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MOS 6560/6561 VIC-I Video Interface Circuit documentation

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The 6560 pinout and most of the register map were quoted from the
Commodore VIC-20 Programmer's Reference Guide, and the register map
and other parts of this document were enhanced with the results got by
measuring the 6560-101 and 6561-101 chips.  Thanks to Miguel Gordillo
for his help in measuring the NTSC-M screen size.

Comparison of the known VIC-20 video chips (summary)

Chip            6560-101        6561-101
System          NTSC-M          PAL-B
Cycles/line     65              71
Lines/frame     261             312
- interlaced    525             -
Crystal         14318181 Hz     4433618 Hz
Bus clock       crystal/14      crystal/4
Screen width    210             233
Screen height   233             284
- interlaced    ?               -
                ^ needs to be
                  measured

6560 pinout (according to the Programmer's Reference Guide):

1 nc
2 comp colour
3 sync&lumin
4 r/w
5-16 db11-db0
17 dotx
18 dot y
19 comp snd
20 vss
21-34 a0-a13
35 pPhi1
36 pPhi2
37 option
38 Phi2 in
39 Phi1 in
40 Vdd

9000 ABBBBBBB
9001 CCCCCCCC
9002 HDDDDDDD
9003 GEEEEEEF
9004 GGGGGGGG
9005 HHHHIIII
9006 JJJJJJJJ
9007 KKKKKKKK
9008 LLLLLLLL
9009 MMMMMMMM
900A NRRRRRRR
900B OSSSSSSS
900C PTTTTTTT
900D QUUUUUUU
900E WWWWVVVV
900F XXXXYZZZ

A: interlace mode (6560-101 only): 0=off, 1=on
   In this mode, the videochip will draw 525 interlaced lines of 65 cycles
   per line, instead of the 261 non-interlaced lines in the normal mode.
   This bit has no effect on the 6561-101.
B: screen origin X (4 pixels granularity)
   6560-101: at 22 chars/line, the suitable range is 1 to 8
             With 22 chars/line, the value 8 will show only 6 pixels of the
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               rightmost column
   6561-101: at 22 chars/line, the suitable range is 5 to 19
               With 22 chars/line, the value 20 will show only 5 pixels of the
               rightmost column

   Both:     If the value B+2*D is greater than CYCLES_PER_LINE-4,
               the picture will mix up.
               With the value 0, there is some disturbance on the screen bottom.
C: screen origin Y (2 lines granularity)
   6560-101: suitable range is 14 to 130=(261-1)/2,
               which will display one raster line of text.
   6561-101: suitable range is 14 to 155=312/2-1
   Both:     No wraparound
D: number of video columns
   6560 range: 0-26 makes sense, >31 will be interpreted as 31.
   6561-101: 0-29 makes sense, >32 will be interpreted as 32.
E: number of video rows (0-63)
   6560-101 practical range: 0-29; at C=14, >=30 gives 29 1/8
   6561-101 practical range: 0-35; at C=14, >=36 gives 35?
F: character size (1=8x16, 0=8x8)
G: current raster line ($9004=raster counter b8-b1, $9003 bit 7 = b0)
   Vertical blank is on lines 0 through 27.
H: screen memory location ($9005:7-4 = b13-b10,
                           $9002:7 = b9 of screen and colour memory)
I: character memory location (b13-b10)
* Note that b13 is connected to the inverse of A15 on the Vic-20.
J: light pen X
K: light pen Y
L: paddle X
M: paddle Y
N: bass switch,    R: freq f=Phi2/256/(255-$900a)  NTSC: Phi2=14318181/14 Hz
O: alto switch,    S: freq f=Phi2/128/(255-$900b)  PAL:  Phi2=4433618/4 Hz
P: soprano switch, T: freq f=Phi2/64/(255-$900c)
Q: noise switch,   U: freq f=Phi2/32/(255-$900d)
W: auxiliary colour
V: volume control
X: screen colour
Y: reverse mode
Z: border colour

multicolour (character colour b7=1)
00 = screen colour
01 = character colour
10 = border colour
11 = auxiliary colour

Colour codes:
0 black
1 white
2 red
3 cyan
4 purple
5 green
6 blue
7 yellow
8 orange
9 light orange
a pink
b light cyan
c light purple
d light green
e light blue
f light yellow

Video timing

As the dot clock on the VIC-I is only 4 times the bus clock, the video
chip has time to read 2 bytes for every 8 pixels it outputs.  All
memory accesses are performed without blocking the processor, using
the interleaved bus.  The basic video timing is very simple.  For
every character the VIC-I is about to display, it first fetches the
character code and colour, then the character appearance (from the
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145   character generator memory).  The character codes are read on every
146   raster line, thus making every line a "bad line".  When the raster
147   beam is outside of the text window, the videochip reads from $001c for
148   most time.  (Some videochips read from $181c instead.)  The address
149   occasionally varies, but it might also be due to a flaky bus.  (By
150   reading from unconnected address space, such as $9100-$910f, you can
151   read the data fetched by the videochip on the previous clock cycle.)
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