sprites are updated, screen 0 is shown and screen 1 sprite updates are drawn.

```
GCOPY 0,1 ‘Copy graphics screen 0 to graphics screen 1
```

Now that your background is setup you are ready to draw the sprites on the screen using the following commands:

A normal Sprite usage routine would look like this:

```
SPRITE LOCATE 0, X1, Y1  ‘ Set the location of sprite 0
SPRITE BACKUP 0          ‘ Copy what’s behind sprite 0
SPRITE SHOW 0, 0         ‘ Draw sprite 0, frame 0
SPRITE LOCATE 1, X2, Y2  ‘ Set the location of sprite 1
SPRITE BACKUP 1          ‘ Copy what’s behind sprite 1
SPRITE SHOW 1, 0         ‘ Draw sprite 1, frame 0
```

Except for the SPRITE LOCATE command the above commands aren’t executed at this point, they are added to a sprite command queue that is executed when the WAIT VBL command is used as:

```
WAIT VBL                 ' This is when the actual sprite updates occur
```

Typically you will next want the sprite erase commands after the Wait VBL command, which again are only added to the sprite command queue at this point. It is usually best to reverse the order of the sprites for erasing.

```
SPRITE ERASE 1           ‘ Erase Sprite 1 (reverse order is good)
SPRITE ERASE 0           ‘ Erase Sprite 0
```

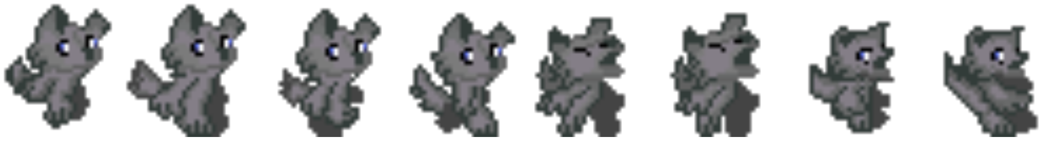
Typically you would have a routine to update your sprites like this:

```
SpriteUpdate:
SPRITE LOCATE 0, X1, Y1  ‘ Set the location of sprite 0
SPRITE BACKUP 0          ‘ Copy what’s behind sprite 0
SPRITE SHOW 0, 0         ‘ Draw sprite 0, frame 0
SPRITE LOCATE 1, X2, Y2  ‘ Set the location of sprite 1
SPRITE BACKUP 1          ‘ Copy what’s behind sprite 1
SPRITE SHOW 1, 0         ‘ Draw sprite 1, frame 0
WAIT VBL                 ' This is when the actual sprite updates occur
SPRITE ERASE 1           ‘ Erase Sprite 1 (reverse order is good)
SPRITE ERASE 0           ‘ Erase Sprite 0
Return                   ‘ All done updating sprites
```

In your program you would change X1,Y1 & X2,Y2 to the locations you want and then update the sprites on the screen with the command:

```
GOSUB SpriteUpdate
```

The last thing to know about the sprites is they can also have a frame option. If you create or download a sprite sheet of an animated sprite, they are usually created as many images in a row. For example a sprite sheet might look something like this:



If you wanted to use this sprite in your program you would use the -axx option with the PNGtoCCSB tool in this case we have 8 frames of animation so we would use the following command:

```
PNGtoCCSB -g15 -s0 -a8 WolfCub.PNG
```

The -a8 tells the tool to create a compiled sprite with 8 frames from the one PNG file. The PNG must only have the images in one horizontal row and be evenly spaced.

In your program you use the same SPRITE commands as above except you also now want to use the frame option of the SPRITE SHOW command where the 8 frames to show are from frame 0 to frame 7

```
Sprite_Load "WolfCub.asm", 2 ‘ Load sprite as #2
```

The sprite update code would now look like this:

```
SpriteUpdate:
SPRITE LOCATE 0, X1, Y1  ‘ Set the location of sprite 0
SPRITE BACKUP 0          ‘ Copy what’s behind sprite 0
SPRITE SHOW 0, 0         ‘ Draw sprite 0, frame 0
SPRITE LOCATE 1, X2, Y2  ‘ Set the location of sprite 1
SPRITE BACKUP 1          ‘ Copy what’s behind sprite 1
SPRITE SHOW 1, 0         ‘ Draw sprite 1, frame 0
SPRITE LOCATE 2, WolfCubX, WolfCubY    ‘ Set the location of sprite 2
SPRITE BACKUP 2          ‘ Copy what’s behind sprite 2
SPRITE SHOW 2, F         ‘ Draw sprite 2, frame F
WAIT VBL                 ' This is when the actual sprite updates occur
SPRITE ERASE 2           ‘ Erase Sprite 2 (reverse order is good)
SPRITE ERASE 1           ‘ Erase Sprite 1
SPRITE ERASE 0           ‘ Erase Sprite 0
Return                   ‘ All done updating sprites
```

