

Phil's Voodoo 2 processor scaling project

FROM 100 TO 1400 MHZ

Western Australia, July 2014

CONTENTS

Introduction	3
Raw results as tables and graphs	5
Super Socket 7 platform (VIA Apollo MVP3)	6
Slot 1 platform (Intel BX440 Chipset)	10
Socket 370 platform (Intel 815E chipset)	12
SLI scaling results	14
Super Socket 7 platform (VIA Apollo MVP3)	14
Slot 1 platform (Intel BX440 Chipset)	17
Socket 370 platform (Intel 815E chipset)	18
Processor and resolution scaling for each game	19
Unreal	20
Quake 2	22
Incoming	24
GLQuake	26
Forsaken	28
Other Observations	30
Voodoo 2 Temperature and cooling	30
SLI interleaving glitches	32
Pentium III Katmai vs. Coppermine	33
intel BX440 vs. 815 chipset.....	35
Hardware, Software and Settings used for this Project	37
DFI K6XV3+/66.....	37
Photo	37
BIOSProce Version and settings.....	38
AOpen AX6BC	42
Photo	42
BIOS version and settings	42
AOPEN MX3S-T	47
Photo	47
BIOS version and settings	47
NVIDIA GEFORCE MX 440.....	55
Photo	55
Driver.....	55
STB Voodoo 2 12 MB (Two for SLI)	56
Photo	56
Driver.....	56
Software used across all platforms	60
Windows 98SE.....	60

USB Storage Driver	60
DirectX 7.....	60
Benchmarks and settings	61
Unreal	61
Quake 2	62
Incoming	63
GLQuake	64
Forsaken	64

INTRODUCTION

Hi,

I am Phil and in my spare time enjoy working on projects that revolve around old computers. Specifically DOS and Windows PCs that run old games. I hope you enjoy reading this document!

In this document I am publishing the results of my Voodoo 2 processor scaling project. What is Voodoo 2? Voodoo 2 is a graphics card from the company 3dfx that launched in 1998. It is the successor to the Voodoo and, at the time, offered leading performance in 3D computer games.

Through SLI (Scan-Line Interleave) technology two Voodoo 2 cards could be used in one system to boost performance. Depending on the computer, game and resolution a performance boost of just over 90% can be achieved this way. SLI also allows using a higher resolution of 1024 x 768. A single card could only display a maximum of 800 x 600 pixels.

A range of five benchmarks have been selected:

- Unreal
- Quake II
- Incoming
- GLQuake
- Forsaken

The games are listed in order of how taxing they are on the graphics card. Unreal is the most demanding game. Quake II and Incoming are less demanding on the graphics. GLQuake and Forsaken are older titles that are even less demanding and, especially at low resolutions, achieve very high frame rates.

For each processor, each game was benchmarked at the following resolutions for a single Voodoo 2:

- 512 x 384
- 640 x 480
- 800 x 600

And at the following resolutions for Voodoo 2 SLI:

- 512 x 384
- 640 x 480
- 800 x 600
- 1024 x 768

The results have been split up according to the platforms tested:

- Super Socket 7
- Slot 1
- Socket 370

The systems have been configured conservatively using BIOS defaults and conservative memory timings. The focus of this project is not to measure absolute performance but to investigate performance scaling across a wide range of processors and systems. All hardware components, as well as software, Windows and BIOS settings have been documented and can be found towards the end of this documents.

A total of 25 processors have been used to collect data. All the way from a Pentium 100 to a very fast Pentium III-S 1400. Voodoo 2 cards scale very well with processing speed but I always wanted to have a better idea of how much exactly.

This document has several sections. The first section shows all the raw data in table form and as graphs.

The next chapter covers SLI scaling. As percentage figures you can see the performance improvement when adding a second Voodoo 2 card. The data shows this for all combinations of games, processors and resolutions.

Looking at the raw data is often not the best way to extract meaning. The next chapter breaks down the data for each game. Graphs show the processor and resolution scaling and it is this section that best answers the question of what processor is sufficient for each game and resolution. Situations when using a faster processor does not make a difference anymore or situations when the graphics card is held back by the processor can be easily identified.

After this I will share other findings:

- Temperature and cooling
- SLI interleaving glitches
- PIII Katmai vs. Coppermine processor
- Intel BX440 vs. 815E chipset

The remaining part of the document is a detailed account of what hardware, software and settings were used to obtain these results. This makes it easy to do your own testing and compare your findings with this document.

If you would like to contact me, the best place to do so is on the VOGONS forum:

<http://www.vogons.org/memberlist.php?mode=viewprofile&u=20732>

Or:

mau1wurf1977@gmail.com

RAW RESULTS AS TABLES AND GRAPHS

In this section all the results are displayed as tables and graphs. A range of five benchmarks have been selected:

- Unreal
- Quake II
- Incoming
- GLQuake
- Forsaken

The games are listed in order of how taxing they are on the graphics card. Unreal is the most demanding game. Quake II and Incoming are less demanding on the graphics. GLQuake and Forsaken are older titles that are even less demanding and, especially at low resolutions, achieve very high frame rates.

For each processor, each game was benchmarked at the following resolutions for a single Voodoo 2:

- 512 x 384
- 640 x 480
- 800 x 600

And at the following resolutions for Voodoo 2 SLI:

- 512 x 384
- 640 x 480
- 800 x 600
- 1024 x 768

The results have been split up according to the platforms tested:

- Super Socket 7
- Slot 1
- Socket 370

The systems have been configured conservatively using BIOS defaults and conservative memory timings. The focus of this project is not to measure absolute performance but to investigate performance scaling across a wide range of processors and systems.

While this section provides all the raw data, later sections will provide in-depth analysis and conclusions.

SUPER SOCKET 7 PLATFORM (VIA APOLLO MVP3)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 100	SLI 1024 x 786	11.78	19.3	18.51	44.7	43.77
	SLI 800 x 600	12.46	19.2	17.75	45.7	43.8
	SLI 640 x 480	13.11	19.2	17.37	45.7	43.98
	SLI 512 x 384	13.55	19.3	16.74	46.4	43.9
	800 x 600	12.41	19.3	18.25	44.2	44.07
	640 x 480	13.16	19.2	17.81	44.8	44.25
	512 x 384	13.66	19.3	17.07	46	44.32
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 133	SLI 1024 x 786	13.76	23.7	22.84	51.2	51.95
	SLI 800 x 600	14.74	23.6	22.09	54.7	51.79
	SLI 640 x 480	15.25	23.6	21.34	54.8	51.87
	SLI 512 x 384	15.99	23.7	20.7	55.9	51.91
	800 x 600	14.93	23.6	22.02	53.5	51.44
	640 x 480	15.43	23.7	21.42	55.1	52.03
	512 x 384	15.93	23.6	20.52	56	52.16
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 166	SLI 1024 x 786	15.18	26.8	25.19	59.3	58.43
	SLI 800 x 600	16.07	26.8	24.4	61.8	58.49
	SLI 640 x 480	16.5	26.8	23.65	62.5	58.43
	SLI 512 x 384	17.62	26.7	22.86	62.8	58.49
	800 x 600	15.97	26.7	23.47	57.9	54.71
	640 x 480	17.06	26.7	23.02	60.5	55.02
	512 x 384	17.78	26.5	22.4	61.8	55.26
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 200	SLI 1024 x 786	16.36	29.5	28.27	65.6	63.43
	SLI 800 x 600	17.3	29.5	27.56	68.6	63.08
	SLI 640 x 480	17.88	29.5	26.63	68.2	63.58
	SLI 512 x 384	18.87	29.6	26	68.8	63.65
	800 x 600	17.35	29.5	26.44	62.7	62.39
	640 x 480	18.02	29.5	26.06	67.7	63.95
	512 x 384	19.07	29.6	25.54	69.4	64.35
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 166	SLI 1024 x 786	19.52	32.9	29.59	71.2	66.22
	SLI 800 x 600	19.84	33.1	28.65	76	66.9
	SLI 640 x 480	20.89	32.9	27.65	77	67.05
	SLI 512 x 384	22.67	32.8	27.07	79.7	66.87
	800 x 600	20.41	32.4	28.56	65.8	64.37
	640 x 480	21.67	32.7	28.55	75.7	66.66
	512 x 384	22.78	32.6	26.84	79.5	66.77
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 200	SLI 1024 x 786	20.52	36.7	33.32	75.2	72.28
	SLI 800 x 600	22.43	36.8	32.34	85.4	73.49
	SLI 640 x 480	23.76	36.6	31.27	87	73.69
	SLI 512 x 384	25.09	36.9	30.44	89.9	74.01
	800 x 600	22.62	36.6	32.2	68.1	69.61
	640 x 480	23.83	37	31.46	83.9	72.56
	512 x 384	25.03	37.1	30.44	89.7	73.12
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 233	SLI 1024 x 786	21.88	40	36.26	77.5	77.12
	SLI 800 x 600	23.85	40.4	35.19	92.6	79.04
	SLI 640 x 480	25.22	40.2	34.18	94.7	79.44
	SLI 512 x 384	26.73	40.3	33.27	98.6	79.55
	800 x 600	23.71	39.9	34.85	69.2	73.69
	640 x 480	25.46	40.1	34.08	90.1	78.72
	512 x 384	26.64	40.5	33.26	98.2	79.08

SOCKET 7 PROCESSORS (66 MHZ FSB)

■ Unreal
 ■ Quake 2
 ■ Incoming
 ■ GLQuake
 ■ Forsaken



		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2/300AFR	SLI 1024 x 786	32.14	41.8	54.96	76.6	101.69
	SLI 800 x 600	34.27	42.3	54.63	88.9	124.07
	SLI 640 x 480	35.84	42.3	53.4	90.9	127.38
	SLI 512 x 384	37.18	42.2	52.38	93.8	126.86
	800 x 600	32.48	42.5	50.7	68.8	90.33
	640 x 480	35.41	42.3	53.32	87.3	120.54
	512 x 384	36.82	42.5	52.05	93.2	130.1
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-III+/400ATZ	SLI 1024 x 786	41.33	53.7	65.8	81	108.72
	SLI 800 x 600	45.87	56	75.17	112.5	156.1
	SLI 640 x 480	47.9	56.2	73.64	121.6	175.04
	SLI 512 x 384	48.68	56.3	72.33	128.5	177.72
	800 x 600	37.17	51.8	56.48	70.9	93.22
	640 x 480	47.31	55.8	71.53	102.8	139.84
	512 x 384	50.53	56	72.11	123.4	168.86
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2/550AGR	SLI 1024 x 786	42.49	58.3	67.28	81.6	108.65
	SLI 800 x 600	46.22	61.7	79.25	118.1	153.48
	SLI 640 x 480	48.34	61.9	78.64	132.7	168.82
	SLI 512 x 384	49.97	62.5	77.8	140.6	170.79
	800 x 600	39.84	55	56.68	71	93.23
	640 x 480	47.62	61.5	73.18	105.5	138.47
	512 x 384	50.73	62.3	74.96	132.6	164.31
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2+/550ACZ	SLI 1024 x 786	46.82	61.5	68.76	81.9	109.72
	SLI 800 x 600	54.32	67.7	91.15	121.8	164.03
	SLI 640 x 480	57.17	67.9	92.53	144.3	189.66
	SLI 512 x 384	59.48	68.5	90.86	155.4	193.15
	800 x 600	42.86	56.7	57.29	71.2	93.21
	640 x 480	54.98	66.3	80.47	107.2	143.62
	512 x 384	59.36	67.7	88.44	140.5	179.46
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-III+/550ATZ	SLI 1024 x 786	47.63	61.2	68.67	81.9	109.72
	SLI 800 x 600	55.69	68.5	93.35	122.7	167.76
	SLI 640 x 480	59.16	68.7	95.39	147.9	203.78
	SLI 512 x 384	61.38	68.8	94.27	161	210.68
	800 x 600	43.01	57	57.39	71.2	93.29
	640 x 480	56.01	67.9	82.35	107.5	145.51
	512 x 384	61.42	69.6	92.67	142.5	189.09

SUPER SOCKET 7 PROCESSORS (100 MHZ FSB)

■ Unreal
 ■ Quake 2
 ■ Incoming
 ■ GLQuake
 ■ Forsaken



SLOT 1 PLATFORM (INTEL BX440 CHIPSET)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Klamath 233	SLI 1024 x 786	32.88	54.60	61.17	80.80	102.57
	SLI 800 x 600	34.95	57.10	62.96	113.80	125.98
	SLI 640 x 480	37.20	57.30	60.80	125.30	130.48
	SLI 512 x 384	38.07	57.20	58.65	131.90	130.78
	800 x 600	34.24	52.30	53.81	70.70	90.38
	640 x 480	37.51	56.40	60.50	102.90	119.61
	512 x 384	39.37	57.20	58.57	124.30	128.26
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Covington 300	SLI 1024 x 786	29.98	55.90	53.77	81.00	95.62
	SLI 800 x 600	32.31	58.30	52.93	115.00	106.63
	SLI 640 x 480	34.28	56.20	51.56	125.50	107.86
	SLI 512 x 384	35.76	57.80	50.48	132.60	108.24
	800 x 600	31.83	53.30	49.88	70.80	87.06
	640 x 480	34.24	57.90	51.29	103.70	104.87
	512 x 384	35.72	58.40	50.13	126.80	107.83
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Deschutes 400	SLI 1024 x 786	48.64	67.50	94.54	82.20	109.78
	SLI 800 x 600	58.51	90.10	94.33	126.80	167.65
	SLI 640 x 480	62.54	94.90	97.47	175.50	203.46
	SLI 512 x 384	65.81	95.70	94.77	212.30	211.89
	800 x 600	43.16	59.30	56.84	71.30	93.49
	640 x 480	58.18	84.60	82.53	108.80	145.55
	512 x 384	64.92	94.20	93.53	152.80	188.54
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Katmai 500	SLI 1024 x 786	52.54	68.00	68.58	82.20	109.93
	SLI 800 x 600	65.07	99.30	100.58	126.70	174.10
	SLI 640 x 480	72.06	112.50	113.46	180.20	227.05
	SLI 512 x 384	76.00	114.80	110.46	241.10	246.74
	800 x 600	44.32	59.40	57.21	71.30	93.38
	640 x 480	63.19	89.10	84.97	108.90	148.19
	512 x 384	74.00	109.30	106.06	154.60	202.95
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500E iBX440	SLI 1024 x 786	54.42	68.00	68.58	82.20	109.87
	SLI 800 x 600	69.44	99.50	101.93	126.80	174.14
	SLI 640 x 480	76.00	112.50	118.12	181.20	223.39
	SLI 512 x 384	79.45	113.20	114.80	237.60	240.47
	800 x 600	45.09	59.40	57.25	71.30	93.31
	640 x 480	66.46	89.20	84.85	108.90	148.31
	512 x 384	77.66	108.80	108.17	154.40	201.96
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 700E iBX440	SLI 1024 x 786	56.72	68.20	68.66	82.20	110.00
	SLI 800 x 600	78.10	104.30	104.34	126.70	178.41
	SLI 640 x 480	92.87	134.90	136.51	183.50	248.51
	SLI 512 x 384	98.69	143.60	142.59	259.80	282.47
	800 x 600	46.21	59.50	57.51	71.30	93.35
	640 x 480	72.60	90.80	85.00	108.90	149.15
	512 x 384	89.31	122.30	115.53	154.70	213.13
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 900E iBX440	SLI 1024 x 786	57.16	68.20	68.72	82.20	110.03
	SLI 800 x 600	83.36	104.50	104.35	126.80	178.98
	SLI 640 x 480	101.03	143.70	143.75	183.50	259.86
	SLI 512 x 384	109.35	163.10	163.04	263.90	309.45
	800 x 600	46.68	59.50	51.61	71.30	93.30
	640 x 480	74.79	90.80	85.08	108.90	149.26
	512 x 384	95.96	125.20	116.22	154.60	217.80

SLOT 1 PROCESSORS

■ Unreal
 ■ Quake 2
 ■ Incoming
 ■ GLQuake
 ■ Forsaken



SOCKET 370 PLATFORM (INTEL 815E CHIPSET)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500E i815E	SLI 1024 x 786	54.64	68.00	68.59	82.20	110.01
	SLI 800 x 600	68.85	99.30	101.26	126.70	174.16
	SLI 640 x 480	77.22	111.90	115.90	181.10	224.47
	SLI 512 x 384	80.55	113.20	112.86	237.40	240.47
	800 x 600	44.96	59.40	57.23	71.30	93.36
	640 x 480	66.43	88.70	84.77	108.90	148.16
	512 x 384	77.92	108.30	106.20	154.50	202.47
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 600EB	SLI 1024 x 786	56.13	68.10	68.69	82.20	109.79
	SLI 800 x 600	74.76	102.80	103.53	126.60	177.32
	SLI 640 x 480	86.12	125.50	125.83	182.80	240.46
	SLI 512 x 384	90.88	130.10	124.53	253.00	266.85
	800 x 600	45.72	59.40	57.44	71.30	93.42
	640 x 480	70.38	90.30	84.85	108.90	149.12
	512 x 384	85.33	118.50	112.61	154.80	209.79
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 800EB	SLI 1024 x 786	57.09	68.20	68.66	82.20	109.84
	SLI 800 x 600	81.66	104.30	104.32	126.70	179.10
	SLI 640 x 480	98.54	140.80	139.73	183.50	256.63
	SLI 512 x 384	106.64	154.40	151.84	263.30	301.00
	800 x 600	46.42	59.50	57.52	71.70	93.47
	640 x 480	73.88	90.80	84.97	109.00	149.14
	512 x 384	86.56	124.70	115.91	154.70	216.57
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 1000EB	SLI 1024 x 786	57.30	68.20	68.74	82.20	109.88
	SLI 800 x 600	84.86	104.60	104.56	126.70	179.57
	SLI 640 x 480	106.23	144.90	144.66	183.40	264.53
	SLI 512 x 384	117.59	168.50	165.71	263.90	322.54
	800 x 600	46.99	59.50	57.61	71.30	93.35
	640 x 480	75.04	90.80	85.20	108.90	149.35
	512 x 384	99.44	125.50	116.40	154.70	218.89
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Tualatin 1133	SLI 1024 x 786	57.70	68.20	68.81	82.20	109.97
	SLI 800 x 600	87.79	104.70	104.55	126.70	179.11
	SLI 640 x 480	119.49	147.50	147.70	183.40	275.55
	SLI 512 x 384	139.06	185.00	189.72	264.90	384.55
	800 x 600	47.56	59.50	57.71	71.30	93.24
	640 x 480	75.74	90.80	85.27	108.90	149.18
	512 x 384	105.13	126.10	116.58	154.70	220.36
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Tualatin 1400	SLI 1024 x 786	57.98	68.20	68.85	82.20	109.99
	SLI 800 x 600	88.22	104.70	104.58	126.70	179.49
	SLI 640 x 480	123.80	147.80	147.71	183.30	276.52
	SLI 512 x 384	146.83	188.80	193.89	264.70	393.49
	800 x 600	47.77	59.50	57.70	71.30	93.44
	640 x 480	75.85	90.80	85.18	108.90	149.11
	512 x 384	106.66	126.50	116.27	154.70	219.59

SOCKET 370 PROCESSORS

■ Unreal
 ■ Quake 2
 ■ Incoming
 ■ GLQuake
 ■ Forsaken



SLI SCALING RESULTS

In this section SLI scaling is shown as performance improvement in percentage. For every processor, game and resolution you can see how much performance you would gain by using dual Voodoo 2 cards in SLI configuration instead of just a single Voodoo 2.

