VGA Timings

The following table lists timing values for several popular resolutions.

Format	Pixel Clock (MHz)	Horizontal (in Pixels)				Vertical (in Lines)			
		Active Video	Front Porch	Sync Pulse	Back Porch	Active Video	Front Porch	Sync Pulse	Back Porch
640x480, 60Hz	25.175	640	16	96	48	480	11	2	31
640x480, 72Hz	31.500	640	24	40	128	480	9	3	28
640x480, 75Hz	31.500	640	16	96	48	480	11	2	32
640x480, 85Hz	36.000	640	32	48	112	480	1	3	25
800x600, 56Hz	38.100	800	32	128	128	600	1	4	14
800x600, 60Hz	40.000	800	40	128	88	600	1	4	23
800x600, 72Hz	50.000	800	56	120	64	600	37	6	23
800x600, 75Hz	49.500	800	16	80	160	600	1	2	21
800x600, 85Hz	56.250	800	32	64	152	600	1	3	27
1024x768, 60Hz	65.000	1024	24	136	160	768	3	6	29
1024x768, 70Hz	75.000	1024	24	136	144	768	3	6	29
1024x768, 75Hz	78.750	1024	16	96	176	768	1	3	28
1024x768, 85Hz	94.500	1024	48	96	208	768	1	3	36

Source: Rick Ballantyne, Xilinx Inc. TABLE 1 VGA CORE VIDEO MODE

Mode	Type	Res.	Colors	Vert.	Horz.	Pix Clk
SM and SXGA MODES						
0, 1	A/N	320 x 200	16	70 Hz	31.778 KHz	25.175 MHz
2, 3	A/N	640 x 200	16	70 Hz	31.778 KHz	25.175 MHz
0*, 1*	A/N	320 x 350	16	70 Hz	31.778 KHz	25.175 MHz
2*, 3*	A/N	640 x 350	16	70 Hz	31.778 KHz	25.175 MHz
0+, 1+	A/N	320 x 350	16	70 Hz	31.778 KHz	28.322 MHz
2+, 3+	A/N	640 x 350	16	70 Hz	31.778 KHz	28.322 MHz
4, 5	APA	320 x 200	4	70 Hz	31.778 KHz	25.175 MHz
6	APA	640 x 200	2	70 Hz	31.778 KHz	25.175 MHz
7	A/N	720 x 350	Mono	70 Hz	31.778 KHz	28.322 MHz
7+	A/N	720 x 400	Mono	70 Hz	31.778 KHz	28.322 MHz
D	APA	320 x 200	16	70 Hz	31.778 KHz	25.175 MHz
E	APA	640 x 200	16	70 Hz	31.778 KHz	25.175 MHz
F	APA	640 x 350	Mono	70 Hz	31.778 KHz	25.175 MHz
10	APA	640 x 350	16	70 Hz	31.778 KHz	25.175 MHz
11	APA	640 x 480	2	60Hz	31.778 KHz	25.175 MHz
12	APA	640 x 480	16	60Hz	31.778 KHz	25.175 MHz
13	APA	320 x 200	256	70 Hz	31.778 KHz	25.175 MHz
SXGA MODES						
101	APA	640x480	256	85 Hz	43.3 KHz	36.00 MHz
102	APA	800 x 600	16	85 Hz	53.7 KHz	56.25 MHz
103	APA	800 x 600	256	85 Hz	53.7 KHz	56.25 MHz
104	APA	1024 x 768	16	85 Hz	68.7 KHz	94.5 MHz
105	APA	1024 x 768	256	85 Hz	68.7 KHz	94.5 MHz
106	APA	1280 x 1024	16	85 Hz	91.1 KHz	157.5 MHz
107	APA	1280 x 1024	256	85 Hz	91.1 KHz	157.5 MHz
114	APA	800 x 600	64K	85 Hz	53.7 KHz	56.25 MHz
115	APA	800 x 600	16.8 M	85 Hz	53.7 KHz	56.25 MHz
117	APA	1024 x 768	64K	85 Hz	68.7 KHz	94.5 MHz
118	APA	1024 x 768	16.8 M	85 Hz	68.7 KHz	94.5 MHz
11A	APA	1280 x 1024	64K	85 Hz	91.1 KHz	157.5 MHz
11B	APA	1280 x 1024	16.8 M	85 Hz	91.1 KHz	157.5 MHz

Note: SM Modes 0-13 only

As with RS-232, the standard for VGA video is that there are lots of standards. Every manufacturer seems to list different timings in the manuals for their monitors. The values given in the table above are not particularly critical. On a CRT monitor, the lengths of the front and back porches control the position of the image on the display. If the image appears offset to the right or left, or up or down, try adjusting the front and back porch values for the corresponding direction (or use the image position adjustments on the monitor, which accomplish the same thing).