***** At this point PNGtoCCSB doesn’t support semigraphics screen modes for sprites.

CoCo 1 & 2 Graphic Modes

GMODE #	Resolution	Colours	Bytes Per Screen	Mode Name
0	32 x 16	9	512	Internal alphanumeric
1	32 x 16	2	512	External alphanumeric
2	64 x 32	9	512	Semi graphic-4
3	64 x 32	9	2048	Semi graphic-8*
4	64 x 48	9**	512	Semi graphic-6
5	64 x 48	9	3072	Semi graphic-12***
6	64 x 64	9	2048	Semi graphic-8
7	64 x 96	9	3072	Semi graphic-12
8	64 x 192	9	6144	Semi graphic-24
9	64 x 64	4	1024	Full graphic 1-C
10	128 x 64	2	1024	Full graphic 1-R
11	128 x 64	4	2048	Full graphic 2-C
12	128 x 96	2	1536	Full graphic 2-R
13	128 x 96	4	3072	Full graphic 3-C
14	128 x 192	2	3072	Full graphic 3-R
15	128 x 192	4	6144	Full graphic 6-C
16	256 x 192	2	6144	Full graphic 6-R
17			6144	DMA Mode (unusable)
18	256 x 192	2	6144	Compile for Artifacts

* Semi graphics 4 Hybrid using Semi Graphics 8 Mode
** 3 Colours for each colour set
*** Semi graphics-6 Hybrid using Semi Graphics 12 mode

CoCo 3 Graphic Modes

<table>
<tr><th>GMODE #</th><th>Resolution</th><th>Colours</th><th>Bytes Per Screen</th></tr>
<tr><td>100</td><td>64 x 192</td><td>4</td><td>3200</td></tr>
<tr><td>101</td><td>64 x 200</td><td>4</td><td>3200</td></tr>
<tr><td>102</td><td>64 x 225</td><td>4</td><td>3600</td></tr>
<tr><td>103</td><td>64 x 192</td><td>16</td><td>6144</td></tr>
<tr><td>104</td><td>64 x 200</td><td>16</td><td>6400</td></tr>
<tr><td>105</td><td>64 x 225</td><td>16</td><td>7200</td></tr>
<tr><td>106</td><td>80 x 192</td><td>4</td><td>3840</td></tr>
<tr><td>107</td><td>80 x 200</td><td>4</td><td>4000</td></tr>
<tr><td>108</td><td>80 x 225</td><td>4</td><td>4500</td></tr>
<tr><td>109</td><td>80 x 192</td><td>16</td><td>7680</td></tr>
<tr><td>110</td><td>80 x 200</td><td>16</td><td>8000</td></tr>
<tr><td>111</td><td>80 x 225</td><td>16</td><td>9000</td></tr>
<tr><td>112</td><td>128 x 192</td><td>2</td><td>3072</td></tr>
<tr><td>113</td><td>128 x 200</td><td>2</td><td>3200</td></tr>
<tr><td>114</td><td>128 x 225</td><td>2</td><td>3600</td></tr>
<tr><td>115</td><td>128 x 192</td><td>4</td><td>6144</td></tr>
<tr><td>116</td><td>128 x 200</td><td>4</td><td>6400</td></tr>
<tr><td>117</td><td>128 x 225</td><td>4</td><td>7200</td></tr>
<tr><td>118</td><td>128 x 192</td><td>16</td><td>12288</td></tr>
<tr><td>119</td><td>128 x 200</td><td>16</td><td>12800</td></tr>
<tr><td>120</td><td>128 x 225</td><td>16</td><td>14400</td></tr>
<tr><td>121</td><td>160 x 192*</td><td>2</td><td>3840</td></tr>
<tr><td colspan="4">*(viewable) really 128x192, * Special mode that repeats the left 4 bytes on the right side of the screen</td></tr>
<tr><td>122</td><td>160 x 200*</td><td>2</td><td>4000</td></tr>
<tr><td colspan="4">*(viewable) really 128x192, * Special mode that repeats the left 4 bytes on the right side of the screen</td></tr>
</table>