To assist in analysing the data conditional formatting has been applied and cells shaded according to the amount of scaling. A red cell represents a scaling of 0% and means that adding a second card does not improve performance. Note however that adding a second card allows running games at a higher resolution (1024 x 768), something you might be interested in, even when performance does not improve.

An orange cell represents scaling of 50%, whereas a green cell represents scaling of 100%.

As processing speed increases, so does SLI scaling. In an ideal situation SLI would scale 100%, doubling frame rate. Because of overheads this is next to impossible to achieve, however, with the right combination of processor, game and resolution, scaling, and therefore a performance improvement, of 80% can be achieved.

SUPER SOCKET 7 PLATFORM (VIA APOLLO MVP3)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 100	800 x 600	0%	-1%	-3%	3%	-1%
	640 x 480	0%	0%	-2%	2%	-1%
	512 x 384	-1%	0%	-2%	1%	-1%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 133	800 x 600	-1%	0%	0%	2%	1%
	640 x 480	-1%	0%	0%	-1%	0%
	512 x 384	0%	0%	1%	0%	0%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 166	800 x 600	1%	0%	4%	7%	7%
	640 x 480	-3%	0%	3%	3%	6%
	512 x 384	-1%	1%	2%	2%	6%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P 200	800 x 600	0%	0%	4%	9%	1%
	640 x 480	-1%	0%	2%	1%	-1%
	512 x 384	-1%	0%	2%	-1%	-1%

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 166	800 x 600	-3%	2%	0%	16%	4%
	640 x 480	-4%	1%	-3%	2%	1%
	512 x 384	0%	1%	1%	0%	0%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 200	800 x 600	-1%	1%	0%	25%	6%
	640 x 480	0%	-1%	-1%	4%	2%
	512 x 384	0%	-1%	0%	0%	1%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
P MMX 233	800 x 600	1%	1%	1%	34%	7%
	640 x 480	-1%	0%	0%	5%	1%
	512 x 384	0%	0%	0%	0%	1%

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2/300AFR	800 x 600	6%	0%	8%	29%	37%
	640 x 480	1%	0%	0%	4%	6%
	512 x 384	1%	-1%	1%	1%	-2%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-III+/400ATZ	800 x 600	23%	8%	33%	59%	67%
	640 x 480	1%	1%	3%	18%	25%
	512 x 384	-4%	1%	0%	4%	5%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2/550AGR	800 x 600	16%	12%	40%	66%	65%
	640 x 480	2%	1%	7%	26%	22%
	512 x 384	-1%	0%	4%	6%	4%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-2+/550ACZ	800 x 600	27%	19%	59%	71%	76%
	640 x 480	4%	2%	15%	35%	32%
	512 x 384	0%	1%	3%	11%	8%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
K6-III+/550ATZ	800 x 600	29%	20%	63%	72%	80%
	640 x 480	6%	1%	16%	38%	40%
	512 x 384	0%	-1%	2%	13%	11%

SLOT 1 PLATFORM (INTEL BX440 CHIPSET)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Klamath 233	800 x 600	2%	9%	17%	61%	39%
	640 x 480	-1%	2%	0%	22%	9%
	512 x 384	-3%	0%	0%	6%	2%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Covington 300	800 x 600	2%	9%	6%	62%	22%
	640 x 480	0%	-3%	1%	21%	3%
	512 x 384	0%	-1%	1%	5%	0%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Deschutes 400	800 x 600	36%	52%	66%	78%	79%
	640 x 480	7%	12%	18%	61%	40%
	512 x 384	1%	2%	1%	39%	12%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Katmai 500	800 x 600	47%	67%	76%	78%	86%
	640 x 480	14%	26%	34%	65%	53%
	512 x 384	3%	5%	4%	56%	22%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500E iBX440	800 x 600	54%	68%	78%	78%	87%
	640 x 480	14%	26%	39%	66%	51%
	512 x 384	2%	4%	6%	54%	19%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 700E iBX440	800 x 600	69%	75%	81%	78%	91%
	640 x 480	28%	49%	61%	69%	67%
	512 x 384	11%	17%	23%	68%	33%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 900E iBX440	800 x 600	79%	76%	81%	78%	92%
	640 x 480	35%	58%	65%	69%	74%
	512 x 384	14%	30%	40%	71%	42%

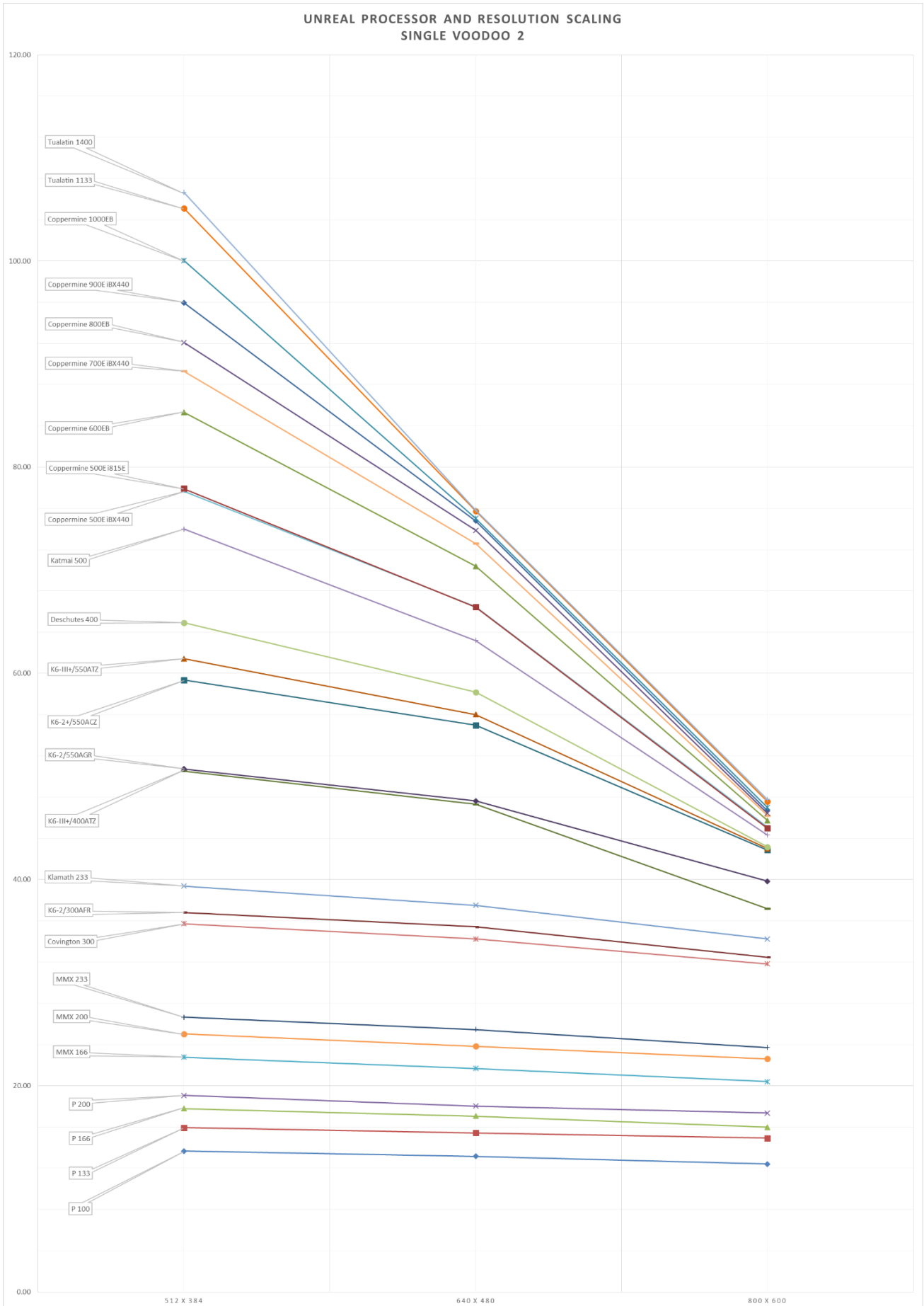
SOCKET 370 PLATFORM (INTEL 815E CHIPSET)

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500/256/100	800 x 600	53%	67%	77%	78%	87%
	640 x 480	16%	26%	37%	66%	52%
	512 x 384	3%	5%	6%	54%	19%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 600/256/133	800 x 600	64%	73%	80%	78%	90%
	640 x 480	22%	39%	48%	68%	61%
	512 x 384	7%	10%	11%	63%	27%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 800/256/133	800 x 600	76%	75%	81%	77%	92%
	640 x 480	33%	55%	64%	68%	72%
	512 x 384	23%	24%	31%	70%	39%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 1000/256/133	800 x 600	81%	76%	81%	78%	92%
	640 x 480	42%	60%	70%	68%	77%
	512 x 384	18%	34%	42%	71%	47%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Tualatin 1133/512/133	800 x 600	85%	76%	81%	78%	92%
	640 x 480	58%	62%	73%	68%	85%
	512 x 384	32%	47%	63%	71%	75%
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Tualatin 1400/512/133	800 x 600	85%	76%	81%	78%	92%
	640 x 480	63%	63%	73%	68%	85%
	512 x 384	38%	49%	67%	71%	79%

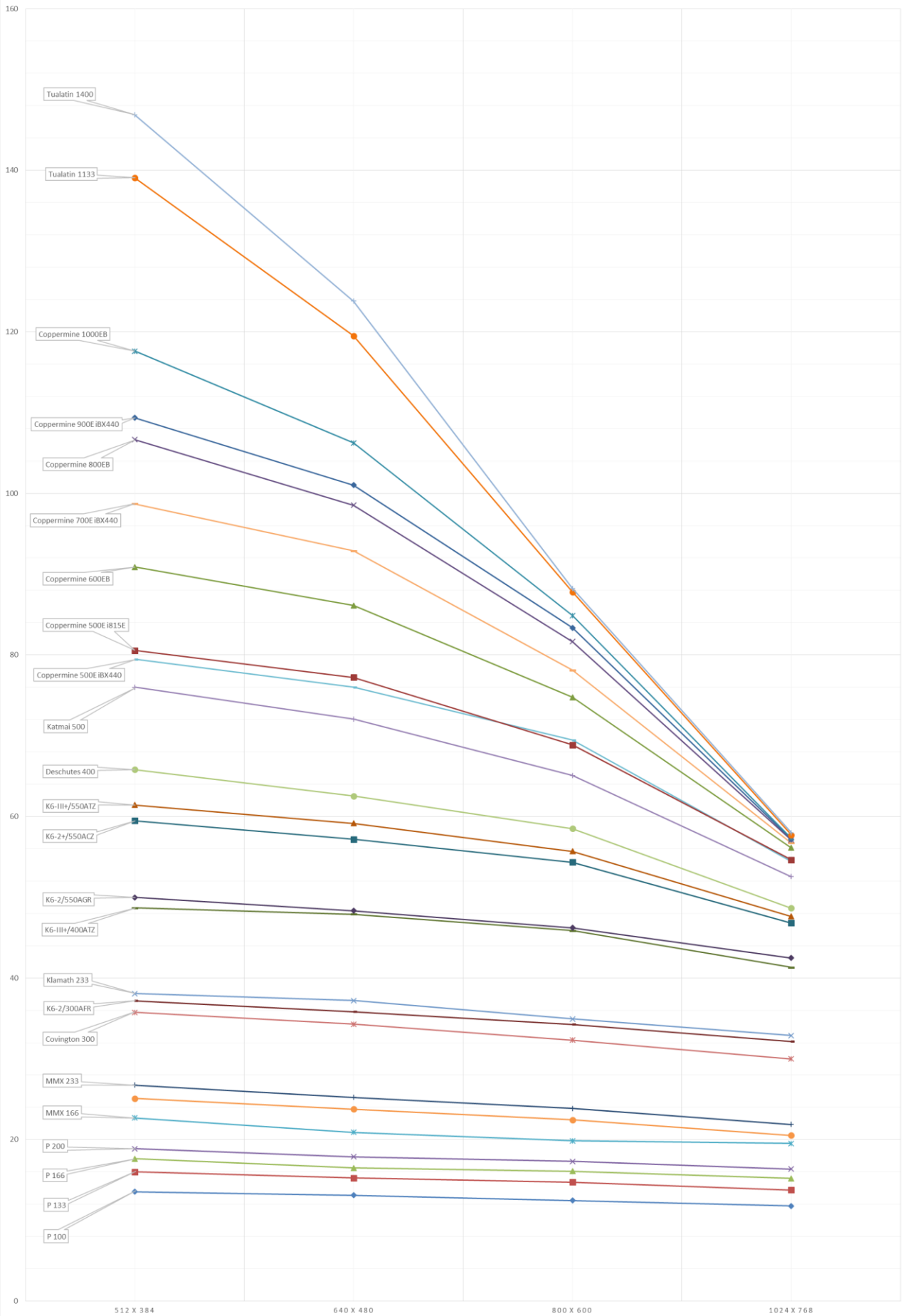
PROCESSOR AND RESOLUTION SCALING FOR EACH GAME

In this section a different set of graphs show processor and resolution scaling for each game. You can use these graphs to more easily identify situations when the processor or resolutions are holding back a game. You can also identify points of diminishing returns, which is when an increase in processing power does not yield any more performance. At some stage you simply reach the limitation of what Voodoo 2 can achieve.

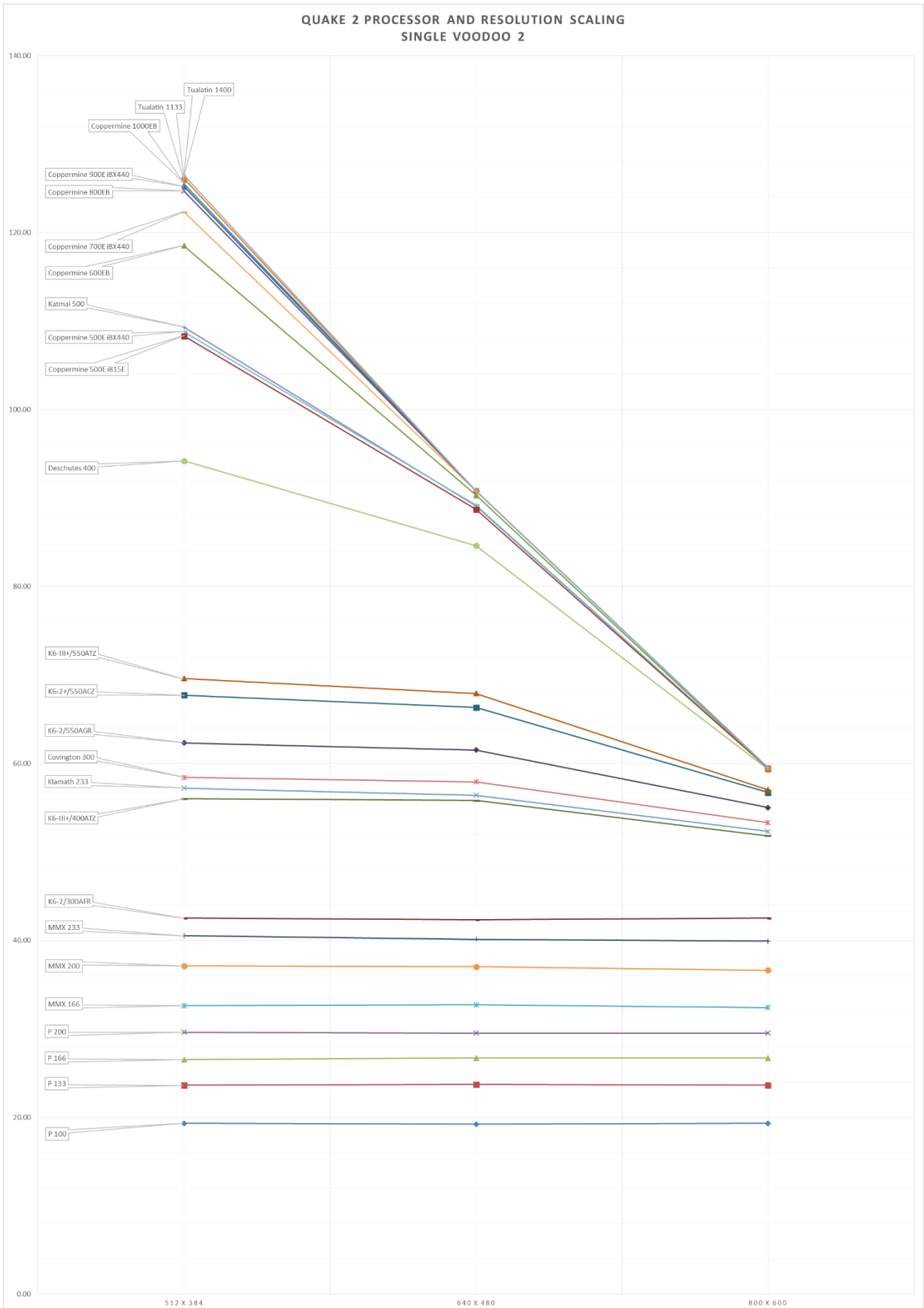
There are two sets of graphs in total, one for a single Voodoo 2 and one for dual Voodoo 2 in SLI configuration.