Mode name		Pixel	syn	c	back a	ctive	front	whole line	Lines	line	sync	sync	back	active	active	front	front	whole frame	whole frame
		clock	pul	se	porch	time	porch	period	Total	width	pulse	pulse	porch	time	time	porch	porch	period	period
		(MHz)	(us)	(pix)	(pix)	(pix)	(pix)	(pix)		(us)	(us)	(lin)	(us) (lin)	(us)	(lin)	(us)	(lin)	(us)	(lin)
VGA 640x480	60Hz	25.175	3.81	96	45	646	13	800	525	31.78	63	2	953 30	15382	484	285	9	16683	525
VGA 640x480	72Hz	31.5	1.27	40	125	646	21	832	520	26.41	79	3	686 26	12782	484	184	7	13735	520
VGA 720x400	70Hz	28.322	3.81	108	51	726	15	900	449	31.78	63	2	1016 32	12839	404	349	11	14268	449
VGA 720x350	70Hz	28.322	3.81	108	51	726	15	900	449	31.78	63	2	1811 57	11250	354	1144	36	14268	449
VGA 800x600	56Hz	36.000	2	72	125	806	21	1024	625	28.44	56	1	568 20	17177	604		-1*	17775	625
VGA 800x600	60Hz	40	3.2	128	85	806	37	1056	628	26.40	106	4	554 21	15945	604		-1*	16579	628
VGA 800x600	72Hz	50.000	2.4	120	61	806	53	1040	666	20.80	125	6	436 21	12563	604	728	35	13853	666
IBM 640x480	75Hz	31.05	3.05	96	45	646	13	800	525	25.397	51	2	761 30	12292	484	228	9	13333	525
MAC 640x480	66Hz	30.240	2.11	64	93	646	61	864	525	28.57	86	3	1057 37	13827	484	28	1	14999	525

- Active area is actually an active area added with 6 overscan border pixels (in some other VGA timing tables those border pixels are included in back and front porch)

	640x480@60	25.2 640 656 752 800 480 490 492 525	-vsync	-hsync
	800x600@56	36.0 800 824 896 1024 600 601 603 625	+hsync	+vsync
	800x600@60	40.0 800 840 968 1056 600 601 605 628	+hsync	+vsync
	1024x768@60	65.0 1024 1048 1184 1344 768 771 777 806	-vsync	-hsync
	1280x960@60	102.1 1280 1360 1496 1712 960 961 964 994	-hsync	+vsync
	1280x1024@60	108.0 1280 1328 1440 1688 1024 1025 1028 1066	+hsync	+vsync
	1400x1050@60	122.61 1400 1488 1640 1880 1050 1051 1054 1087	-hsync	+vsync
	1600x1200@60	162.0 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
640x350 @ 85Hz (VESA) hsync: 37.9kHz	640x350	31.5 640 672 736 832 350 382 385 445	+hsync	-vsync
640x400 @ 85Hz (VESA) hsync: 37.9kHz	640x400	31.5 640 672 736 832 400 401 404 445	-hsync	+vsync
720x400 @ 85Hz (VESA) hsync: 37.9kHz	720x400	35.5 720 756 828 936 400 401 404 446	-hsync	+vsync
640x480 @ 60Hz (Industry standard) hsync: 31.5kHz	640x480	25.2 640 656 752 800 480 490 492 525	-hsync	-vsync
640x480 @ 72Hz (VESA) hsync: 37.9kHz	640x480	31.5 640 664 704 832 480 489 491 520	-hsync	-vsync
640x480 @ 75Hz (VESA) hsync: 37.5kHz	640x480	31.5 640 656 720 840 480 481 484 500	-hsync	-vsync
640x480 @ 85Hz (VESA) hsync: 43.3kHz	640x480	36.0 640 696 752 832 480 481 484 509	-hsync	-vsync
800x600 @ 56Hz (VESA) hsync: 35.2kHz	800x600	36.0 800 824 896 1024 600 601 603 625	+hsync	+vsync
800x600 @ 60Hz (VESA) hsync: 37.9kHz	800x600	40.0 800 840 968 1056 600 601 605 628	+hsync	+vsync
800x600 @ 72Hz (VESA) hsync: 48.1kHz	800x600	50.0 800 856 976 1040 600 637 643 666	+hsync	+vsync
800x600 @ 75Hz (VESA) hsync: 46.9kHz	800x600	49.5 800 816 896 1056 600 601 604 625	+hsync	+vsync
800x600 @ 85Hz (VESA) hsync: 53.7kHz	800x600	56.3 800 832 896 1048 600 601 604 631	+hsync	+vsync

