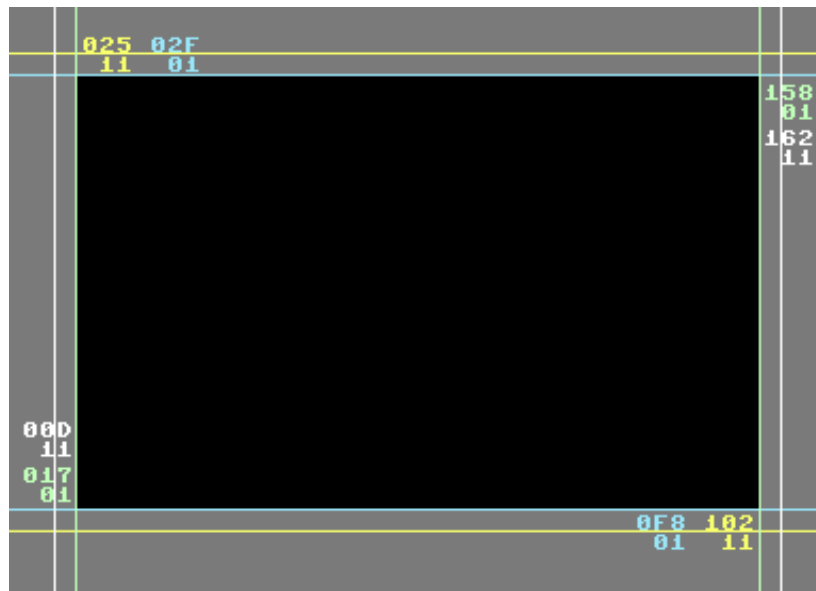


Borderpolizei

Version 1.25, March 23, 2021



About

This program is an attempt to finally end the ongoing discussions about how much is actually visible in the borders of the C64 screen.

Why?

Knowing the limits of the borders is interesting for coders who want to make sure their production looks fine on all kind of setups. It is also needed for emulators so they can produce realistic output and offer most effective debugging help.

Prerequisites

Before using the program, make sure your monitor symmetry is calibrated as far as possible.

First find the related knobs at your monitor – usually labeled Hsize / Vsize for the size adjustment and Hpos / Vpos for the centering. Not all monitors expose all of those calibration knobs to the user, TV sets in particular usually only have them inside of the cabinet. When you can not find them at the front panel, look at the back of the cabinet, sometimes they are accessible there.

Do NOT open your monitor/TV unless you are qualified to do so – High Voltage inside!

Now adjust Hsize / Vsize so a displayed circle is actually round – for this you can use the reference programs mentioned below. Then center the image using Hpos / Vpos (*). It may take a bit of fiddling until all of the following conditions are met:

- The picture fills the entire CRT area (no black borders with no picture content at all)
- The border area is as wide as possible (without creating a black/unused area around it)
- The circle displayed by the reference program is actually a circle (same size vertically and horizontally)
- the "text window" of the C64 is centered as much as possible (without breaking the above conditions)

(*) On regular TV screens the display window is usually not centered. This is normal.

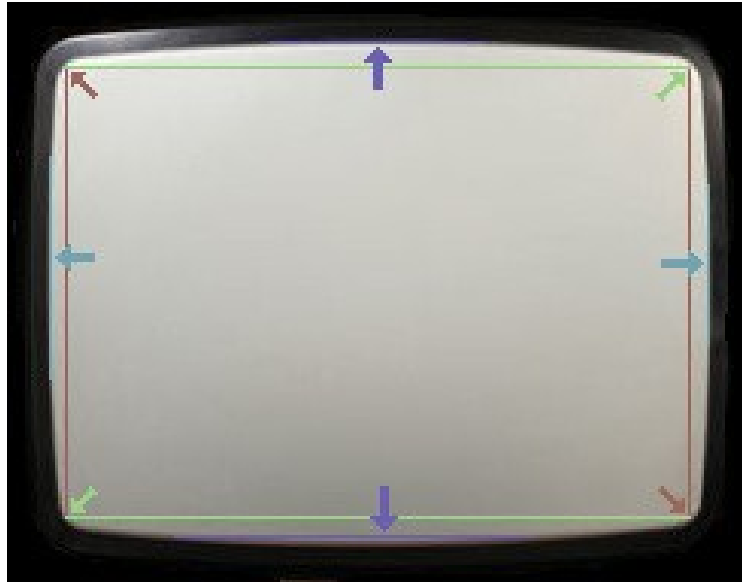
reference programs

For PAL you can use "Testbild Generator v2.1": <https://csdb.dk/release/?id=80498>

We are still looking for an equivalent NTSC utility that can be used with the upcoming NTSC fixed release of this tool – please let us know if you know such program!

What?

Defining the limits of the border area is a bit tricky, because CRTs do not produce a perfectly square picture. That means “in the middle” the border is wider than “in the corners”.