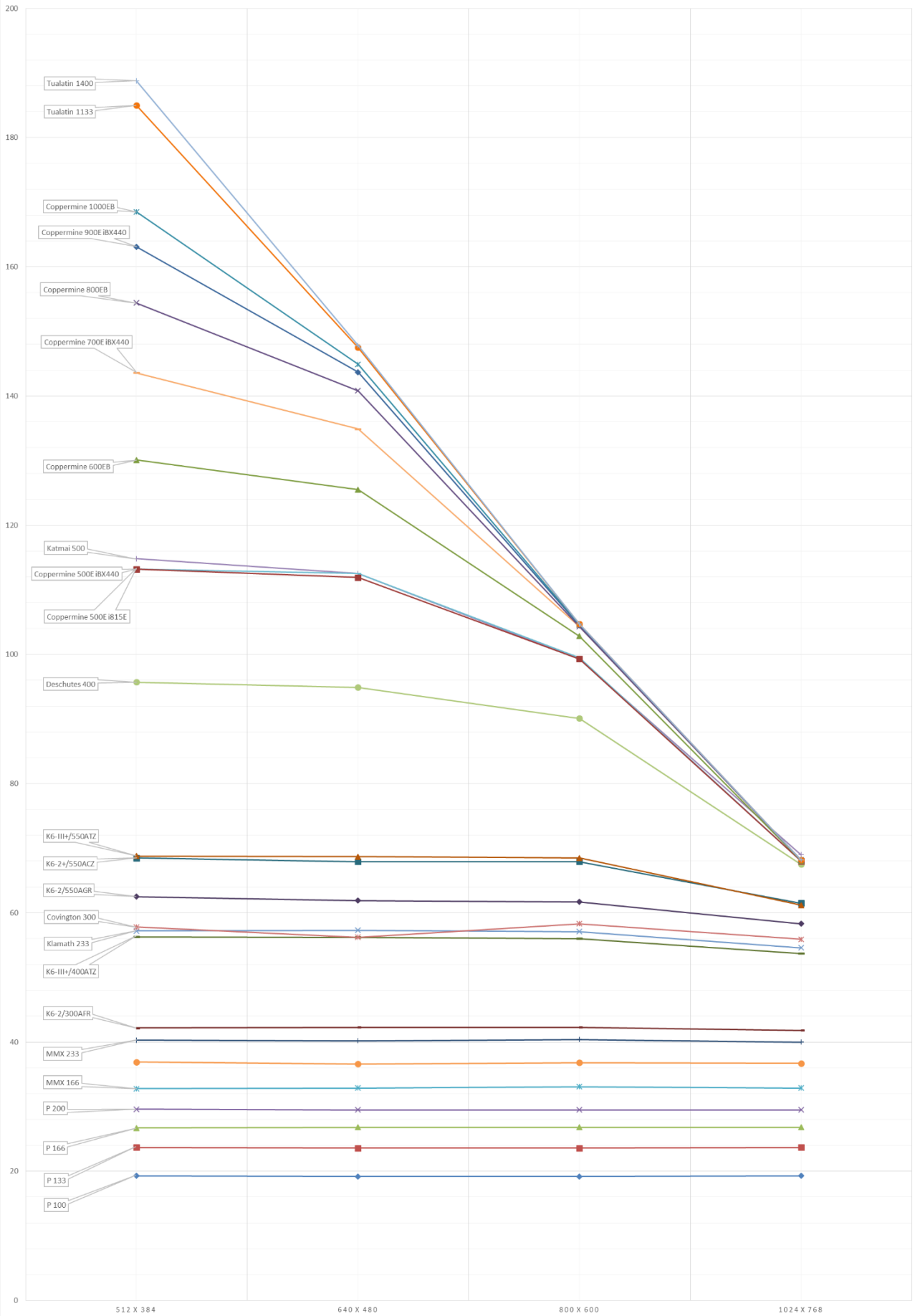
UNREAL PROCESSOR AND RESOLUTION SCALING DUAL VOODOO 2 IN SLI CONFIGURATION



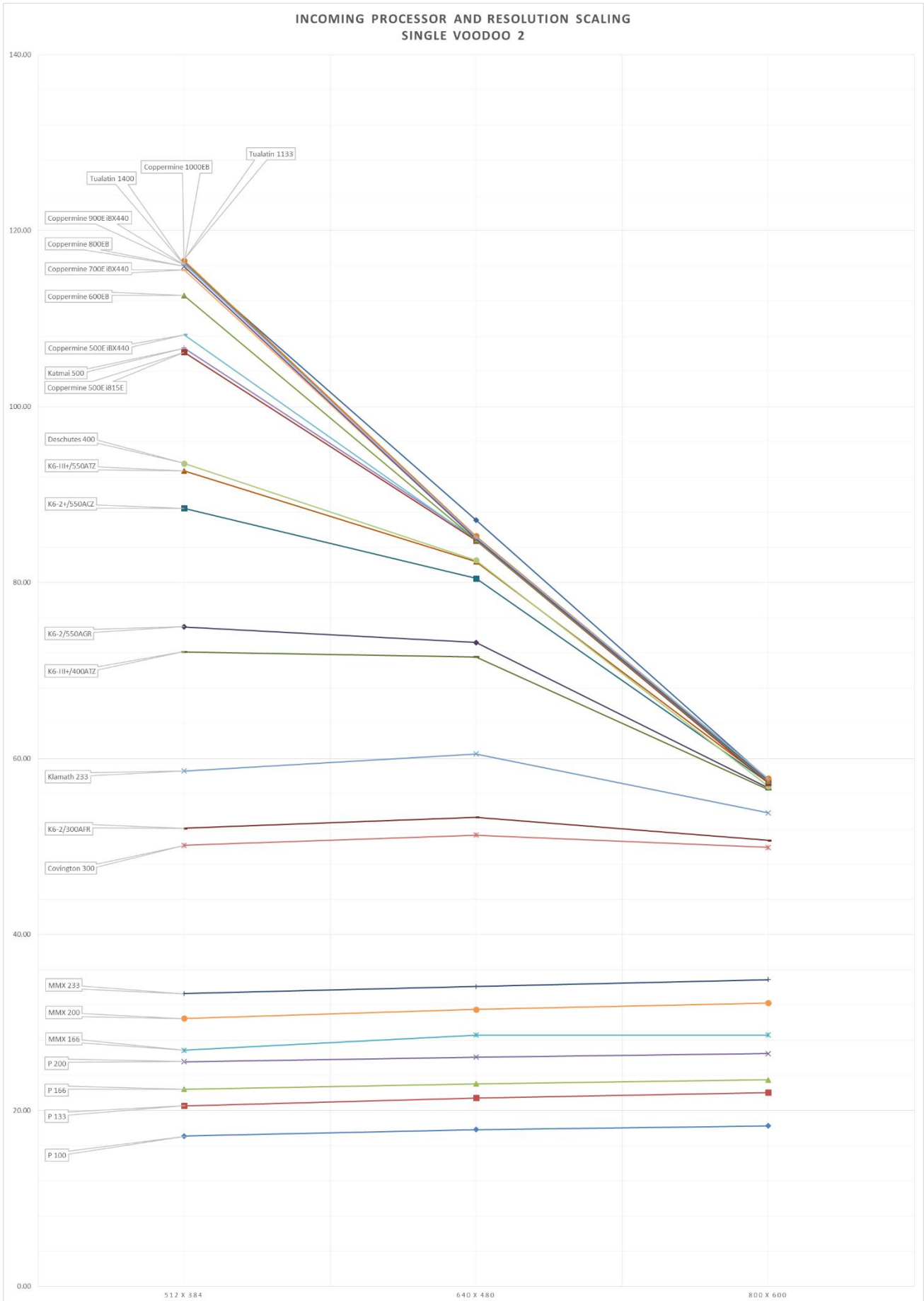
QUAKE 2



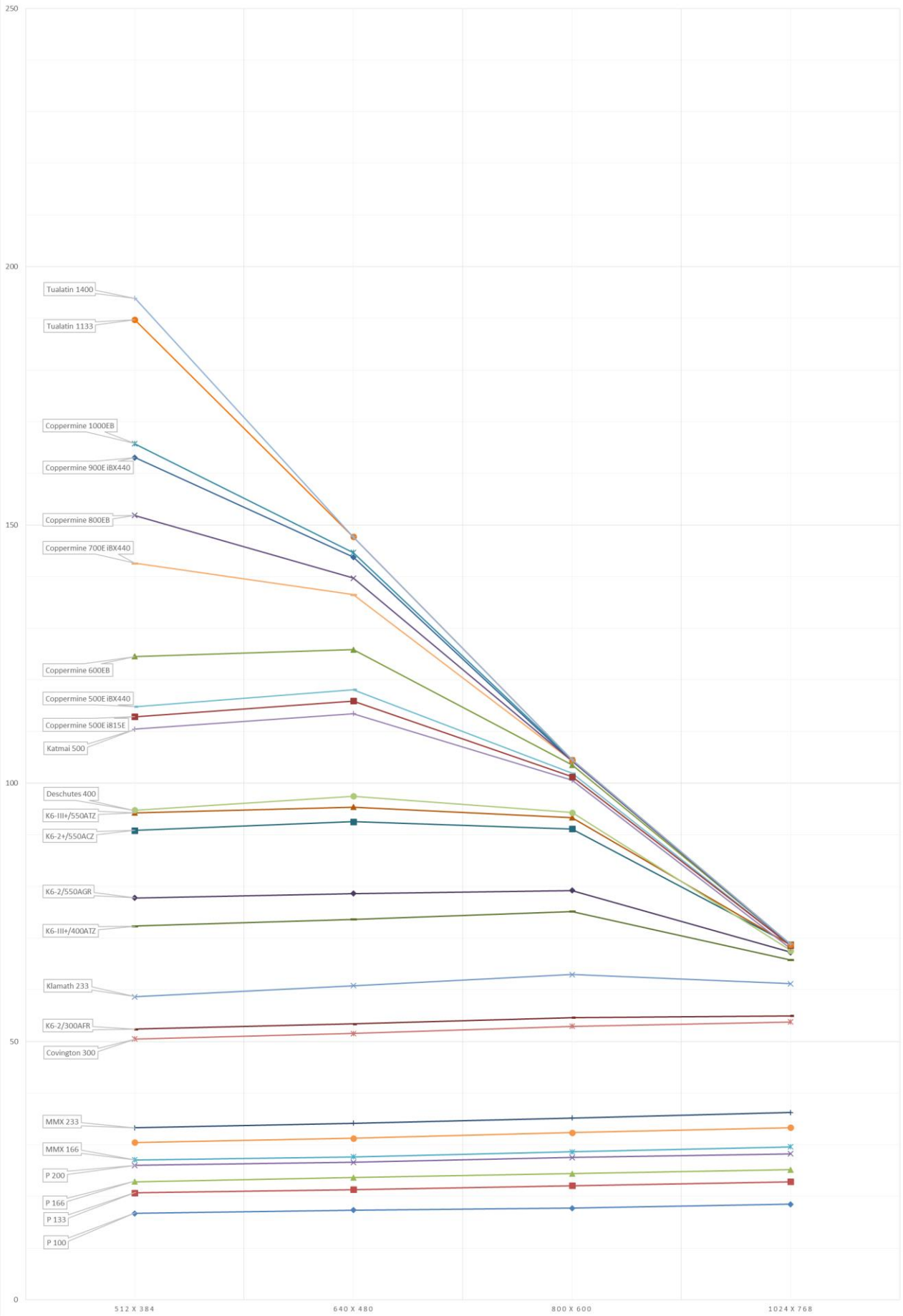
QUAKE 2 PROCESSOR AND RESOLUTION SCALING
 DUAL VOODOO 2 IN SLI CONFIGURATION

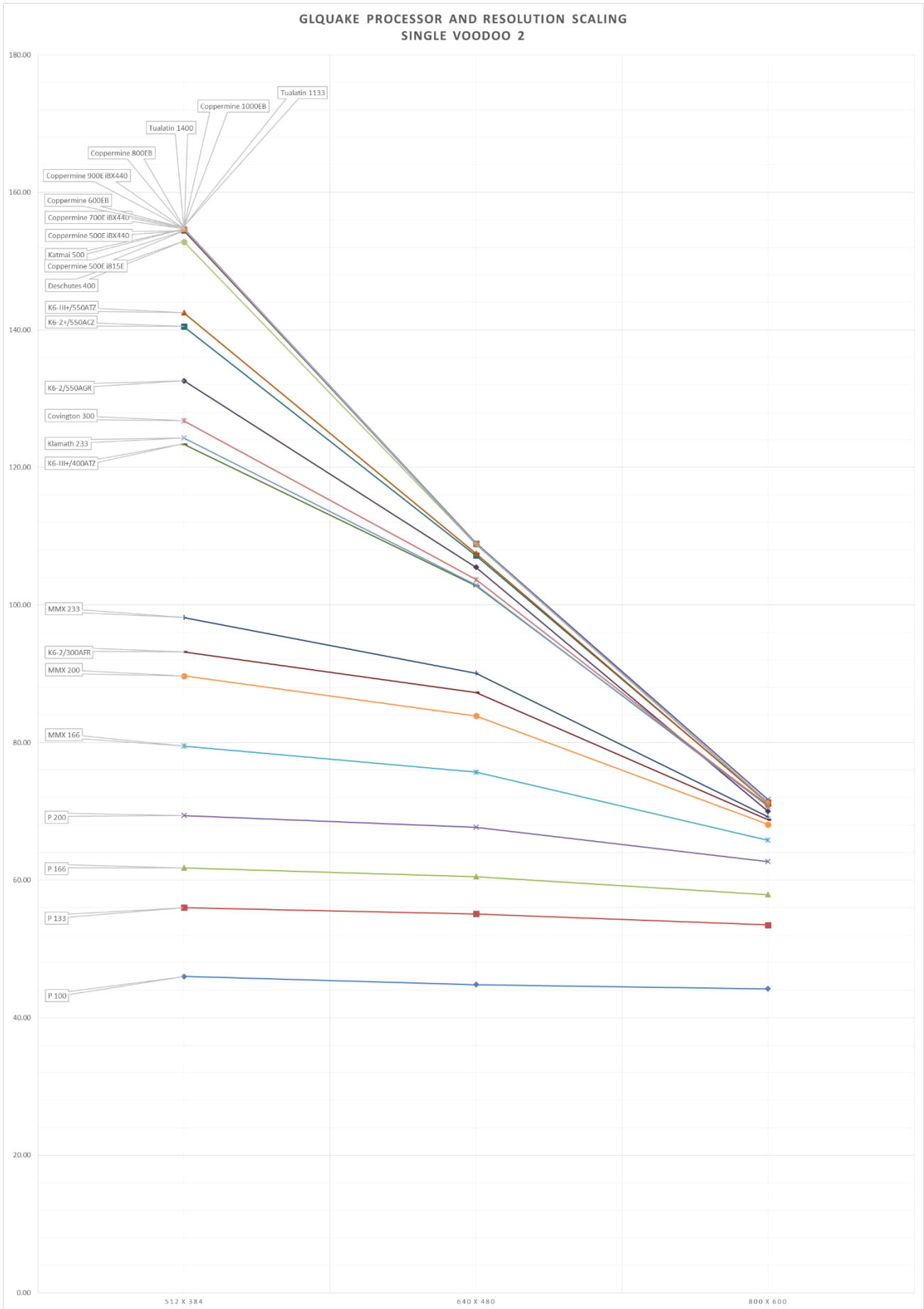


INCOMING

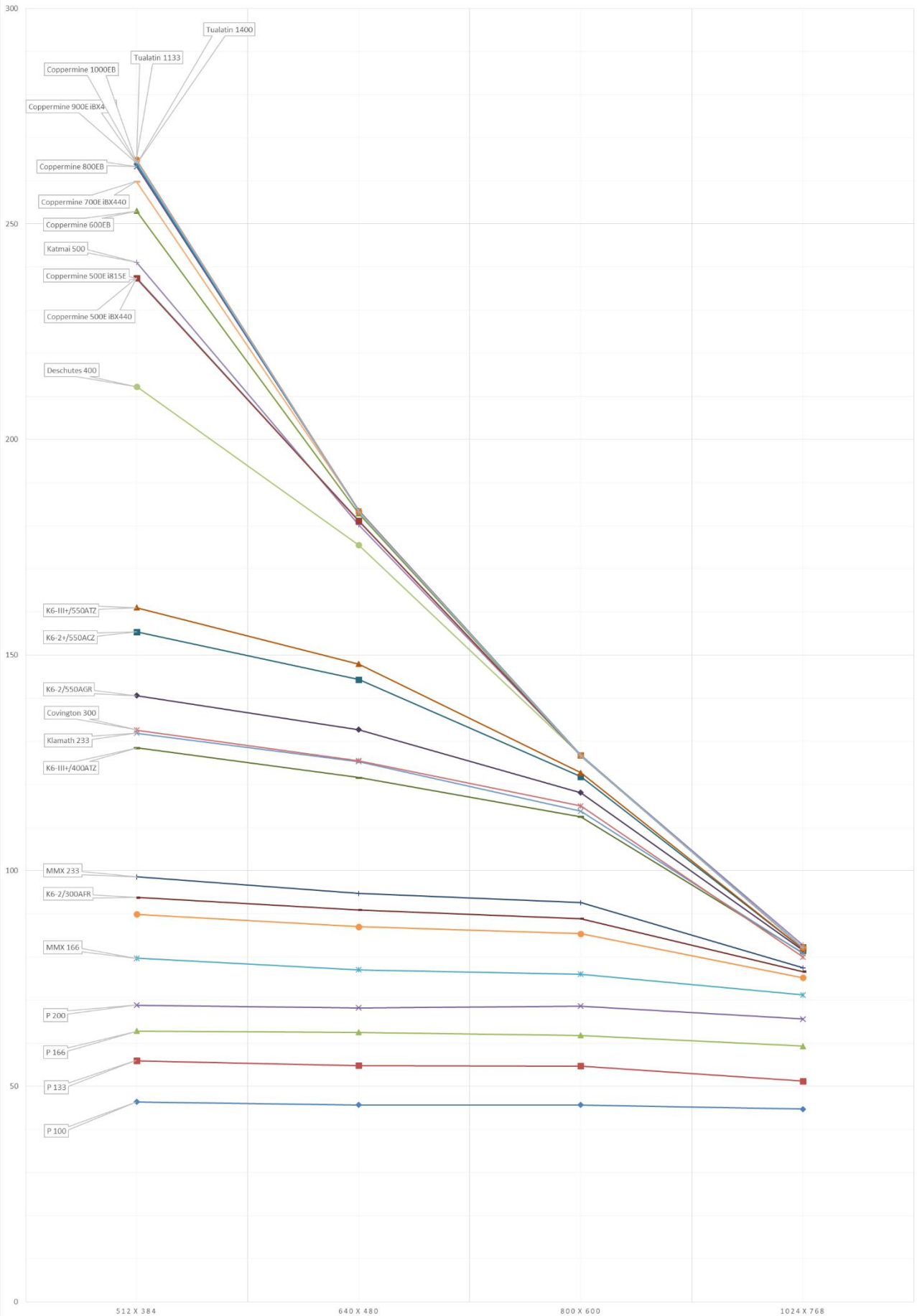


INCOMING PROCESSOR AND RESOLUTION SCALING
 DUAL VOODOO 2 IN SLI CONFIGURATION

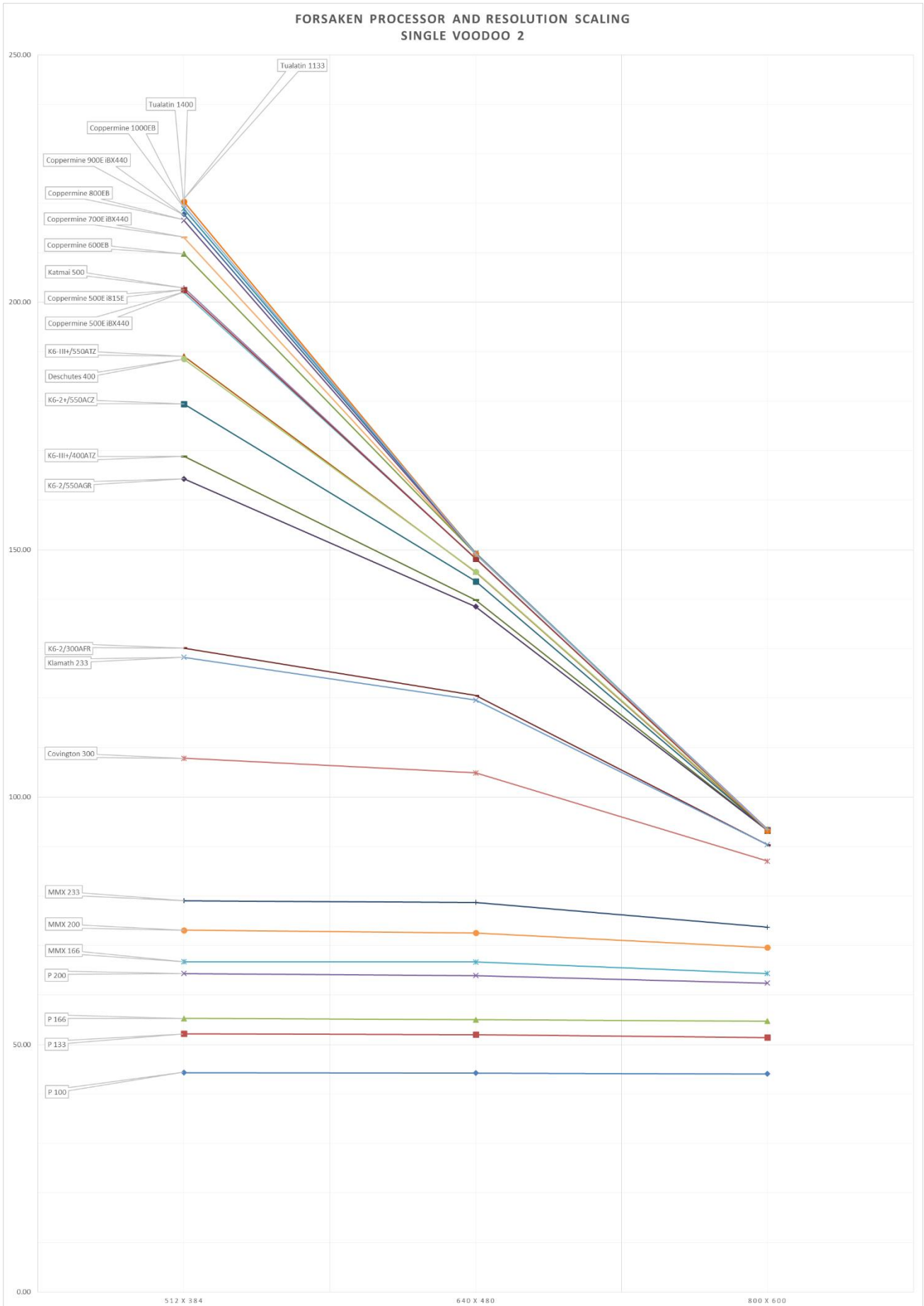




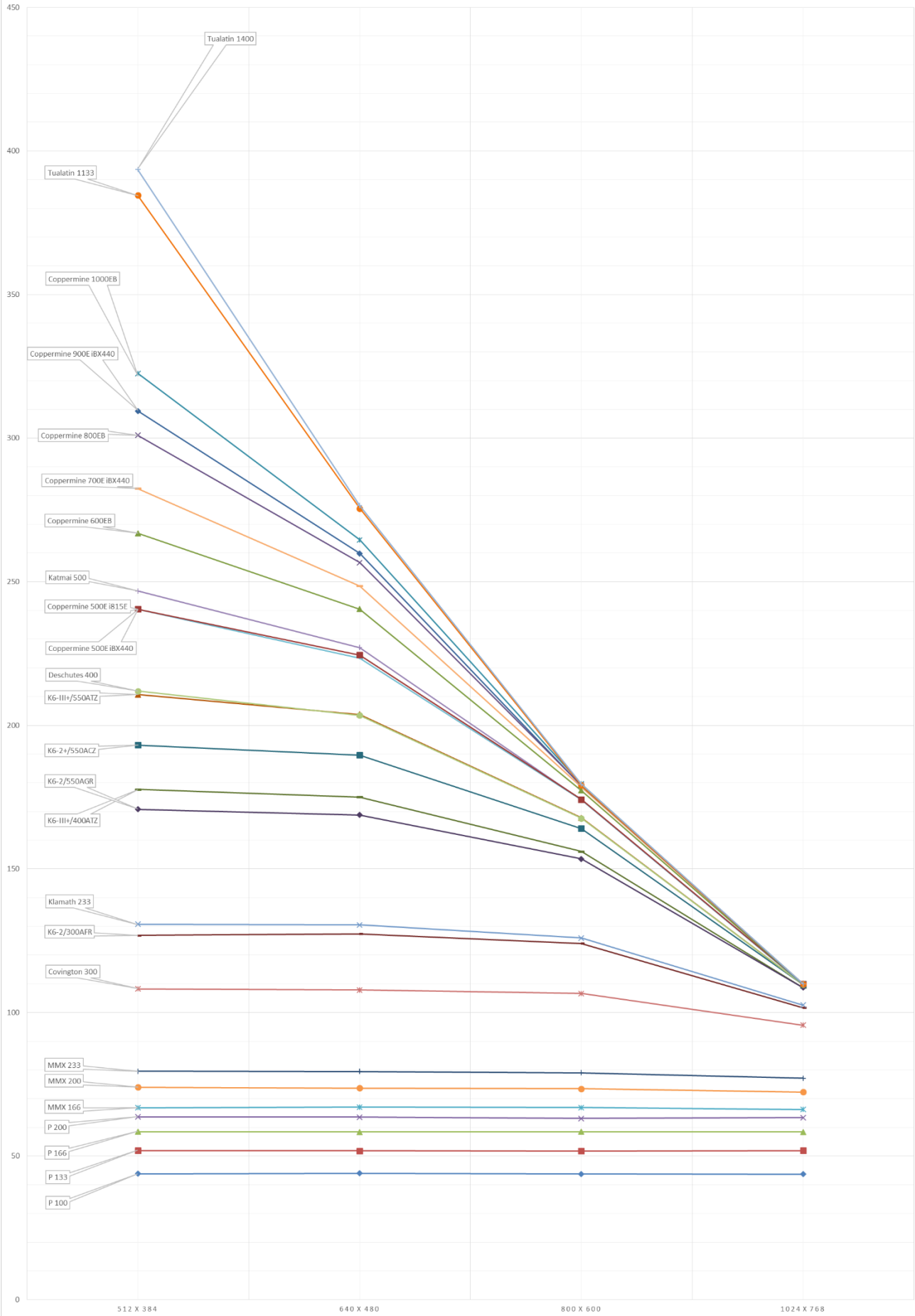
OPENGL PROCESSOR AND RESOLUTION SCALING
 DUAL VOODOO 2 IN SLI CONFIGURATION



FORSAKEN



FORSAKEN PROCESSOR AND RESOLUTION SCALING
 DUAL VOODOO 2 IN SLI CONFIGURATION



OTHER OBSERVATIONS

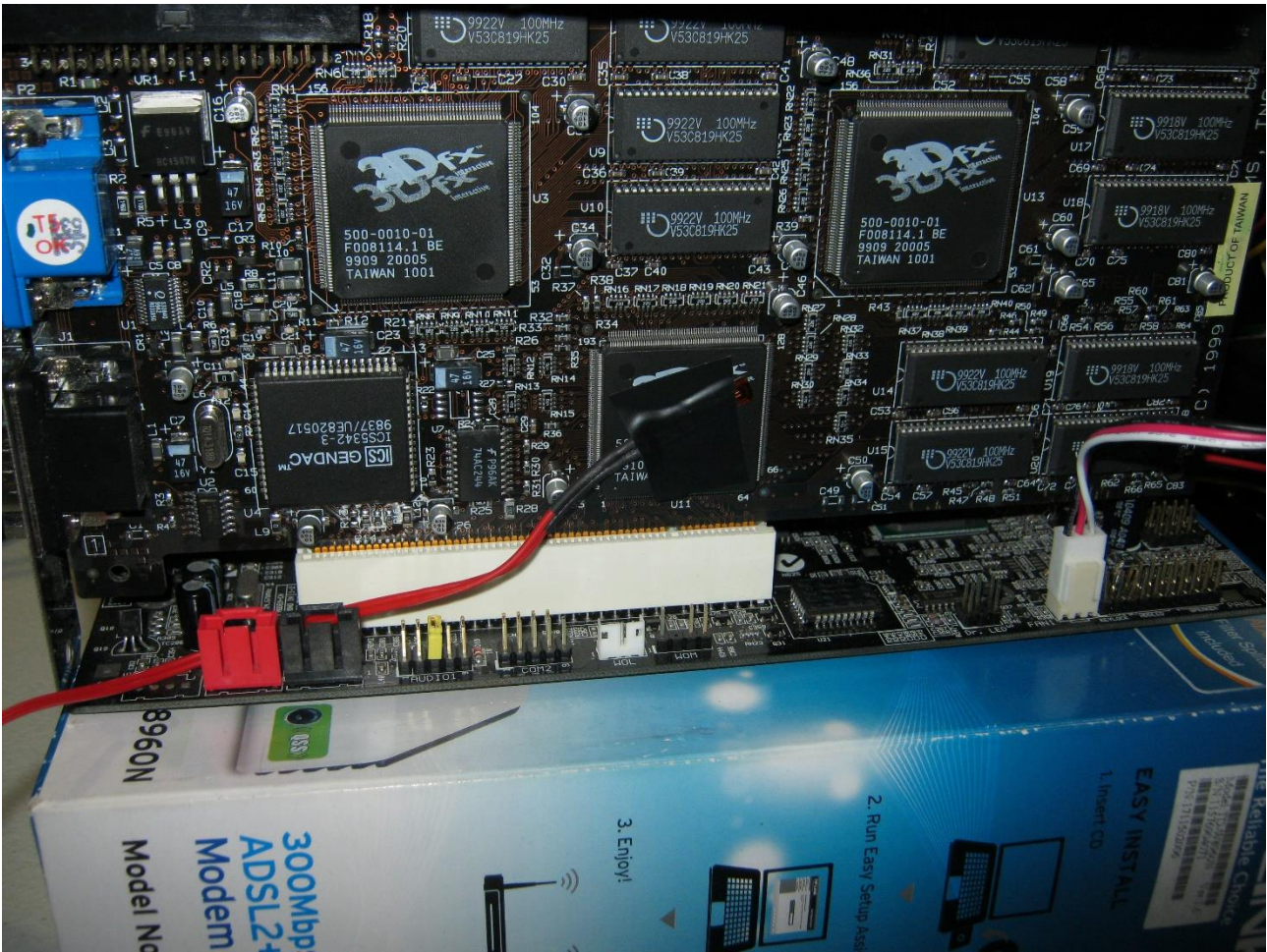
VOODOO 2 TEMPERATURE AND COOLING

On fast computers Voodoo 2 cards are known to run quite hot. I wanted to measure this. Again it is not so much about the absolute temperatures, but about the differences between running the Voodoo 2 cards with and without active cooling.

For cooling I have a 120mm Zalman Fan blowing air from the top down. It is currently winter in Australia, my reverse cycle heater is turned on and the thermostat set to 25 degrees Celsius.