1024x768i @ 43Hz (industry standard) hsync: 35.5kHz	1024x768	44.9 1024 1032 1208 1264 768 768 776 817	+hsync	+vsync Interlace
1024x768 @ 60Hz (VESA) hsync: 48.4kHz	1024x768	65.0 1024 1048 1184 1344 768 771 777 806	-hsync	-vsync
1024x768 @ 70Hz (VESA) hsync: 56.5kHz	1024x768	75.0 1024 1048 1184 1328 768 771 777 806	-hsync	-vsync
1024x768 @ 75Hz (VESA) hsync: 60.0kHz	1024x768	78.8 1024 1040 1136 1312 768 769 772 800	+hsync	+vsync
1024x768 @ 85Hz (VESA) hsync: 68.7kHz	1024x768	94.5 1024 1072 1168 1376 768 769 772 808	+hsync	+vsync
1152x864 @ 75Hz (VESA) hsync: 67.5kHz	1152x864	108.0 1152 1216 1344 1600 864 865 868 900	+hsync	+vsync
1280x960 @ 60Hz (VESA) hsync: 60.0kHz	1280x960	108.0 1280 1376 1488 1800 960 961 964 1000	+hsync	+vsync
1280x960 @ 85Hz (VESA) hsync: 85.9kHz	1280x960	148.5 1280 1344 1504 1728 960 961 964 1011	+hsync	+vsync
1280x1024 @ 60Hz (VESA) hsync: 64.0kHz	1280x1024	108.0 1280 1328 1440 1688 1024 1025 1028 1066	+hsync	+vsync
1280x1024 @ 75Hz (VESA) hsync: 80.0kHz	1280x1024	135.0 1280 1296 1440 1688 1024 1025 1028 1066	+hsync	+vsync
1280x1024 @ 85Hz (VESA) hsync: 91.1kHz	1280x1024	157.5 1280 1344 1504 1728 1024 1025 1028 1072	+hsync	+vsync
1600x1200 @ 60Hz (VESA) hsync: 75.0kHz	1600x1200	162.0 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
1600x1200 @ 65Hz (VESA) hsync: 81.3kHz	1600x1200	175.5 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
1600x1200 @ 70Hz (VESA) hsync: 87.5kHz	1600x1200	189.0 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
1600x1200 @ 75Hz (VESA) hsync: 93.8kHz	1600x1200	202.5 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
1600x1200 @ 85Hz (VESA) hsync: 106.3kHz	1600x1200	229.5 1600 1664 1856 2160 1200 1201 1204 1250	+hsync	+vsync
1792x1344 @ 60Hz (VESA) hsync: 83.6kHz	1792x1344	204.8 1792 1920 2120 2448 1344 1345 1348 1394	-hsync	+vsync
1792x1344 @ 75Hz (VESA) hsync: 106.3kHz	1792x1344	261.0 1792 1888 2104 2456 1344 1345 1348 1417	-hsync	+vsync
1856x1392 @ 60Hz (VESA) hsync: 86.3kHz	1856x1392	218.3 1856 1952 2176 2528 1392 1393 1396 1439	-hsync	+vsync
1856x1392 @ 75Hz (VESA) hsync: 112.5kHz	1856x1392	288.0 1856 1984 2208 2560 1392 1393 1396 1500	-hsync	+vsync
1920x1440 @ 60Hz (VESA) hsync: 90.0kHz	1920x1440	234.0 1920 2048 2256 2600 1440 1441 1444 1500	-hsync	+vsync
1920x1440 @ 75Hz (VESA) hsync: 112.5kHz	1920x1440	297.0 1920 2064 2288 2640 1440 1441 1444 1500	-hsync	+vsync
	1800x1440	230 1800 1896 2088 2392 1440 1441 1444 1490	+HSync	+VSync
	1800x1440	250 1800 1896 2088 2392 1440 1441 1444 1490	+HSync	+VSync
640x480 @ 100.00 Hz (GTF) hsync: 50.90 kHz; pclk: 43.16 MHz	640x480	43.16 640 680 744 848 480 481 484 509	-HSync	+Vsync
768x576 @ 60.00 Hz (GTF) hsync: 35.82 kHz; pclk: 34.96 MHz	768x576	34.96 768 792 872 976 576 577 580 597	-HSync	+Vsync
768x576 @ 72.00 Hz (GTF) hsync: 43.27 kHz; pclk: 42.93 MHz	768x576	42.93 768 800 880 992 576 577 580 601	-HSync	+Vsync
768x576 @ 75.00 Hz (GTF) hsync: 45.15 kHz; pclk: 45.51 MHz	768x576	45.51 768 808 888 1008 576 577 580 602	-HSync	+Vsync
768x576 @ 85.00 Hz (GTF) hsync: 51.42 kHz; pclk: 51.84 MHz	768x576	51.84 768 808 888 1008 576 577 580 605	-HSync	+Vsync
768x576 @ 100.00 Hz (GTF) hsync: 61.10 kHz; pclk: 62.57 MHz	768x576	62.57 768 816 896 1024 576 577 580 611	-HSync	+Vsync