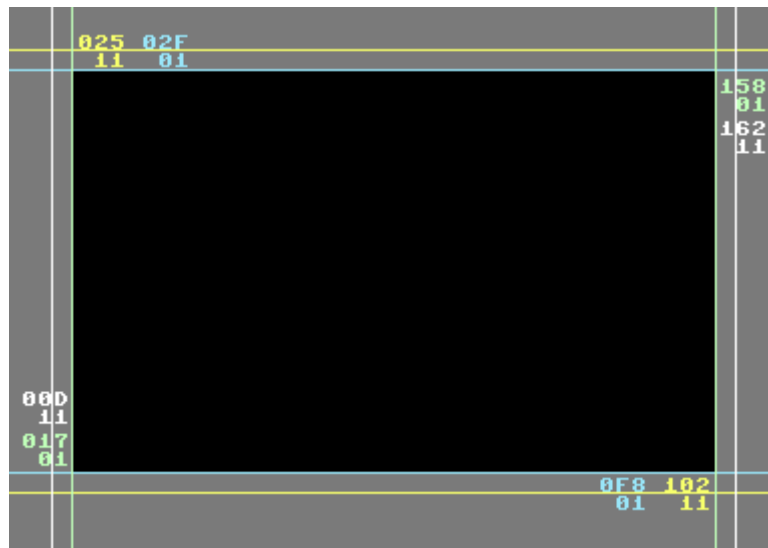
So, to get an Idea about the dimensions of the border area we can measure two distinct things:

- The outer maximum, this is the farthest position were even a tiny fraction of the movable line is still visible
- The inner square, this is the farthest position were the movable lines form a complete rectangle whose corners are located in the corners of the CRT

The outer limits define the area where a programmer should look for “glitches” eg in raster code. The inner square defines the so called “safe area” where the programmer can be sure that everything shown in this area is visible at all times.

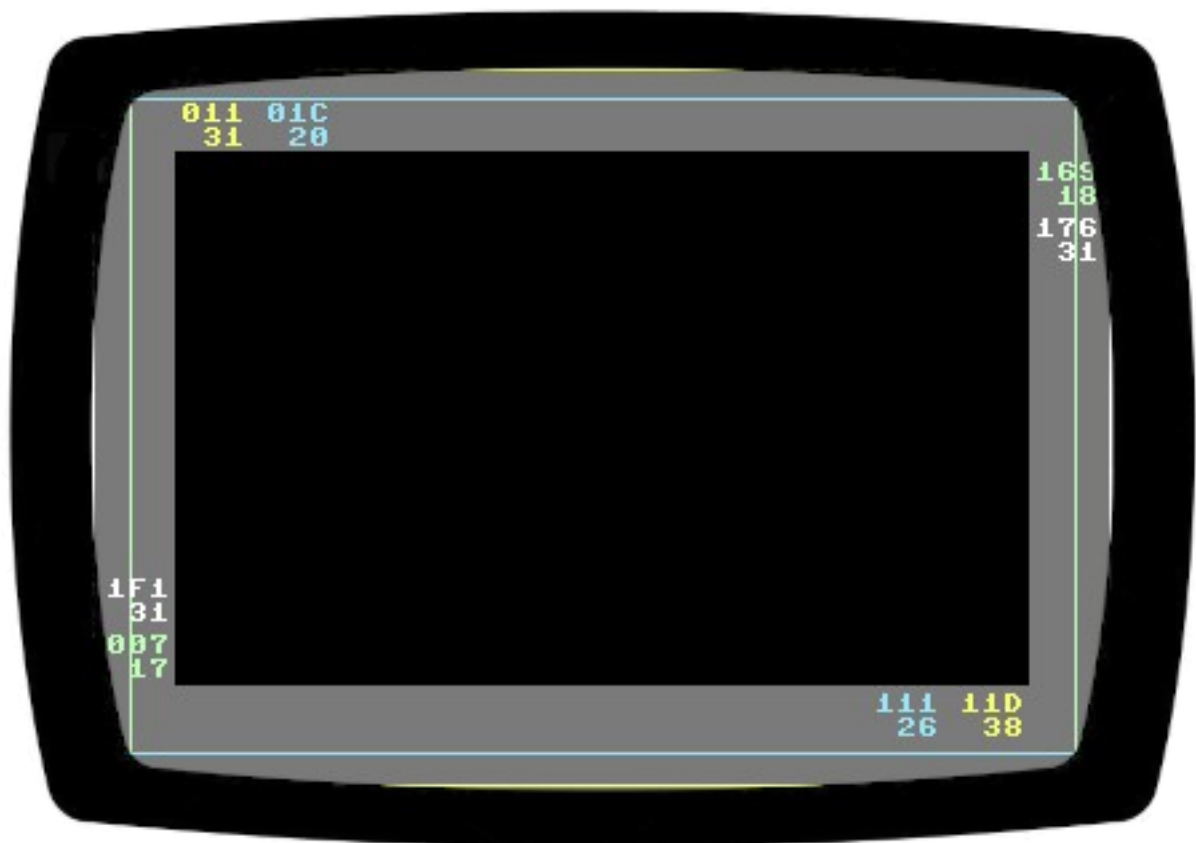
How?