To measure the temperature I used a media bay which came with a thermal probe. I simply stuck it onto the middle chip, which gets the hottest out of the three chips on a Voodoo 2.



To measure temperatures I ran Unreal timedemo for 20 minutes and recorded the temperature reading of the last minute. Resolution was set to 640 x 480.

	Idle	V-sync on (60 fps limit)	V-sync off
Active cooling	32.5	40.1	44.2
No active cooling	38.5	55.2	59

Please understand that an open test bench represents an ideal scenario. I used a cooking thermal sensor to measure also the memory and the other two chips. They measured just over 40 degrees Celcius.

Personally I believe using a fan to cool your Voodoo 2 card(s) cannot hurt. Turning V-sync on limits the frame rate and has a slight effect on the temperature.

SLI INTERLEAVING GLITCHES

At high frame rates when using SLI image glitches can be seen. To avoid this enable V-sync.



PENTIUM III KATMAI VS. COPPERMINE

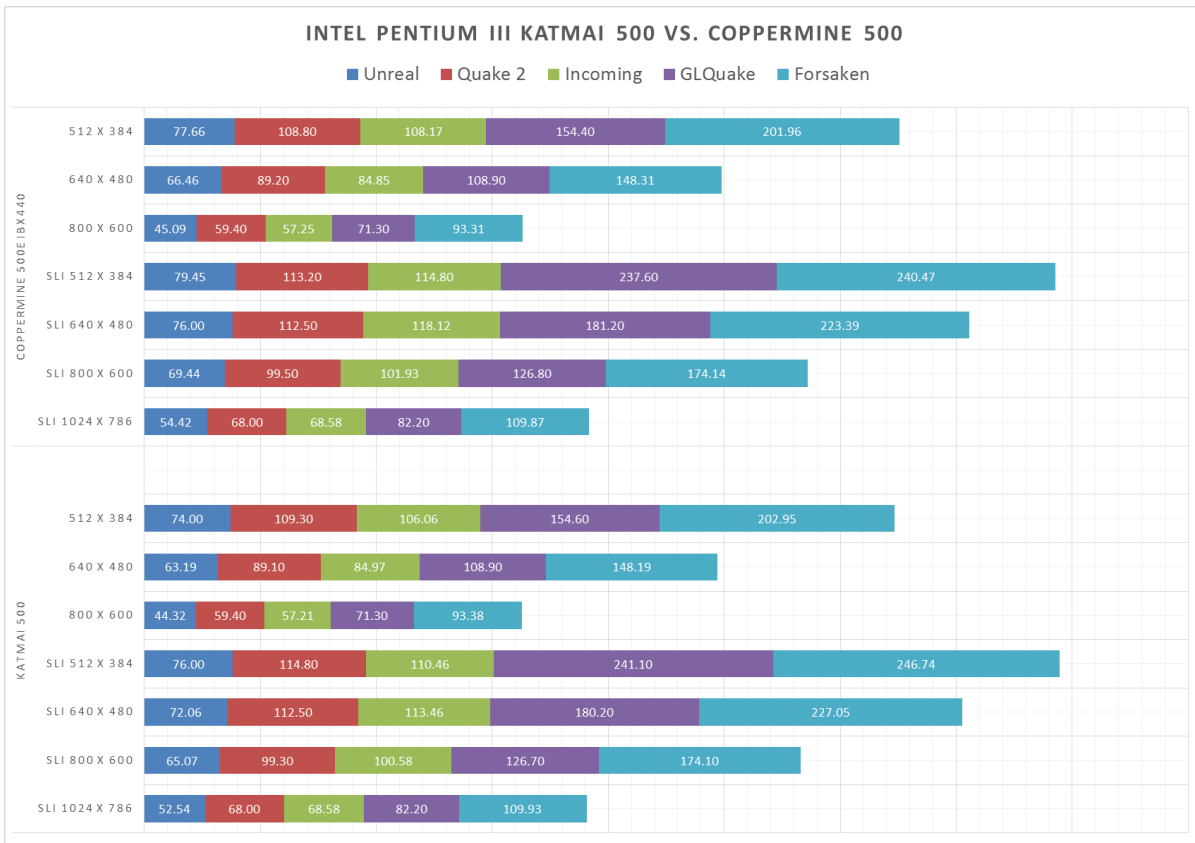
In this section we are looking at the Pentium III with Katmai and Coppermine core. This might be useful if you have to choose between the two processors. I happened to have a 500 MHz model of each so I took the opportunity to compare them. Firstly what are the main differences?