800x600 @ 100.00 Hz (GTF) hsync: 63.60 kHz; pclk: 68.18 MHz	800x600	68.18 800 848 936 1072 600 601 604 636	-HSync	+Vsync
1024x768 @ 100.00 Hz (GTF) hsync: 81.40 kHz; pclk: 113.31 MHz	1024x768	113.31 1024 1096 1208 1392 768 769 772 814	-HSync	+Vsync
1152x864 @ 60.00 Hz (GTF) hsync: 53.70 kHz; pclk: 81.62 MHz	1152x864	81.62 1152 1216 1336 1520 864 865 868 895	-HSync	+Vsync
1152x864 @ 85.00 Hz (GTF) hsync: 77.10 kHz; pclk: 119.65 MHz	1152x864	119.65 1152 1224 1352 1552 864 865 868 907	-HSync	+Vsync
1152x864 @ 100.00 Hz (GTF) hsync: 91.50 kHz; pclk: 143.47 MHz	1152x864	143.47 1152 1232 1360 1568 864 865 868 915	-HSync	+Vsync
1280x800 @ 60.00 Hz (GTF) hsync: 49.68 kHz; pclk: 83.46 MHz	1280x800	83.46 1280 1344 1480 1680 800 801 804 828	-HSync	+Vsync
1280x960 @ 72.00 Hz (GTF) hsync: 72.07 kHz; pclk: 124.54 MHz	1280x960	124.54 1280 1368 1504 1728 960 961 964 1001	-HSync	+Vsync
1280x960 @ 75.00 Hz (GTF) hsync: 75.15 kHz; pclk: 129.86 MHz	1280x960	129.86 1280 1368 1504 1728 960 961 964 1002	-HSync	+Vsync
1280x960 @ 100.00 Hz (GTF) hsync: 101.70 kHz; pclk: 178.99 MHz	1280x960	178.99 1280 1376 1520 1760 960 961 964 1017	-HSync	+Vsync
1280x1024 @ 100.00 Hz (GTF) hsync: 108.50 kHz; pclk: 190.96 MHz	1280x1024	190.96 1280 1376 1520 1760 1024 1025 1028 1085	-HSync	+Vsync
1368x768 @ 60.00 Hz (GTF) hsync: 47.70 kHz; pclk: 85.86 MHz	1368x768	85.86 1368 1440 1584 1800 768 769 772 795	-HSync	+Vsync
1400x1050 @ 60.00 Hz (GTF) hsync: 65.22 kHz; pclk: 122.61 MHz	1400x1050	122.61 1400 1488 1640 1880 1050 1051 1054 1087	-HSync	+Vsync
1400x1050 @ 72.00 Hz (GTF) hsync: 78.77 kHz; pclk: 149.34 MHz	1400x1050	149.34 1400 1496 1648 1896 1050 1051 1054 1094	-HSync	+Vsync
1400x1050 @ 75.00 Hz (GTF) hsync: 82.20 kHz; pclk: 155.85 MHz	1400x1050	155.85 1400 1496 1648 1896 1050 1051 1054 1096	-HSync	+Vsync
1400x1050 @ 85.00 Hz (GTF) hsync: 93.76 kHz; pclk: 179.26 MHz	1400x1050	179.26 1400 1504 1656 1912 1050 1051 1054 1103	-HSync	+Vsync
1400x1050 @ 100.00 Hz (GTF) hsync: 111.20 kHz; pclk: 214.39 MHz	1400x1050	214.39 1400 1512 1664 1928 1050 1051 1054 1112	-HSync	+Vsync
1440x900 @ 60.00 Hz (GTF) hsync: 55.92 kHz; pclk: 106.47 MHz	1440x900	106.47 1440 1520 1672 1904 900 901 904 932	-HSync	+Vsync
1600x1200 @ 100.00 Hz (GTF) hsync: 127.10 kHz; pclk: 280.64 MHz	1600x1200	280.64 1600 1728 1904 2208 1200 1201 1204 1271	-HSync	+Vsync
1680x1050 @ 60.00 Hz (GTF) hsync: 65.22 kHz; pclk: 147.14 MHz	1680x1050	147.14 1680 1784 1968 2256 1050 1051 1054 1087	-HSync	+Vsync
1920x1200 @ 60.00 Hz (GTF) hsync: 74.52 kHz; pclk: 193.16 MHz	1920x1200	193.16 1920 2048 2256 2592 1200 1201 1204 1242	-HSync	+Vsync