123	160 x 225*	2	4500
*(viewable) really 128x192, * Special mode that repeats the left 4 bytes on the right side of the screen			
124	160 x 192	4	7680
125	160 x 200	4	8000
126	160 x 225	4	9000
127	160 x 192	16	15360
128	160 x 200	16	16000
129	160 x 225	16	18000
130	256 x 192	2	6144
131	256 x 200	2	6400
132	256 x 225	2	7200
133	256 x 192	4	12288
134	256 x 200	4	12800
135	256 x 225	4	14400
136	256 x 192	16	24576
137	256 x 200	16	25600
138	256 x 225	16	28800
139	320 x 192	2	7680
140	320 x 200	2	8000
141	320 x 225	2	9000
142	320 x 192	4	15360
143	320 x 200	4	16000
144	320 x 225	4	18000
145	320 x 192	16	30720
146	320 x 200	16	32000
147	320 x 225	16	36000
148	512 x 192	2	12288
149	512 x 200	2	12800
150	512 x 225	2	14400
151	512 x 192	4	24576

152	512 x 200	4	25600
153	512 x 225	4	28800
154	640 x 192	2	15360
155	640 x 200	2	16000
156	640 x 225	2	18000
157	640 x 192	4	30720
158	640 x 200	4	32000
159	640 x 225	4	36000
160*	128 x 192	256	24576
161*	128 x 200	256	25600
162*	128 x 225	256	28800
163*	160 x 192	256	30720
164*	160 x 200	256	32000
165*	160 x 225	256	36000

* These modes are NTSC composite CoCo 3 output only

GET dimension size calculation

To calculate the size of the array space for your GET/PUT buffer use the following formula:

First dimension in the array is calculated with this formula:
(INT(Width in pixels/8)+3)*8

Second dimension in the array is simply the number of rows in your sprite

For example, if you have a sprite that is 15 pixels wide and 9 rows high such as:

```
GET(0,0)-(14,8),Sprite1,G
```

The calculation for the needed space is:
(INT(15/8)+3)*8 = 32

The DIM command for this array would be:

```
DIM Sprite1(32,9)
```

*** If the calculated value for the first dimension of your GET buffer array is larger than 254 you will need to use these values for your array
(INT(Width in pixels/8)+3) * 4 , Height in Pixels * 2

```
GET(0,0)-(255,3),Sprite1,G
```

The calculation for the needed space is:
(INT(256/8)+3)*4 = 140 , 4 * 2 = 8

The DIM command for this array would be:

```
DIM Sprite1(140,8)
```

The reason so much space is needed for the GET buffer is because the GET command preprocesses the sprite data and saves bit shifted versions in the array space that are ready to be PUT on the screen as fast as possible. This means sprites will be just as fast on a byte boundary as it is on any other pixel.

Limitations of the Compiler

- Other than support for LOADM it can’t handle Disk access. But you can access the CoCoSDC for many disk type functions. See here for more info

- CIRCLE command can only draw complete circles, you can’t squeeze them or draw an arc

Error Handling

If your program isn't compiling, a lot of the times it's because the compiler is having a hard time parsing the program. Usually making sure you have spaces between commands and variables and operators and variables.

You can sometimes figure out what is causing the problem from the error message and line number given where the compiler found the problem. If you don't use line numbers in your program then the error message won't be able to give you the correct line the error occurred.

Also looking at the end of the actual .asm file it created might help to see what the compiler is trying to parse and failed.

Specifications

SDC_BIGLOADM"FILENAME.BIN",#

Loads CoCo 3 Memory Blocks very fast. Useful for loading in background screens for games or other large amounts of data.
is the file number 0 or 1

This command loads complete $2000 byte blocks into the CoCo 3's memory. The format of this file is written in 512 byte chunks, as the SDC streaming mode reads file data 512 bytes at a time.
Chunk 0 is the header/Memory Mapping Chunk:
Bytes
0 & 1 File version #
Version 1 is the only supported version to date
2 & 3 Is the 16 bit number of the first bank to load
x & x+1 Is the 16 bit number of the next bank to load and so on until we get a $FFFF
If we reach a $FFFF this signifies we've copied the last block and are done.
512 & 513 Chunk 1 - This is the actual first word of data for the first block
This contains $2000 bytes of data, the next $2000 bytes will be the data for the 2nd bank number given in the memory mapping Chunk and will continue with $2000 bytes of data for all the rest of the banks given in the memory map Chunk.

Thanks

I’d like to thank Scott Cooper (Tazman) for initial testing of the compiler. Scott also wrote the assembly code for the SET and POINT routines used in the semi-graphics modes.

I’d also like to thank others on Discord who inspired me to keep adding new features, including Bruce D. Moore, Erico Monteiro & Pete Willard.