Katmai: This is the older processor, manufactured on 0.25 μm process and running on 2V it consumes more power. With 512 KB Cache it has double the level 2 cache compared to Coppermine, however the Cache is clocked at half the speed (250 MHz).

Coppermine: Is the newer processor, manufactured on 0.18 μm process and running on 1.65V it consumes less power. While the 256KB level 2 cache is only half the size compared to Katmai, it is clocked at full speed (500 MHz).

So let us find out how the two compare in Voodoo 2 benchmarks?

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500E iBX440	SLI 1024 x 786	54.42	68.00	68.58	82.20	109.87
	SLI 800 x 600	69.44	99.50	101.93	126.80	174.14
	SLI 640 x 480	76.00	112.50	118.12	181.20	223.39
	SLI 512 x 384	79.45	113.20	114.80	237.60	240.47
	800 x 600	45.09	59.40	57.25	71.30	93.31
	640 x 480	66.46	89.20	84.85	108.90	148.31
	512 x 384	77.66	108.80	108.17	154.40	201.96
		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Katmai 500	SLI 1024 x 786	52.54	68.00	68.58	82.20	109.93
	SLI 800 x 600	65.07	99.30	100.58	126.70	174.10
	SLI 640 x 480	72.06	112.50	113.46	180.20	227.05
	SLI 512 x 384	76.00	114.80	110.46	241.10	246.74
	800 x 600	44.32	59.40	57.21	71.30	93.38
	640 x 480	63.19	89.10	84.97	108.90	148.19
	512 x 384	74.00	109.30	106.06	154.60	202.95



To make it easier to spot any differences I have created another table showing the difference as percentage. A positive percentage means Coppermine is faster than Katmai. A lower percentage means Coppermine is slower than Katmai.

The right table compared the SLI scaling. A positive percentage means that Coppermine scales better when going from a single Voodoo 2 to dual Voodoo 2 in SLI configuration.

Single Voodoo 2	SLI 1024 x 786	4%	0%	0%	0%	0%	Dual Voodoo 2 SLI configuration	SLI 1024 x 786	15%	1%	3%	0%	0%
	SLI 800 x 600	7%	0%	1%	0%	0%		SLI 800 x 600	2%	-1%	17%	1%	-5%
	SLI 640 x 480	5%	0%	4%	1%	-2%		SLI 640 x 480	-15%	-20%	48%	-4%	-12%
	SLI 512 x 384	5%	-1%	4%	-1%	-3%		SLI 512 x 384					
	800 x 600	2%	0%	0%	0%	0%		800 x 600					
	640 x 480	5%	0%	0%	0%	0%		640 x 480					
512 x 384	5%	0%	2%	0%	0%	512 x 384							

Unreal is one game that stands out and performs clearly better on Coppermine. The other games show little difference. Looking at SLI scaling results are mixed and inconsistent. At higher resolutions Coppermine is ahead but at lower resolutions the situation is reversed.

INTEL BX440 VS. 815 CHIPSET

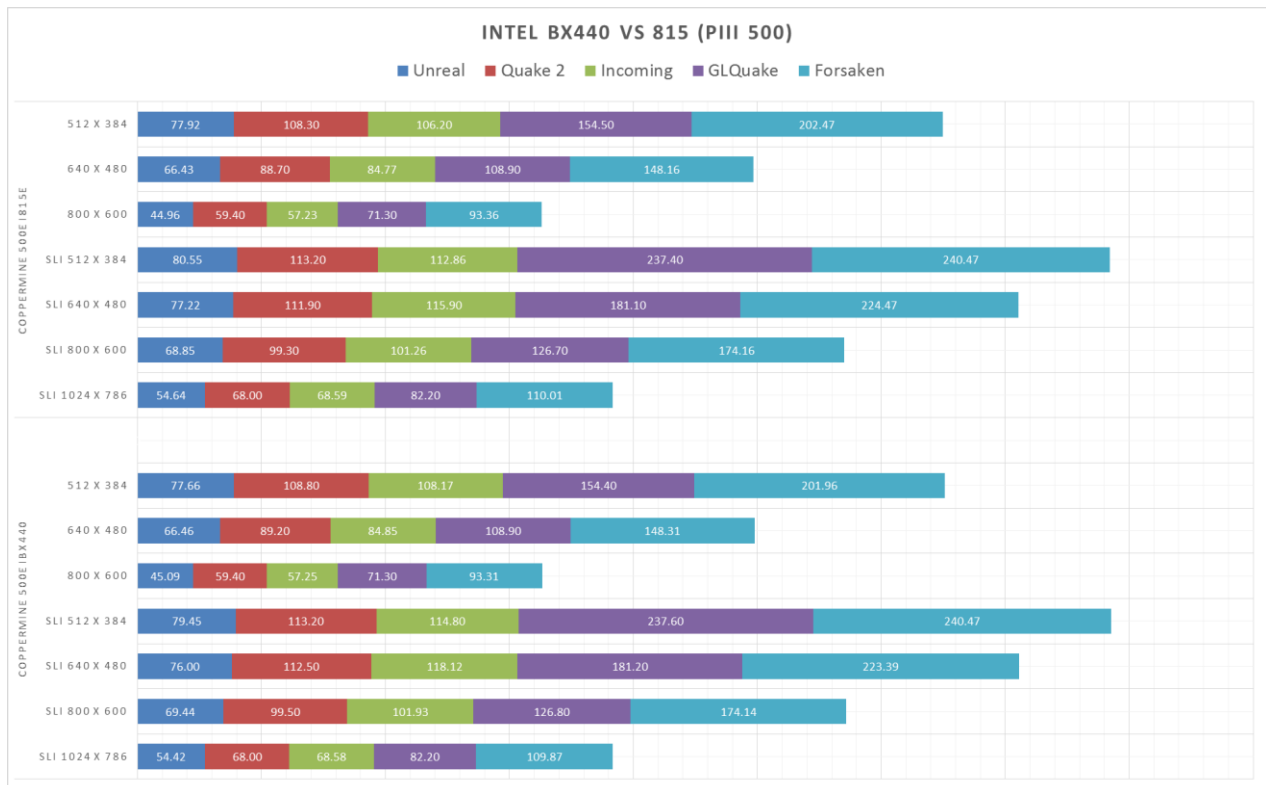
This topic is often discussed. The Intel BX440 chipset is legendary and very fast. Later chipsets have failed to match it in terms of performance. I wanted to see if this holds true for Voodoo 2 performance as well. Note that the i815 chipset is the final PIII chipset from Intel.

Motherboard BIOS settings can be found towards the end of this document.

The processor I used to compare is, once again, the Coppermine 500. In the Slot 1 motherboard I used a Slot 1 to 370 adapter.

So let's find out how they compare!

		Unreal	Quake 2	Incoming	GLQuake	Forsaken
Coppermine 500E iBX440	SLI 1024 x 786	54.42	68.00	68.58	82.20	109.87
	SLI 800 x 600	69.44	99.50	101.93	126.80	174.14
	SLI 640 x 480	76.00	112.50	118.12	181.20	223.39
	SLI 512 x 384	79.45	113.20	114.80	237.60	240.47
	800 x 600	45.09	59.40	57.25	71.30	93.31
	640 x 480	66.46	89.20	84.85	108.90	148.31
	512 x 384	77.66	108.80	108.17	154.40	201.96
Coppermine 500E i815E	SLI 1024 x 786	54.64	68.00	68.59	82.20	110.01
	SLI 800 x 600	68.85	99.30	101.26	126.70	174.16
	SLI 640 x 480	77.22	111.90	115.90	181.10	224.47
	SLI 512 x 384	80.55	113.20	112.86	237.40	240.47
	800 x 600	44.96	59.40	57.23	71.30	93.36
	640 x 480	66.43	88.70	84.77	108.90	148.16
	512 x 384	77.92	108.30	106.20	154.50	202.47



To make it easier to spot any differences I have created another table showing the difference as percentage. A positive percentage means the BX440 is faster than 815. A negative percentage means BX440 is slower than 815.

Single Voodoo 2	SLI 1024 x 786	0%	0%	0%	0%	0%	Dual Voodoo 2 in SLI configuration	SLI 1024 x 786						
	SLI 800 x 600	1%	0%	1%	0%	0%		SLI 800 x 600	2%	1%	1%	0%	0%	
	SLI 640 x 480	-2%	1%	2%	0%	0%		SLI 640 x 480	-12%	0%	7%	0%	-2%	
	SLI 512 x 384	-1%	0%	2%	0%	0%		SLI 512 x 384	-32%	-11%	-2%	0%	2%	
	800 x 600	0%	0%	0%	0%	0%		800 x 600						
	640 x 480	0%	1%	0%	0%	0%		640 x 480						
512 x 384	0%	0%	2%	0%	0%	512 x 384								

While some results show a difference of 2%, most results are identical. The results showing a difference are mostly in favour of the BX440, apart from 2. Looking at SLI scaling results we can see that the BX440 falls behind at low resolutions, but ends up slightly ahead at high resolutions.

With the motherboards and BIOS settings I used there are very small performance differences between these two chipset. If I had to pick a winner I would have to go with the BX440. The lower SLI scaling results at low resolutions are interesting but most people will use SLI to play at high resolutions.

BIOSPROCE VERSION AND SETTINGS

The motherboard was flashed with the latest BIOS dated 04/12/2000.

```
ROM PCI/ISA BIOS (2A5LED4G)
CMOS SETUP UTILITY
AWARD SOFTWARE, INC.

STANDARD CMOS SETUP
BIOS FEATURES SETUP
CHIPSET FEATURES SETUP
POWER MANAGEMENT SETUP
PNP/PCI CONFIGURATION
LOAD FAIL-SAFE SETTINGS
LOAD OPTIMAL SETTINGS

INTEGRATED PERIPHERALS
SUPERVISOR PASSWORD
USER PASSWORD
IDE HDD AUTO DETECTION
SAVE & EXIT SETUP
EXIT WITHOUT SAVING

Esc : Quit
F10 : Save & Exit Setup

↑ ↓ → ← : Select Item
(Shift)F2 : Change Color

Time, Date, Hard Disk Type...
```

```
ROM PCI/ISA BIOS (2A5LED4G)
STANDARD CMOS SETUP
AWARD SOFTWARE, INC.

Date (mm:dd:yy) : Sat, May 3 2014
Time (hh:mm:ss) : 17 : 14 : 19

HARD DISKS          TYPE      SIZE  CYLS  HEAD  PRECOMP  LANDZ  SECTOR  MODE
-----
Primary Master   : Auto      0M    0    0     0     0     0    AUTO
Primary Slave   : Auto      0M    0    0     0     0     0    AUTO
Secondary Master : Auto      0M    0    0     0     0     0    AUTO
Secondary Slave  : Auto      0M    0    0     0     0     0    AUTO

Drive A : 1.44M, 3.5 in.
Drive B : None

Video : EGA/UGA
Halt On : All,But Keyboard

Base Memory: 640K
Extended Memory: 130048K
Other Memory: 384K
Total Memory: 131072K

ESC : Quit
F1 : Help

↑ ↓ → ← : Select Item
(Shift)F2 : Change Color
PU/PD/+/- : Modify
```

ROM PCI/ISA BIOS (2A5LED4G)
 BIOS FEATURES SETUP
 AWARD SOFTWARE, INC.

Virus Warning : Disabled
 CPU Internal Cache : Enabled
 External Cache : Enabled
 Quick Power On Self Test : Enabled
 Boot Sequence : CDR0M,C,A
 Swap Floppy Drive : Disabled
 Boot Up Floppy Seek : Disabled
 Boot Up NumLock Status : On
 Memory ECC Function : Disabled
 Typematic Rate Setting : Disabled
 Typematic Rate (Chars/Sec) : 6
 Typematic Delay (Msec) : 250
 Security Option : Setup
 PCI/UGA Palette Snoop : Disabled
 OS Select For DRAM > 64MB : Non-OS2
 HDD S.M.A.R.T. Capability : Disabled

Video BIOS Shadow : Enabled
 C8000-CBFFF Shadow : Disabled
 CC000-CFFFF Shadow : Disabled
 D0000-D3FFF Shadow : Disabled
 D4000-D7FFF Shadow : Disabled
 D8000-DBFFF Shadow : Disabled
 DC000-DFFFF Shadow : Disabled
 Cyrix 6x86/MII CPUID: Enabled

ESC : Quit ↑↓→← : Select Item
 F1 : Help PU/PD/+/- : Modify
 F5 : Old Values (Shift)F2 : Color
 F6 : Load Fail-Safe Settings
 F7 : Load Optimal Settings

ROM PCI/ISA BIOS (2A5LED4G)
 CHIPSET FEATURES SETUP
 AWARD SOFTWARE, INC.

DIMM 1 DRAM Timing : Fast
 DIMM 2 DRAM Timing : Fast
 DIMM 3 DRAM Timing : Fast
 SDRAM CAS Latency : 3
 Video BIOS Cacheable : Enabled
 System BIOS Cacheable : Disabled
 Memory Hole At 15M-16M : Disabled
 AGP Aperture Size (MB) : 64
 AGP-2X Mode : Enabled
 CPU to PCI Write Buffer : Enabled
 PCI Dynamic Bursting : Enabled
 PCI Master 0 WS Write : Enabled
 PCI Delay Transaction : Enabled
 AGP Master 1 WS Write : Disabled
 AGP Master 1 WS Read : Disabled
 Spread Spectrum : Disabled
 Software Power-off : Enabled

**** System Health Monitor ****
 Current CPU Temperature : 30°C/ 86°F
 Current CPU FAN Speed : 4444 RPM
 Current AGP FAN Speed : 1558 RPM
 CPU Temperature Limit : Ignore
 CPU FAN Speed Limit : Ignore
 AGP FAN Speed Limit : Ignore
 +3.3V Voltage : Ignore
 +12V Voltage : Ignore
 +5V Voltage : Ignore

ESC : Quit ↑↓→← : Select Item
 F1 : Help PU/PD/+/- : Modify
 F5 : Old Values (Shift)F2 : Color
 F6 : Load Fail-Safe Settings
 F7 : Load Optimal Settings

ROM PCI/ISA BIOS (2A5LED4G)
POWER MANAGEMENT SETUP
AWARD SOFTWARE, INC.

ACPI Function : Disabled
Power Management : Disabled
PM Control by APM : Yes
Video Off Method : DPMS
Video Off After : Suspend
Standby Mode : Disabled
Suspend Mode : Disabled
HDD Power Down : Disabled
Soft-Off by PWRBTN : Instant-Off
Resume on Ring : Disabled
Resume on Alarm : Disabled

** PM Events **
IRQ3 (COM 2) : Primary
IRQ4 (COM 1) : Primary
IRQ5 (LPT 2) : Primary
IRQ6 (Floppy Disk) : Primary
IRQ7 (LPT 1) : Primary
IRQ8 (RTC Alarm) : Disabled
IRQ9 (IRQ2 Redir) : Secondary
IRQ10 (Reserved) : Secondary
IRQ11 (Reserved) : Secondary
IRQ12 (PS/2 Mouse) : Primary
IRQ13 (Coprocessor) : Primary
IRQ14 (Hard Disk) : Primary
IRQ15 (Reserved) : Disabled

ESC : Quit ↑↓→← : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values (Shift)F2 : Color
F6 : Load Fail-Safe Settings
F7 : Load Optimal Settings

ROM PCI/ISA BIOS (2A5LED4G)
PNP/PCI CONFIGURATION
AWARD SOFTWARE, INC.

Resources Controlled By : Auto
Reset Configuration Data : Disabled

Assign IRQ For USB : Enabled
Assign IRQ For UGA : Enabled
PCI Slot 1 Use IRQ : Auto
PCI Slot 2 Use IRQ : Auto
PCI Slot 3 Use IRQ : Auto
PCI Slot 4 Use IRQ : Auto

ESC : Quit ↑↓→← : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values (Shift)F2 : Color
F6 : Load Fail-Safe Settings
F7 : Load Optimal Settings

ROM PCI/ISA BIOS (2A5LED4G)
INTEGRATED PERIPHERALS
AWARD SOFTWARE, INC.