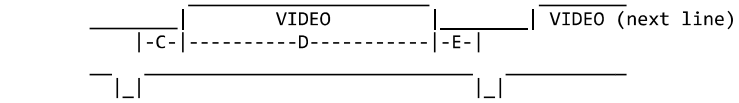
VGA timing information

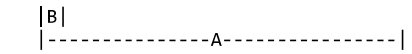
This documents tries to collect together information about standard VGA card timing details.

Information form HP monitor manual

Horizonal Timing

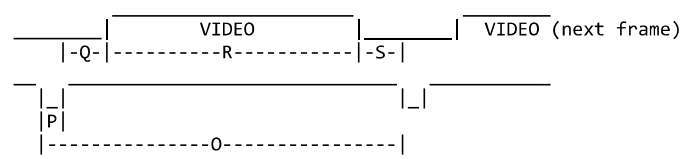
```
Horizonal Dots         640     640     640
Vertical Scan Lines    350     400     480
Horiz. Sync Polarity   POS     NEG     NEG
A (us)                 31.77   31.77   31.77     Scanline time
B (us)                 3.77    3.77    3.77      Sync pulse lenght
C (us)                 1.89    1.89    1.89      Back porch
D (us)                 25.17   25.17   25.17     Active video time
E (us)                 0.94    0.94    0.94      Front porch
```





Vertical Timing

Horizonal Dots	640	640	640	
Vertical Scan Lines	350	400	480	
Vert. Sync Polarity	NEG	POS	NEG	
Vertical Frequency	70Hz	70Hz	60Hz	
O (ms)	14.27	14.27	16.68	Total frame time
P (ms)	0.06	0.06	0.06	Sync length
Q (ms)	1.88	1.08	1.02	Back porch
R (ms)	11.13	12.72	15.25	Active video time
S (ms)	1.2	0.41	0.35	Front porch



Informations source

- HP D1194A Super VGA Display & HP D1195A Erognomic Super VGA Display Installation Guide, Hewlett Packard

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More VGA mode information

There are the 3 "standard" VGA modes that each VGA card is supposed to be able to do:

- 640 x 350 x 70 is compatible with the old EGA mode, but on a VGA display.
- 640 x 400 x 70 is the MS-DOS text mode (when the computer is booting !).
- 640 x 480 x 60 is the default Windows(tm) graphics mode (16 colours !).

