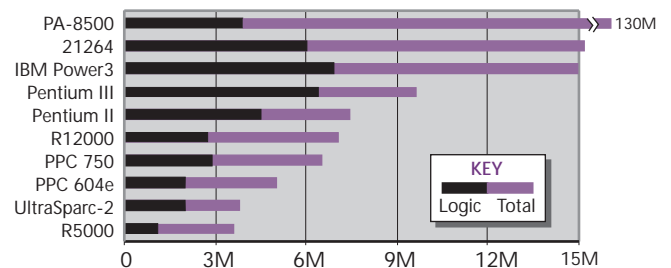


## CHART WATCH: WORKSTATION PROCESSORS

	Alpha 21264	Alpha 21164	IBM Power3	PowerPC G4	Sun Ultra-2	Sun Ultra-2i	HP PA-8500	HP PA-7300LC	MIPS R12000	Intel PIII Xeon
Clock rate	667 MHz	600 MHz	200 MHz	400 MHz	450 MHz	360 MHz	440 MHz	180 MHz	300 MHz	600 MHz
Cache size	64K/64K	8K/8K/96K	32K/64K	32K/32K	16K/16K	16K/16K	512K/1M	64K/64K	32K/32K	16K/16K
Issue rate	4 issue	4 issue	4 issue	3 issue	4 issue	4 issue	4 issue	2 issue	4 issue	3 x86 instr
Pipe stages‡	7/9 stages	7 stages	7/8 stages	4/5 stages	6/9 stages	6/9 stages	7/9 stages	5 stages	6 stages	12/14
Out of order	80 instr	6 loads	32 instr	5 instr	None	None	56 instr	None	48 instr	40 ROPs
Rename regs	48/41	None	16 int/24 fp	6 int/6 fp	None	None	56 total	None	32/32	40 total
BHT entries	4K x 9-bit	2K x 2-bit	2K x 2-bit	512 x 2-bit	512 x 2-bit	512 x 2-bit	2K x 2-bit	None	2K x 2-bit	≥512
TLB entries	128/128	48 I/64 D	128/128	128/128	64 I/64 D	64 I/64 D	120 unified	96 unified	64 unified	32 I/64 D
Memory b/w	2.7 GB/s	~400 MB/s	1.6 GB/s	1.6 GB/s	1.9 GB/s	600 MB/s	1.5 GB/s	213 MB/s	539 MB/s	800 MB/s
Package	CPGA-588	CPGA-499	SCC-1,088	CBGA-360	CLGA-787	PBGA-587	LGA-544	CPGA-464	CPGA-527	PBGA-528
IC process	0.25µ 6M	0.35µ 4M	0.25µ 5M	0.22µ 6M	0.29µ 4M	0.29µ 4M	0.25µ 4M	0.5µ 4M	0.25µ 4M	0.25µ 4M
Die size	205 mm²	209 mm²	270 mm²	83 mm²	126 mm²	150 mm²	475 mm²	259 mm²	204 mm²	128 mm²
Transistors	15.2 million	9.3 million	15 million	10.5 million	3.8 million	4.1 million	130 million	9.2 million	7.2 million	9.5 million
Est mfg cost*	\$160	\$125	\$320	\$45	\$70	\$85	\$330	\$95	\$140	\$150
Power (max)	75 W	25 W	46 W	<8 W	20 W	38 W	>40 W	15 W	20 W	22 W*
SPEC95b†	31.8/49.0	19.2/26.6	12.5/27.6	18/18	16.2/23.9	11.9/17.1	30.8/48.7	8.6/9.2	16/26*	26/17*
Availability	3Q99	2Q97	3Q98	3Q99	4Q98	4Q98	1Q99	3Q96	1Q99	2Q99
1K list price	\$2,296\$\$	Not public	Not public	Not avail.	\$4,249\$\$	\$470	Not public	Not public	Not public	\$931\$

†SPEC95 baseline (int/fp) ‡integer ALU/load §includes 512K L2 cache §§includes 2M L2 cache (Source: vendors, except \*MDR estimates)

The table above gives the vital statistics for the key high-end processors available soon. The table below provides the best reported SPEC95 results for each shipping processor. The graph compares transistor counts for these devices for the logic (noncache) portion and the complete design.



Processor	Alpha 21264	HP PA-8500	Intel PIII Xeon	Sun Ultra-2	MIPS R12000	Hal Sparc64	PowerPC 604e	IBM Northstar	IBM Power3	Sun Ultra-2i
System	Samsung UP2000†	HP9000 N4000	Siemens Celsius 630	Ultra 60 Mod. 1450	SGI Origin2000	Fujitsu GP7000F	RS/6000 43P-150	RS/6000 H70	RS/6000 43P-260	Ultra 10 Mod 360
Clock rate	667 MHz	440 MHz	550 MHz	450 MHz	270 MHz	296 MHz	375 MHz	340 MHz	200 MHz	360 MHz
Ext cache	4M	none	512K	4M	4M	8M	1M	4M	4M	2M
099.go	33.3	34.0	24.7	18.0	14.1	15.0	16.4	19.7	14.4	13.1
124.m88Ksim	28.8	33.3	25.3	15.1	14.0	11.9	18.9	11.6	13.5	11.3
126.gcc	32.7	26.7	22.1	18.2	13.5	18.0	13.1	15.3	11.9	12.4
129.compress	26.1	29.1	20.7	18.6	15.2	15.3	11.1	15.8	13.1	14.2
130.li	32.8	33.0	27.9	13.1	12.8	12.8	12.7	11.3	10.8	9.9
132.ljpeg	36.9	24.9	21.8	16.6	13.5	15.4	17.1	11.6	13.0	12.6
134.perl	32.8	27.7	26.0	15.6	17.6	14.8	15.9	13.0	10.9	10.9
147.vortex	32.5	40.0	27.6	15.4	20.1	15.3	12.4	13.4	12.9	11.2
SPECint95b*	31.8	30.8	24.4	16.2	14.9	14.7	14.5	13.7	12.5	11.9
101.tomcatv	59.7	83.3	21.0	32.9	27.8	58.5	10.8	26.9	45.2	23.7
102.swim	91.5	121	30.1	44.2	39.3	67.9	17.1	24.0	50.6	32.4
103.su2cor	22.6	29.0	10.1	15.8	14.2	16.0	4.76	11.2	16.9	11.5
104.hydro2d	35.8	23.6	9.64	16.1	16.0	22.8	4.29	12.4	22.0	9.32
107.mgrid	54.3	39.7	10.3	25.3	24.5	26.4	7.81	20.2	27.9	16.8
110.applu	30.1	33.4	9.52	12.9	14.9	14.5	5.60	15.4	18.0	10.6
125.turb3d	32.3	40.6	14.4	20.7	19.3	18.4	12.6	23.0	34.0	15.4
141.apsi	55.3	40.1	19.3	30.4	23.4	20.7	11.7	17.7	22.3	23.7
145.fpppp	95.0	84.8	27.8	26.8	39.7	38.9	35.6	36.9	37.3	17.3
146.wave5	65.2	59.3	16.9	30.5	34.4	32.3	9.07	26.5	20.8	22.7
SPECfp95b*	49.0	48.7	15.5	23.9	23.7	27.7	9.76	20.2	27.6	17.1

\*SPEC95 baseline †motherboard available from Alpha Processor Inc.

(Source: SPEC)