Onboard Primary PCI IDE : **Enabled**
Onboard Secondary PCI IDE: Enabled
IDE Prefetch Mode : Enabled
IDE HDD Block Mode : Enabled
IDE Primary Master PIO : Auto
IDE Primary Slave PIO : Auto
IDE Secondary Master PIO : Auto
IDE Secondary Slave PIO : Auto
IDE Primary Master UDMA : Auto
IDE Primary Slave UDMA : Auto
IDE Secondary Master UDMA: Auto
IDE Secondary Slave UDMA: Auto
USB Controller : Enabled
USB Keyboard Support : Disabled
Init Display First : AGP

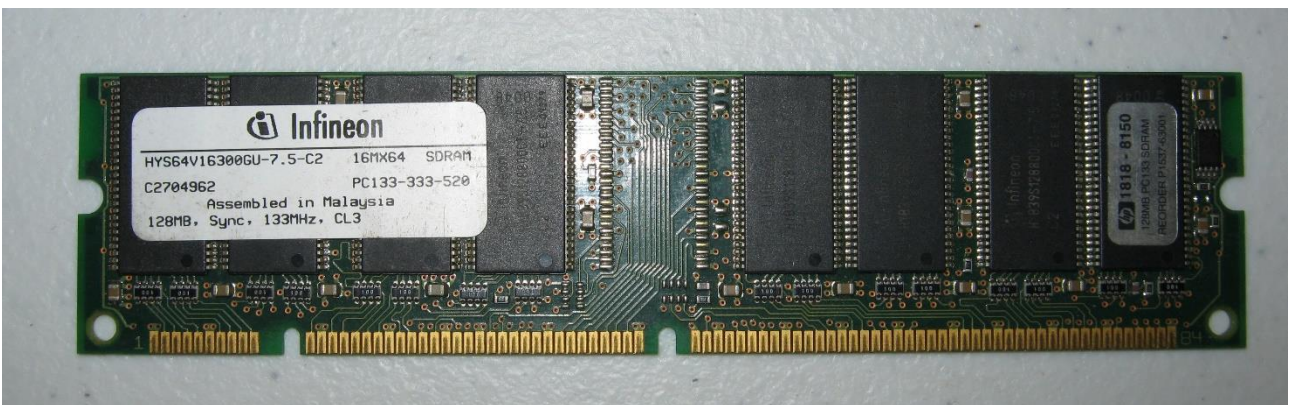
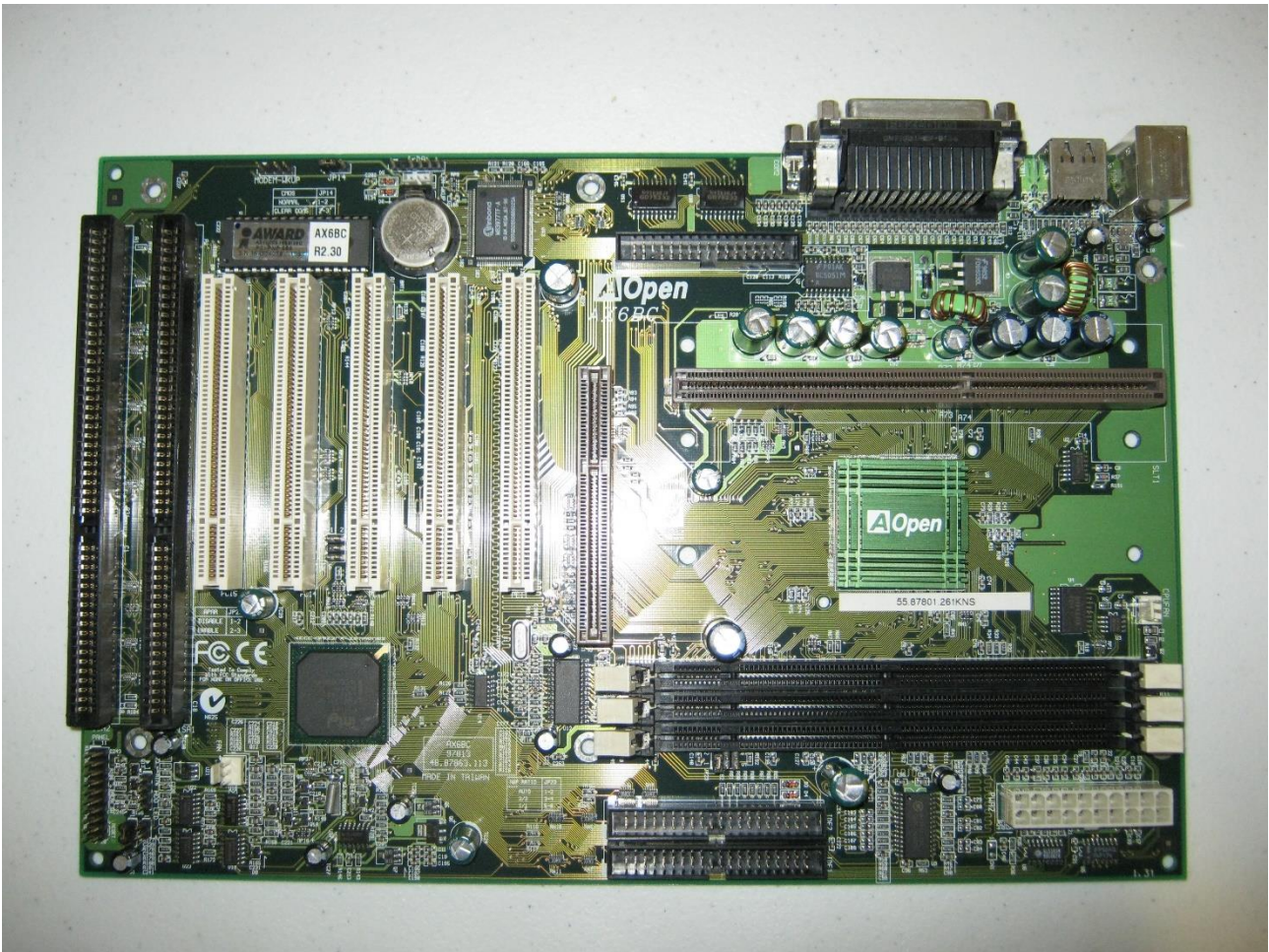
Onboard FDC Controller : Enabled
Onboard UART 1 : 3F8/IRQ4
Onboard UART 2 : 2F8/IRQ3
Onboard UART 2 Mode : Standard

Onboard Parallel Port : 378/IRQ7
Parallel Port Mode : ECP+EPP
ECP Mode Use DMA : 3
Parallel Port EPP Type : EPP1.7

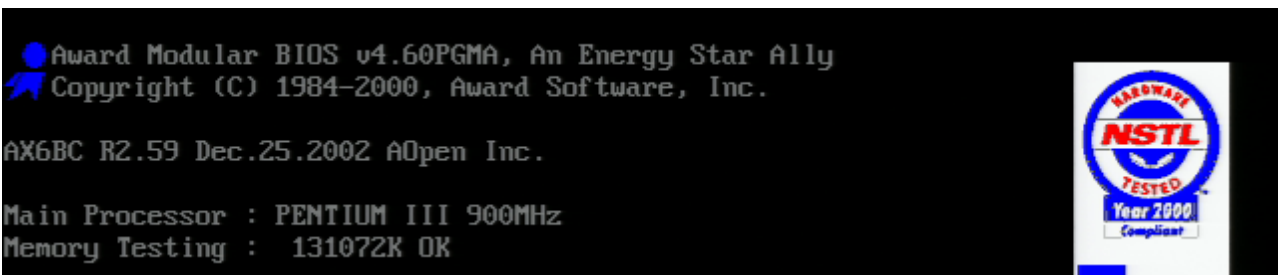
ESC : Quit ↑↓←→ : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values (Shift)F2 : Color
F6 : Load Fail-Safe Settings
F7 : Load Optimal Settings

AOPEN AX6BC

PHOTO



BIOS VERSION AND SETTINGS



ROM PCI/ISA BIOS (00000006)
 CMOS SETUP UTILITY
 AWARD SOFTWARE, INC.

STANDARD CMOS SETUP

BIOS FEATURES SETUP

CHIPSET FEATURES SETUP

POWER MANAGEMENT SETUP

PNP/PCI CONFIGURATION

LOAD SETUP DEFAULTS

LOAD TURBO DEFAULTS

INTEGRATED PERIPHERALS

PASSWORD SETTING

IDE HDD AUTO DETECTION

SAVE & EXIT SETUP

EXIT WITHOUT SAVING

LOAD EEPROM DEFAULTS

SAVE EEPROM DEFAULTS

Esc : Quit

F10 : Save & Exit Setup

↑ ↓ → ← : Select Item

F9 : Change Language

Time, Date, Hard Disk Type...

ROM PCI/ISA BIOS (00000006)
 STANDARD CMOS SETUP
 AWARD SOFTWARE, INC.

Date (mm:dd:yy) : Sat, **Jul 12 2014**

Time (hh:mm:ss) : 20 : 51 : 11

HARD DISKS	TYPE	SIZE	CYLS	HEAD	PRECOMP	LANDZ	SECTOR	MODE
Primary Master	: Auto	0M	0	0	0	0	0	AUTO
Primary Slave	: Auto	0M	0	0	0	0	0	AUTO
Secondary Master	: Auto	0M	0	0	0	0	0	AUTO
Secondary Slave	: Auto	0M	0	0	0	0	0	AUTO

Drive A : 1.44M, 3.5 in.

Drive B : None

Video : EGA/UGA

Halt On : All Errors

Base Memory: 640K

Extended Memory: 130048K

Other Memory: 384K

Total Memory: 131072K

ESC : Quit

F1 : Help

↑ ↓ → ← : Select Item

F9 : Change Language

PU/PD/+/- : Modify

ROM PCI/ISA BIOS (00000006)
 BIOS FEATURES SETUP
 AWARD SOFTWARE, INC.

Virus Warning	: Disabled	Video BIOS Shadow	: Enabled
External Cache	: Enabled	C8000-CBFFF Shadow	: Disabled
CPU L2 Cache ECC Checking	: Disabled	CC000-CFFFF Shadow	: Disabled
Processor Number Feature	: Enabled	D0000-D3FFF Shadow	: Disabled
Quick Power On Self Test	: Enabled	D4000-D7FFF Shadow	: Disabled
Boot From LAN First	: Enabled	D8000-DBFFF Shadow	: Disabled
Boot Sequence	: C only	DC000-DFFFF Shadow	: Disabled
Swap Floppy Drive	: Disabled		
Boot Up Floppy Seek	: Enabled		
Boot Up NumLock Status	: Off		
Boot Up System Speed	: High		
Typematic Rate Setting	: Disabled		
Typematic Rate (Chars/Sec)	: 6		
Typematic Delay (Msec)	: 250		
Security Option	: Setup	ESC : Quit	↑↓→← : Select Item
PCI/UGA Palette Snoop	: Disabled	F1 : Help	PU/PD/+/- : Modify
OS Select For DRAM > 64MB	: Non-OS2	F5 : Old Values	F9 : Language
Show Logo On Screen	: Enabled	F6 : Load Setup Defaults	
EzRestore	: Disabled	F7 : Load Turbo Defaults	

ROM PCI/ISA BIOS (00000006)
 CHIPSET FEATURES SETUP
 AWARD SOFTWARE, INC.

SDRAM CAS Latency	: 3 T	***** Jumperless Setup *****
SDRAM RAS# to CAS# Delay	: 3 T	Manufacture Freq Default : 350Mhz
SDRAM RAS# Precharge	: 3 T	Clock Spread Spectrum : On
SDRAM Precharge Control	: Disabled	CPU Speed Detected : 900 MHz
DRAM ECC Function	: Disabled	CPU Clock Frequency : 100.0 MHz
System BIOS Cacheable	: Disabled	CPU Clock Ratio : 3.5
Video BIOS Cacheable	: Disabled	CPU Speed Setting : 350.0 MHz
Video RAM Cacheable	: Disabled	Y2K CMOS Update : Disabled
8 Bit I/O Recovery Time	: 4	
16 Bit I/O Recovery Time	: 1	
Memory Hole At 15M-16M	: Disabled	
Passive Release	: Disabled	
Delayed Transaction	: Disabled	
AGP Aperture Size (MB)	: 64	
Pentium II Micro Codes	: Enabled	
		ESC : Quit
		↑↓→← : Select Item
		F1 : Help
		PU/PD/+/- : Modify
		F5 : Old Values
		F9 : Language
		F6 : Load Setup Defaults
		F7 : Load Turbo Defaults

ROM PCI/ISA BIOS (00000006)
POWER MANAGEMENT SETUP
AWARD SOFTWARE, INC.

ACPI function : **Enabled**
Power Management : Disabled
PM Control by APM : No
Video Off Method : U/H SYNC+Blank
Video Off After : Standby
Standby Mode : Disabled
Suspend Mode : Disabled
HDD Power Down : Disabled
OU Wake On Modem : Disabled
Wake On Lan : Disabled
Suspend Mode Option : PowerOn Suspend
Throttle Duty Cycle : 62.5%
UGA Active Monitor : Disabled
Soft-Off by PWR-BTTN : Instant-Off
Wake On RTC Timer : Disabled

** Break Event From Suspend **
IRQ 8 Break Suspend : Disabled

** Reload Global Timer Events **
IRQ[3-7,9-15],NMI : Enabled
Primary IDE 0 : Disabled
Primary IDE 1 : Disabled
Secondary IDE 0 : Disabled
Secondary IDE 1 : Disabled
Floppy Disk : Disabled
Serial Port : Enabled
Parallel Port : Disabled

ESC : Quit ↑↓→← : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values F9 : Language
F6 : Load Setup Defaults
F7 : Load Turbo Defaults

ROM PCI/ISA BIOS (00000006)
PNP/PCI CONFIGURATION
AWARD SOFTWARE, INC.

PNP OS Installed : **Yes**
Resources Controlled By : Auto

PCI IDE IRQ Map To : ISA

Assign IRQ For USB : Enabled
Assign IRQ For UGA : Enabled
MODEM Use IRQ : 3

PCI Slot 1 IRQ (Right) : Auto
PCI Slot 2 IRQ : Auto
PCI Slot 3 IRQ : Auto
PCI Slot 4 IRQ (Left) : Auto

ESC : Quit ↑↓→← : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values F9 : Language
F6 : Load Setup Defaults
F7 : Load Turbo Defaults

ROM PCI/ISA BIOS (00000006)
INTEGRATED PERIPHERALS
AWARD SOFTWARE, INC.

IDE HDD Block Mode : **Enabled**
IDE Primary Master PIO : Auto
IDE Primary Slave PIO : Auto
IDE Secondary Master PIO : Auto
IDE Secondary Slave PIO : Auto
IDE Primary Master UDMA : Auto
IDE Primary Slave UDMA : Auto
IDE Secondary Master UDMA : Auto
IDE Secondary Slave UDMA : Auto
On-Chip Primary PCI IDE : Enabled
On-Chip Secondary PCI IDE : Enabled
USB Keyboard Support : Disabled
Init Display First : AGP

Onboard FDC Controller : Enabled
Onboard Serial Port 1 : Disabled
Onboard Serial Port 2 : Disabled

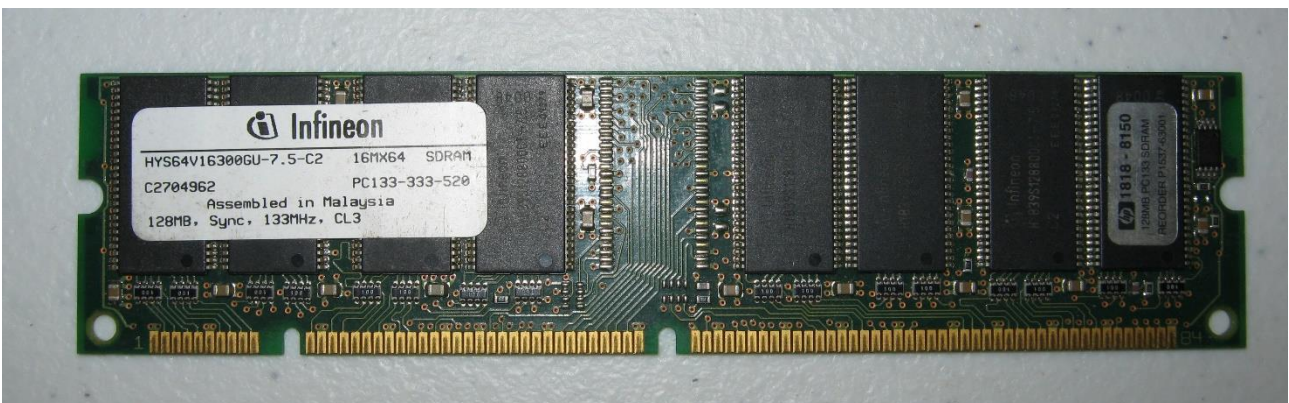
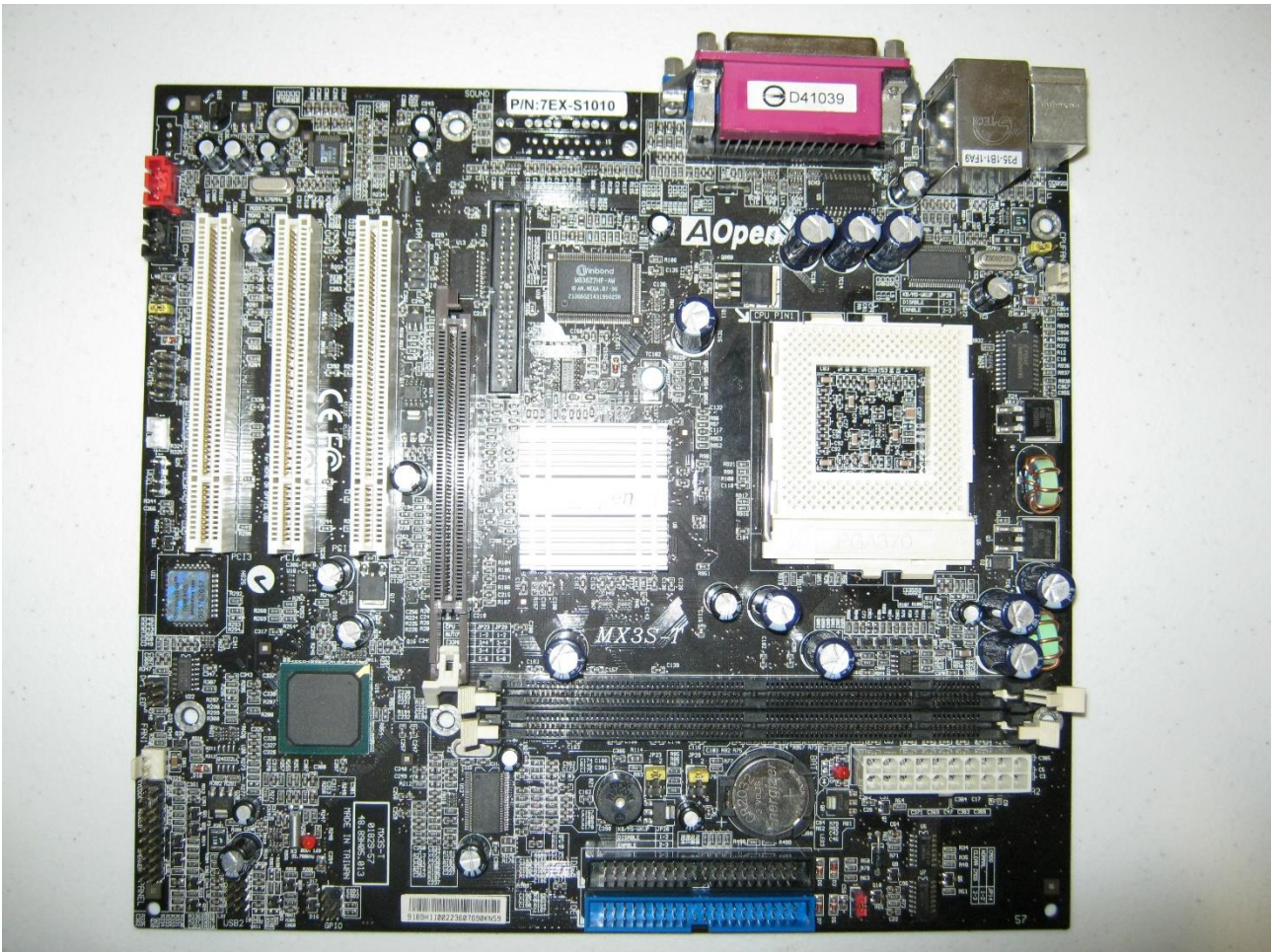
Onboard Parallel Port : Disabled