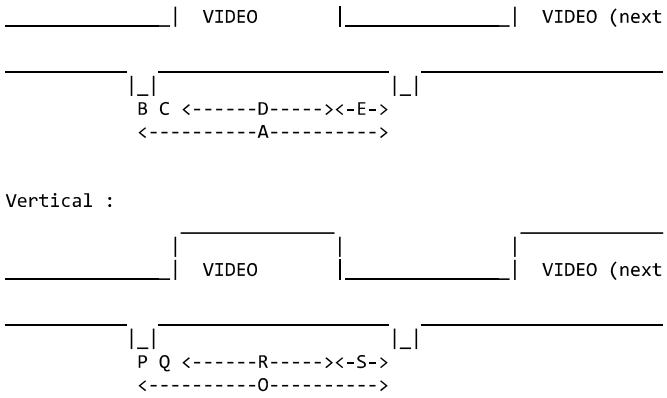
Their line frequency is exactly twice that of the NTSC television system, or almost twice that of the PAL television system. This makes it fairly easy to implement a VGA input on a television set that uses line doubling for the television signals so the line deflection already runs on 31 kHz.

The following timings come from a list of 82 different computer timings, and by now there will be even more. Some video cards even have variable timing (allowing the user to set width, height and shift...). **The only standard is that there is no standard !**

"640 x 350 (EGA on VGA)"	"640 x 400 VGA text"	"VGA industry standard"
Clock frequency 25.175 MHz	Clock frequency 25.175 MHz	Clock frequency 25.175 MHz
Line frequency 31469 Hz	Line frequency 31469 Hz	Line frequency 31469 Hz
Field frequency 70.086 Hz	Field frequency 70.086 Hz	Field frequency 59.94 Hz
One line:	One line:	One line:
8 pixels front porch	8 pixels front porch	8 pixels front porch
96 pixels horizontal sync	96 pixels horizontal sync	96 pixels horizontal sync
40 pixels back porch	40 pixels back porch	40 pixels back porch
8 pixels left border	8 pixels left border	8 pixels left border
640 pixels video	640 pixels video	640 pixels video
8 pixels right border	8 pixels right border	8 pixels right border
---	---	---
800 pixels total per line	800 pixels total per line	800 pixels total per line
One field:	One field:	One field:
31 lines front porch	5 lines front porch	2 lines front porch
2 lines vertical sync	2 lines vertical sync	2 lines vertical sync
54 lines back porch	28 lines back porch	25 lines back porch
6 lines top border	7 lines top border	8 lines top border
350 lines video	400 lines video	480 lines video
6 lines bottom border	7 lines bottom border	8 lines bottom border
---	---	---
449 lines total per field	449 lines total per field	525 lines total
per field		
Sync polarity: H positive, V negative	Sync polarity: H negative, V positive	Sync polarity: H negative, V negative
Scan type: non interlaced.	Scan type: non interlaced.	Scan type: non interlaced.

SuperVGA timing from NEC monitor manual

Horizontal :



For VESA 800*600 @ 60Hz:

```
Fh (kHz) :37.88
A  (us)  :26.4
B  (us)  :3.2
C  (us)  :2.2
D  (us)  :20.0
E  (us)  :1.0

Fv (Hz)  :60.32
O  (ms)  :16.579
P  (ms)  :0.106
Q  (ms)  :0.607
R  (ms)  :15.84
S  (ms)  :0.026
```

Timing used in one VGA monitor tester product

The following timings are used in VTG-KIT VGA monitor tester kit sold my Data Sync Engineering.

Mode	Horiz Dots	Vertical Lines	Horiz KHz	Vert Hz	Horiz Sync	HSYNC Pol	Vertical Sync	VSYNC Pol
VGA-480	640	480	31.5	60	3.8 us	-	64 us	-
VGA-400	640	400	31.5	70	3.8 us	-	64 us	+
SVGA I	800	600	35.2	56	2.0 us	-	57 us	-
SVGA II	800	600	37.8	60	3.2 us	+	106 us	+
SVGA III	800	600	48.0	72	2.4 us	+	125 us	+
XGA	1024	768	48.5	60	2.0 us	-	124 us	-