Make sure your monitor picture is centered and fills the screen (see Prerequisites above), then run the test program. You will be presented this initial image:



Now first use 1-4 to select the outer bars, and then move them to the outer extremes using F1 and F3. Then use 5-8 to select the inner bars, and move them so they form a rectangle that lines up with the corners of your CRT.

You should now see an image similar to this:



Now each block of numbers in the border relates to one of the bars (with the same color). The upper number (in hexadecimal) shows the rasterline (at the top and at the bottom) or the absolute sprite position (left and right).

For the above example illustration (which is quite exaggerated) you'd read the result as follows:

	Inner limits (safe area)				Outer limits (maximum area)			
	top	bottom	left	right	top	bottom	left	right
Border Size	20	26	17	18	31	38	31	31
Border Position	\$01C	\$111	\$007	\$169	\$011	\$11D	\$1F1	\$176

Keys

Key	Action
1 ... 4	Select outer top/bottom/left/right bar to move
5 ... 8	Select inner top/bottom/left/right bar to move
F1 / F3	Move selected bar
HOME	Reset the positions of all bars
CBM	Stop the flashing

Some results

The following shows some results that we gathered so far. For emulators only the outer limits are present in the tables, because their output is perfectly square, so giving a second set of data makes no sense.

Please help us to fill those tables with more data and measure the limits of your own TV(s) and/or Monitor(s). Send the results to groepaz@gmx.net

Border Size

	Inner limits (safe area)				Outer limits (maximum area)			
	top	bottom	left	right	top	bottom	left	right
VICE 3.5 (full)	-	-	-	-	40	53	48	40
Commodore 1084S (Full Image) (*)	-	-	-	-	40	52	46	37
VICE 3.5 (normal)	-	-	-	-	32	40	32	32
Commodore 1701 (GPZ) (*1)	20	28	18	22	31	38	27	28
Commodore 1701 (Lux) (*1)	20	27	18	22	27	38	24	25
Philips CM8802 (Lux)	25	44	37	30	32	52	45	35
Commodore 1084S (CF)	20	41	31	27	26	45	37	34
Commodore 1084S (1st) (Lux)	21	45	41	31	32	52	46	37
Commodore 1084S (2nd) (Lux)	20	44	40	27	29	51	45	34
LG CF-14F80K CRT TV (Silpheed)	21	43	18	20	28	50	27	30
Grundig ??? CRT TV (GPZ) (*2)	18	39	22	23	29	50	32	35
	minimum safe area				maximum outer limits			
	top	bottom	left	right	top	bottom	left	right
	18	28	18	20	32	52	46	37

Border Position

	Inner limits (safe area)				Outer limits (maximum area)			
	top	bottom	left	right	top	bottom	left	right
VICE 3.5 (full)	-	-	-	-	\$008	\$12C	\$1E0	\$17F
Commodore 1084S (Full Image) (*)	-	-	-	-	\$008	\$12B	\$1E2	\$17C
VICE 3.5 (normal)	-	-	-	-	\$010	\$11F	\$1F0	\$177
Commodore 1701 (GPZ) (*1)	\$01C	\$113	\$006	\$16D	\$011	\$11D	\$1F5	\$173
Commodore 1701 (Lux) (*1)	\$016	\$112	\$006	\$16D	\$015	\$11D	\$000	\$170
Philips CM8802 (Lux)	\$017	\$123	\$1E3	\$175	\$010	\$12B	\$1EB	\$17A
Commodore 1084S (CF)	\$01C	\$120	\$1F1	\$172	\$016	\$124	\$1EB	\$179
Commodore 1084S (1st) (Lux)	\$01B	\$124	\$1E7	\$176	\$010	\$12B	\$1E2	\$17C
Commodore 1084S (2nd) (Lux)	\$01C	\$123	\$1E8	\$172	\$013	\$12A	\$1E3	\$179
LG CF-14F80K CRT TV (Silpheed)	\$01B	\$122	\$006	\$16B	\$014	\$129	\$1F5	\$175
Grundig ??? CRT TV (GPZ) (*2)	\$01E	\$11E	\$002	\$16E	\$013	\$129	\$1F0	\$17A
	minimum safe area				maximum outer limits			
	top	bottom	left	right	top	bottom	left	right
	\$01E	\$113	\$006	\$16B	\$010	\$12B	\$1E2	\$17C

(*) With Hsize/Vsize adjusted so all generated image content is shown. Note that in the left border at sprite positions \$1E0 and \$1E1 the HSYNC Signal is visible as a white vertical bar.

(*1) Has no Hsize/Vsize controls

(*2) Has no Hsize/Vsize/Hpos/Vpos controls

Credits

Code:	Copyfault
Idea, Documentation:	Groepaz
Help:	Lux, Silpheed

inspired by the “Borderline 2021 Compo”, <https://csdb.dk/event/?id=3021>

Greetings

Ich grüsse meine Mama, und alle die mich kennen.