LED Flash As Power Saving: Enabled

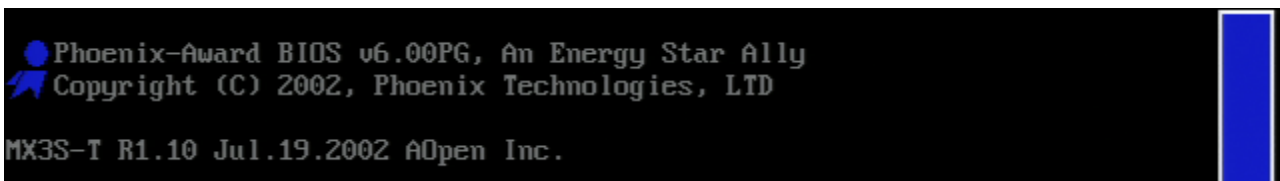
ESC : Quit ↑↓→← : Select Item
F1 : Help PU/PD/+/- : Modify
F5 : Old Values F9 : Language
F6 : Load Setup Defaults
F7 : Load Turbo Defaults

AOPEN MX3S-T

PHOTO



BIOS VERSION AND SETTINGS



Phoenix - AwardBIOS CMOS Setup Utility
Standard CMOS Features

Date (mm:dd:yy)	Thu, Jul 10 2014	Item Help
Time (hh:mm:ss)	15 : 51 : 44	
▶ IDE Primary Master	SAMSUNG HD204UI	Menu Level ▶ To set the date, highlight the Date parameter. Press <PgUp> or <PgDn> to set the current date. The date format is month, date, and year.
▶ IDE Primary Slave	None	
▶ IDE Secondary Master	GCR-8481B	
▶ IDE Secondary Slave	None	
Drive A	1.44M, 3.5 in.	
Drive B	None	
Video	EGA/UGA	
Halt On	All Errors	
Base Memory	640K	
Extended Memory	130048K	
Total Memory	131072K	

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility

▶ Standard CMOS Features	Load Setup Defaults
▶ Advanced BIOS Features	Load Turbo Defaults
▶ Advanced Chipset Features	Set Password
▶ Integrated Peripherals	Save & Exit Setup
▶ Power Management Setup	Exit Without Saving
▶ PnP/PCI Configurations	Load EEPROM Defaults
▶ PC Health Status	Save EEPROM Defaults
▶ Frequency/Voltage Control	▶ Credits
Esc : Quit	↑ ↓ → ← : Select Item
F10 : Save & Exit Setup	(Shift)F3 : Change Language
Time, Date, Hard Disk Type...	

Phoenix - AwardBIOS CMOS Setup Utility
Advanced BIOS Features

Virus Warning	Disabled
CPU Internal Cache	Enabled
External Cache	Enabled
CPU L2 Cache ECC Checking	Enabled
Processor Number Feature	Enabled
Quick Power On Self Test	Enabled
First Boot Device	C:
Second Boot Device	Disabled
Third Boot Device	Disabled
Boot Other Device	Enabled
Swap Floppy Drive	Disabled
Boot Up Floppy Seek	Enabled
Boot Up NumLock Status	Off
Typematic Rate Setting	Disabled
x Typematic Rate (Chars/Sec)	6
x Typematic Delay (Msec)	250
Security Option	Setup
OS Select For DRAM > 64MB	Non-OS2
EzRestore	Enabled

Item Help

Menu Level ▶

Set this item to Enabled to activate the warning message. This feature protects the boot sector and partition table of your hard disk from virus intrusion. Any attempt during boot up to write to the boot sector of the HDD stops the system and the following warning message appears on the screen.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Advanced BIOS Features

External Cache	Enabled
CPU L2 Cache ECC Checking	Enabled
Processor Number Feature	Enabled
Quick Power On Self Test	Enabled
First Boot Device	C:
Second Boot Device	Disabled
Third Boot Device	Disabled
Boot Other Device	Enabled
Swap Floppy Drive	Disabled
Boot Up Floppy Seek	Enabled
Boot Up NumLock Status	Off
Typematic Rate Setting	Disabled
x Typematic Rate (Chars/Sec)	6
x Typematic Delay (Msec)	250
Security Option	Setup
OS Select For DRAM > 64MB	Non-OS2
EzRestore	Enabled
Show Logo On Screen	Enabled
Bypass Vivid BIOS	Disabled

Item Help

Menu Level ▶

This item lets you bypass or wait Vivid BIOS animation logo completely showed on the POST screen.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Advanced Chipset Features

SDRAM CAS Latency Time	3
SDRAM Cycle Time Tras/Trc	7/9
SDRAM RAS-to-CAS Delay	3
SDRAM RAS Precharge Time	3
SM I/O Buffers Control	Normal
System BIOS Cacheable	Disabled
Video BIOS Cacheable	Disabled
Delayed Transaction	Enabled
AGP MODE	Auto

Item Help

Menu Level ▶

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Integrated Peripherals

On-Chip Primary PCI IDE	Enabled
On-Chip Secondary PCI IDE	Enabled
IDE Primary Master PIO	Auto
IDE Primary Slave PIO	Auto
IDE Secondary Master PIO	Auto
IDE Secondary Slave PIO	Auto
IDE Primary Master UDMA	Auto
IDE Primary Slave UDMA	Auto
IDE Secondary Master UDMA	Auto
IDE Secondary Slave UDMA	Auto
USB Controller	Enabled
USB Keyboard Support	Disabled
Init Display First	Onboard/AGP
AC97 Audio	Disabled
Onboard LAN	Disabled
IDE HDD Block Mode	Enabled
POWER ON Function	BUTTON ONLY
× KB Power ON Password	Enter
× Hot Key Power ON	Ctrl-F1

Item Help

Menu Level ▶

This parameter lets you enable or disable the IDE device connected to the IDE connector.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Integrated Peripherals

```

IDE HDD Block Mode      Enabled
POWER ON Function      BUTTON ONLY
x KB Power ON Password  Enter
x Hot Key Power ON      Ctrl-F1
Onboard FDC Controller  Enabled
Onboard Serial Port 1   3F8/IRQ4
Onboard Serial Port 2   2F8/IRQ3
UART Mode Select        Normal
x RxD , TxD Active      Hi,Lo
x IR Transmission Delay  Enabled
x IR Duplex Mode         Half
Onboard Parallel Port   378/IRQ7
Parallel Port Mode      SPP
x EPP Mode Select        EPP1.9
x ECP Mode Use DMA       3
AC PWR Auto Recovery    Off
Game Port Address       Disabled
Midi Port Address       Disabled
x Midi Port IRQ          5
  
```

Item Help

Menu Level ▶
This item is used to assign an address for the MIDI port.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Power Management Setup

```

ACPI Function           Enabled
ACPI Suspend Type      S1
Power Management        User Define
Video Off Method        U/H SYNC+Blank
Video Off In Suspend   Yes
Suspend Type           CPU Sleep Mode
MODEM Use IRQ           3
Suspend Mode           Disabled
HDD Power Down          Disabled
Soft-Off by PWR-Button Instant-Off
Wake On PCI Card        By OS
Wake On Modem           Disabled
Wake On LAN             Disabled
Wake On RTC            By OS
x Date(of Month) Alarm  0
x Time(hh:mm:ss) Alarm  0 : 0 : 0

** Reload Global Timer Events **
Primary IDE 0          Disabled
  
```

Item Help

Menu Level ▶
If your OS is ACPI enabled you have to set this item to Enabled, or there may be unexpected errors. If your OS is APM mode, you can remain the Disabled setting.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Power Management Setup

Suspend Type	CPU Sleep Mode
MODEM Use IRQ	3
Suspend Mode	Disabled
HDD Power Down	Disabled
Soft-Off by PWR-Button	Instant-Off
Wake On PCI Card	By OS
Wake On Modem	Disabled
Wake On LAN	Disabled
Wake On RTC	By OS
x Date(of Month) Alarm	0
x Time(hh:mm:ss) Alarm	0 : 0 : 0

** Reload Global Timer Events **

Primary IDE 0	Disabled
Primary IDE 1	Disabled
Secondary IDE 0	Disabled
Secondary IDE 1	Disabled
FDD,COM,LPT Port	Disabled
PCI PIRQ[A-D]#	Disabled

Item Help

Menu Level ▶
These items enable or disable the detection of IDE, floppy, serial, parallel and PCI IRQ activities for power down state transition.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
PnP/PCI Configurations

Reset Configuration Data	Disabled
Resources Controlled By	Auto(ESCD)
x IRQ Resources	Press Enter
PCI/UGA Palette Snoop	Disabled
Assign IRQ For UGA	Enabled
Assign IRQ For USB	Enabled

Item Help

Menu Level ▶
Default is Disabled. Select Enabled to reset Extended System Configuration Data (ESCD) when you exit Setup if you have installed a new add-on and the system reconfiguration has caused such a serious conflict that the OS cannot boot

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
PC Health Status

CPU Warning Temperature	60° C/140° F
Current System Temp.	32° C/ 89° F
Current CPU Temperature	33° C/ 91° F
Current CPUFAN Speed	3590 RPM
Current FAN1 Speed	2934 RPM
Vcore(U)	1.60 U
+ 3.3 U	3.32 U
+ 5 U	4.75 U
+12 U	12.34 U
-12 U	- 11.70 U
VBAT(U)	3.23 U
5USB(U)	5.40 U

Item Help

Menu Level ▶

This item is used to specify a CPU warning temperature. When the CPU temperature is higher than this predefined value, the CPU speed will automatically slow down and there will be a warning from BIOS.

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Frequency/Voltage Control

CPU Speed Detected	500(100x5.0)
Clock Spread Spectrum	0.45%
CPU Speed Setting	100.2 x 5.0 = 500
SDRAM/PCI Clock(MHz)	100/33

Item Help

Menu Level ▶

The maximum ratio available for adjustment is 8.0X. CPUs having ratios greater than 8.0X usually have their ratios fixed by the manufacturer, in such condition the ratio will be determined by the CPU itself, regardless of BIOS settings. The actual ratio CPU running at will still be

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

Phoenix - AwardBIOS CMOS Setup Utility
Credits

We design this board with pride !

Our Outstanding Design Team

Hardware : Ricky Guao, Ken Cheng
Software : Vincent Lu, Gordon Lee, Aaron Ho
EMC/CAD : Jabor Yu, Thunder Lay
Testing : Kevin Fan Chiang, Chien Liang

Item Help

Menu Level ▶

↑↓←→:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F2:Item Help F3:Language F5:Previous Values F6:Setup Defaults F7:Turbo Defaults

NVIDIA GEFORCE MX 440

PHOTO




DRIVER

NVIDIA GeForce4 MX 440 with AGP8X Properties

General | Adapter | Monitor | Performance

Color Management | GeForce4 MX 440 with AGP8X

g-FORCE 4 MX 

Processor: GeForce4 MX 440 with AGP8X
IRQ: 11 BIOS: 4.18.20.22
TV Encoder Type: Integrated (MV)

Adapter Information
Bus: AGP 2X
Memory: 64 MB

System Information
System Processor: AMD-K6(tm)-III Processor with 3DNNow!(tm)
DirectX Version: DirectX 7

Driver Version Information

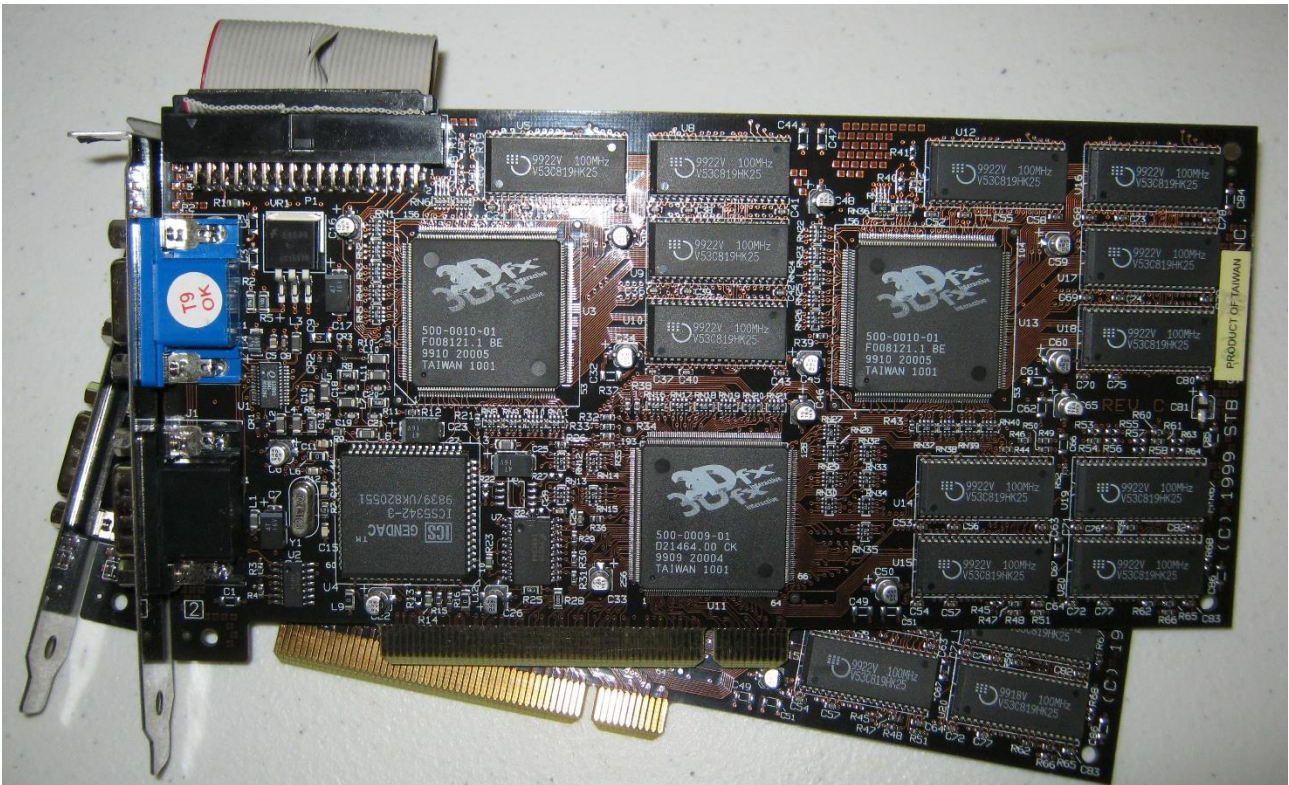
Filename	Description	Version
nvdisp.driv	Display driver	4.14.01.4345
nvdd32.dll	DirectDraw driver	4.14.01.4345
nvopengl.dll	OpenGL installable client driver	4.14.01.4345
nvcore.vxd	Resource Manager kernel	4.14.01.4345

Additional Properties... | NVIDIA on the Internet >>

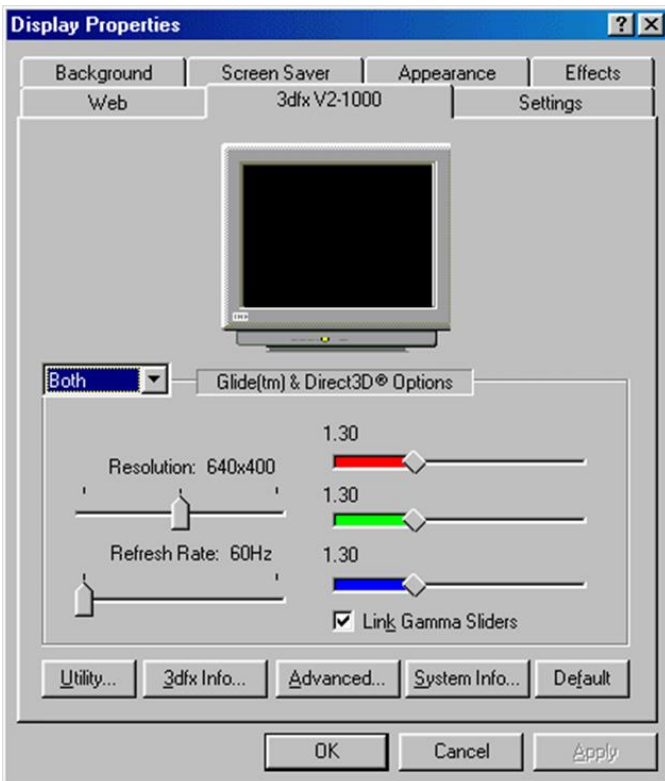
OK | Cancel | Apply

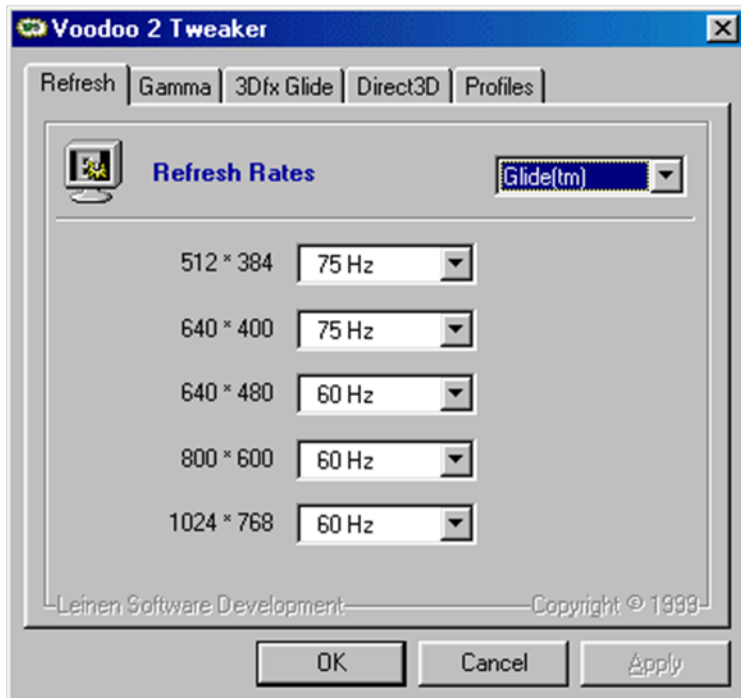
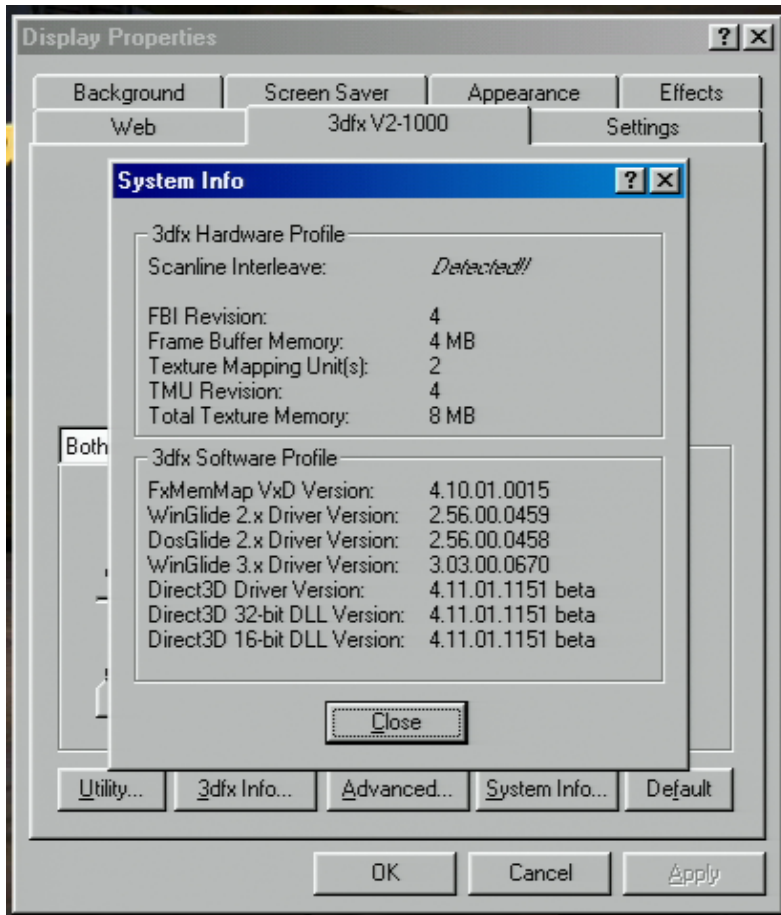
STB VOODOO 2 12 MB (TWO FOR SLI)

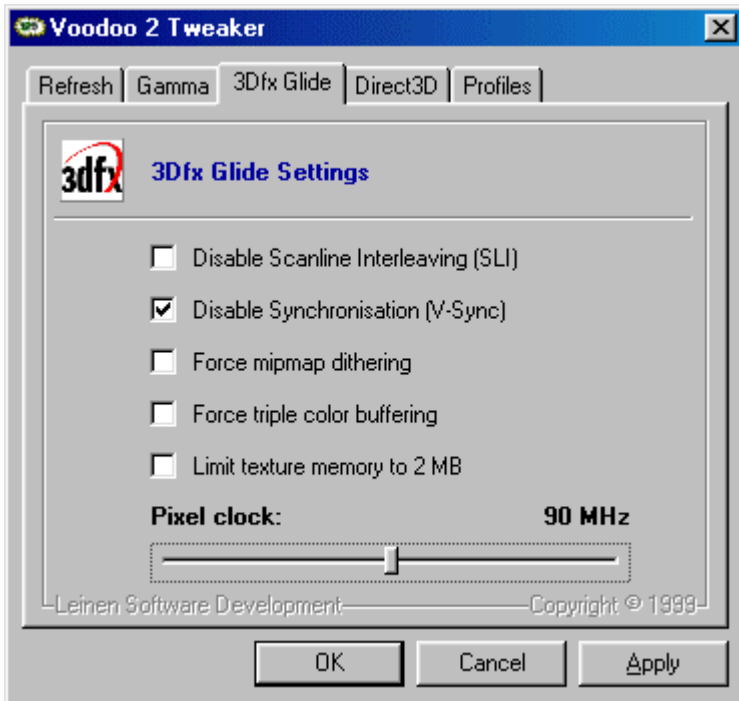
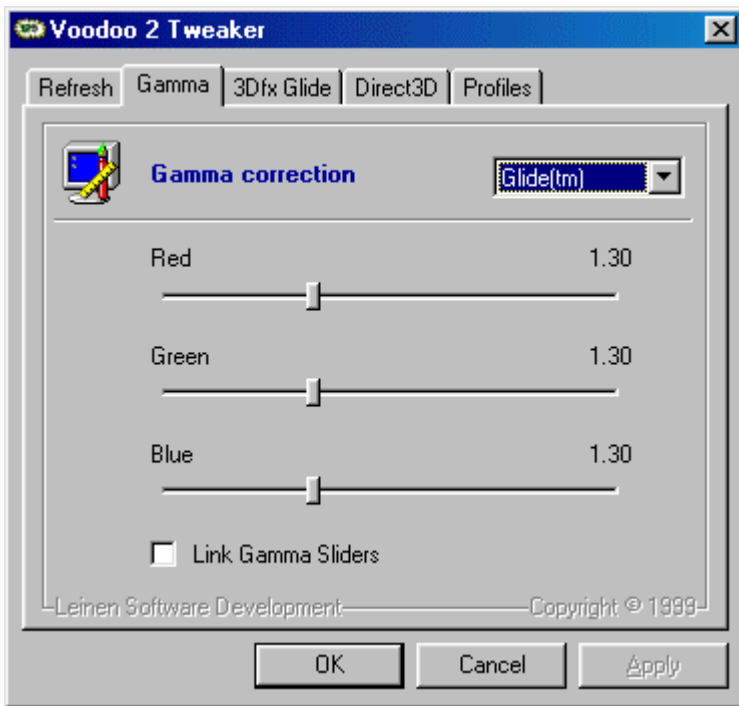
PHOTO

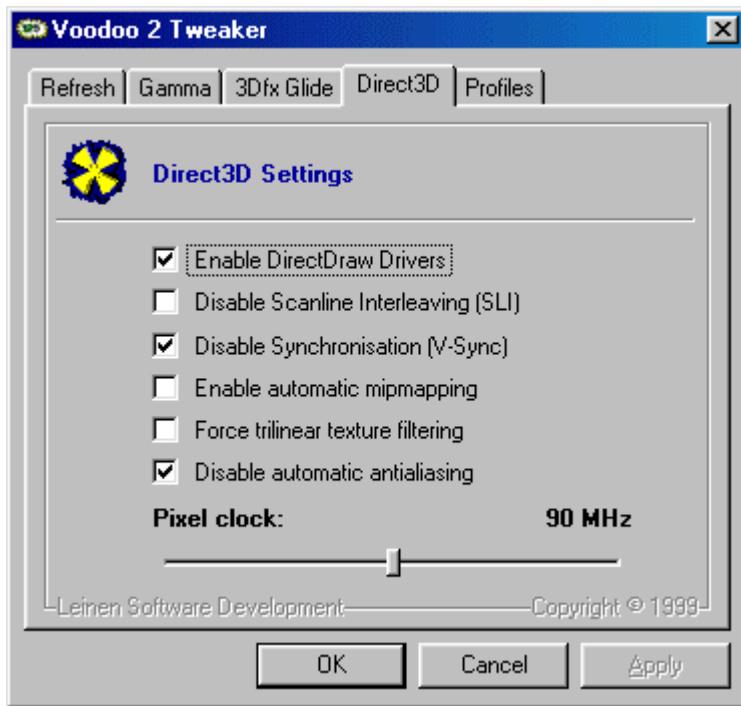


DRIVER



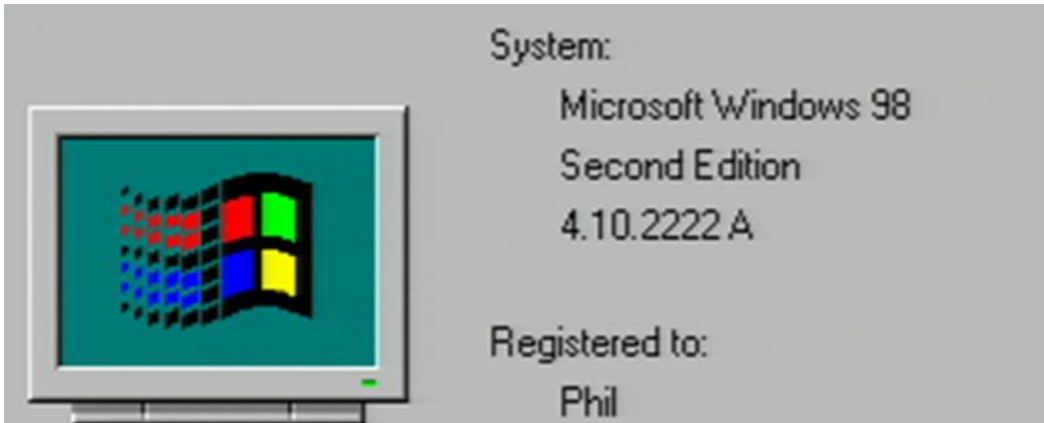




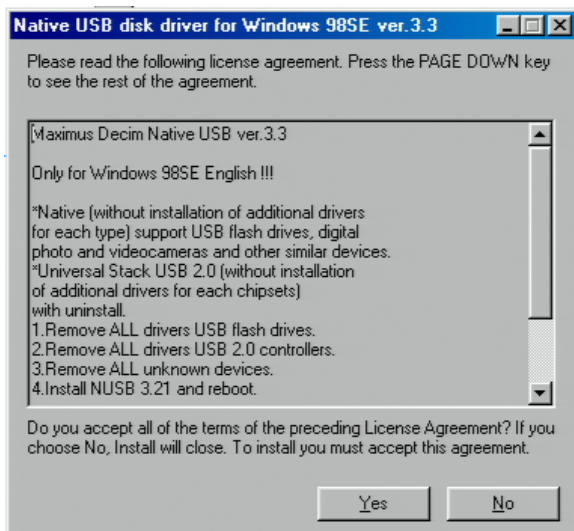


SOFTWARE USED ACROSS ALL PLATFORMS

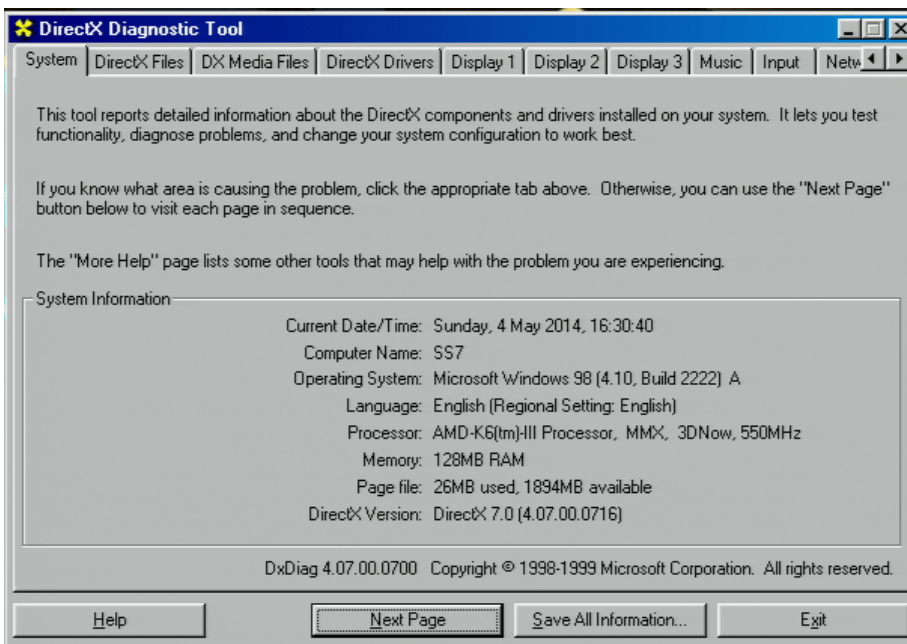
WINDOWS 98SE



USB STORAGE DRIVER



DIRECTX 7



BENCHMARKS AND SETTINGS

UNREAL

Version 2.26 was used. I always had to run the game twice. After the first run the image was missing objects and benchmarking didn't work. I would then quit and ran the game again and this time it would have all the objects and benchmarking would function.

To benchmark open the console (~ key) and type

```
timedemo 1
```

The Cycle #2 results have been used.

Everything was left at default settings.



QUAKE 2

Version 3.06 was used. To run the benchmark enter the console (~ key) then type

timedemo 1

map demo1.dm2

Everything was left at default settings apart from 8-bit textures setting. This was set to no.

```
...using desktop display depth of 16
...calling CD5: ok
GL PFD: color(24-bits) Z(32-bit)
GL_VENDOR: 3Dfx Interactive Inc.
GL_RENDERER: 3Dfx Interactive
Voodoo(tm)
GL_VERSION: 1.1
GL_EXTENSIONS: 3DFX_set_global_palette
WGL_EXT_swap_control
GL_EXT_paletted_texture
GL_EXT_shared_texture_palette
GL_SGIS_multitexture
...allowing CD5
...enabling WGL_EXT_swap_control
...GL_EXT_point_parameters not found
...ignoring
GL_EXT_shared_texture
...using GL_SGIS_multi
----- VIDEO -----
----- sound initialization -----
Initializing DirectSound
Failed driver [3Dfx OpenGL ]
*** dsound init failed *** video mode [640 480 ]
Initializing Wave sound screen size
Failed brightness
Have sound init failed fullscreen yes
couldn't exec autoexec.cfg fullscreen
==== InitGame ====
Server Initialization
@ entities inhibited texture quality
@ teams with @ entities 8-bit textures no
----- Quake2 Initialization -----
reset to defaults
Connecting to localhost... apply
0.0.0.0:0: connect

----- sound initialization -----
Cmd_AddCommand: play already defined
Cmd_AddCommand: stopsound already
defined
Cmd_AddCommand: soundlist already
defined
Cmd_AddCommand: soundinfo already
defined
==== ShutdownGame ====
Server was killed.

----- sound initialization -----
Cmd_AddCommand: play already defined
Cmd_AddCommand: stopsound already
defined
Cmd_AddCommand: soundlist already
defined
Cmd_AddCommand: soundinfo already
defined
```

INCOMING

Demo version 1.0 was used. The following shortcut was used to launch the game:

```
C:\incoming\gameindex.exe -secondary -screenmode -nosound
```

-secondary makes Voodoo 2 card the default 3D card

-screenmode prompts the user to select a resolution

-nosound disables sound

The benchmark results will be in the fps.txt file.

Everything was left at default settings:



GLQUAKE



Batch files were used to launch GLQuake at various resolutions. They are listed below:

```
glquake.exe -window +timedemo demo1 -width 512 -height 384 -nosound -nocdaudio
```

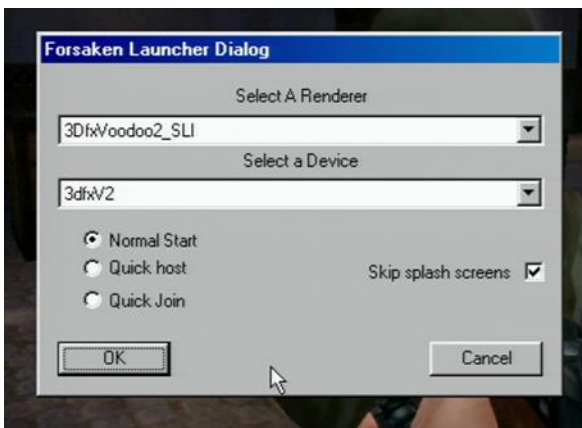
```
glquake.exe +timedemo demo1 -width 640 -height 480 -nosound -nocdaudio
```

```
glquake.exe +timedemo demo1 -width 800 -height 600 -nosound -nocdaudio
```

```
glquake.exe +timedemo demo1 -width 1024 -height 768 -nosound -nocdaudio
```

FORSAKEN

Patch 1.01 needs to be installed as it allows setting 1024 x 768 resolution on a SLI configuration. It also adds more graphics profiles. The profiles used are 3DfxVoodoo2 and 3DfxVoodoo2_SLI. Make sure you change the device to your Voodoo 2 card.



To run the benchmark go to Load Game, select and run the Nuke demo. To read the result go the same menu and just select the Nuke demo. The result will be displayed here.

Everything was left at default settings.

