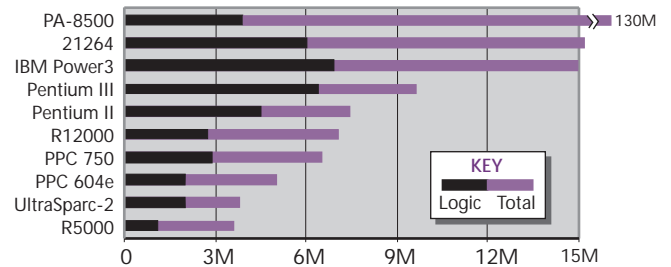


CHART WATCH: WORKSTATION PROCESSORS

	Digital 21264	Digital 21164	IBM Power3	PowerPC G4	Sun Ultra-2	Sun Ultra-2i	HP PA-8500	HP PA-7300LC	MIPS R12000	Intel PIII Xeon
Clock rate	575 MHz	600 MHz	200 MHz	400 MHz	400 MHz	300 MHz	440 MHz	180 MHz	300 MHz	550 MHz
Cache size	64K/64K	8K/8K/96K	32K/64K	32K/64K	32K/32K	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 Package	2.7 GB/s CPGA-588	~400 MB/s CPGA-499	1.6 GB/s SCC-1,088	1.6 GB/s CBGA-360	1.9 GB/s CLGA-787	600 MB/s PBGA-587	1.5 GB/s LGA-544	213 MB/s CPGA-464	539 MB/s CPGA-527	800 MB/s PBGMA-528
IC process	0.35µ 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	298 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*	\$300	\$125	\$320	\$45	\$70	\$85	\$330	\$95	\$140	\$60
Power (max)	70 W	25 W	46 W	<8 W	20 W	38 W	>40 W	15 W	20 W	22 W*
SPEC95‡	26.0/47.2	19.2/26.6	12.5/27.6	18/18	14.0/22.8	11.9/17.1	30/50	7.3/7.4	17/26*	24.4/15.5
Availability	4Q98	2Q97	3Q98	2Q99	4Q98	4Q98	1Q99	3Q96	1Q99	2Q99
1K list price	Not public	Not public	Not public	Not avail.	\$4,249\$	\$470	Not public	Not public	Not public	\$1,059\$

†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	Digital 21264	Intel PIII Xeon	Digital 21164	HP PA-8200	MIPS R12000	PowerPC 604e	Sun UltraSparc	IBM Northstar	IBM Power3	Sun Ultra-2i
System	AlphaServ. 8400 6/575	Siemens Celsius 630	AlphaServ. 7310 6600	HP9000 K580	SGI Origin2000	RS/6000 43P-150	Sun Ent. 450	RS/6000 H70	RS/6000 43P-260	Ultra 10 Mod. 360
Clock rate	575 MHz	550 MHz	600 MHz	240 MHz	270 MHz	375 MHz	400 MHz	340 MHz	200 MHz	360 MHz
Ext. cache	4M	512K	2M	4M	4M	1M	4M	4M	4M	2M
099.go	28.8	24.7	19.7	17.3	14.1	16.4	15.5	19.7	14.4	13.1
124.m88Ksim	23.4	25.3	20.9	17.5	14.0	18.9	12.9	11.6	13.5	11.3
126.gcc	22.7	22.1	20.7	14.8	13.5	13.1	16.0	15.3	11.9	12.4
129.compress	21.3	20.7	17.5	16.2	15.2	11.1	15.9	15.8	13.1	14.2
130.li	22.2	27.9	17.3	16.4	12.8	12.7	11.7	11.3	10.8	9.9
132.jpeg	30.8	21.8	19.4	14.1	13.5	17.1	14.4	11.6	13.0	12.6
134.perl	31.3	26.0	20.0	14.0	17.6	15.9	12.2	13.0	10.9	10.9
147.vortex	29.8	27.6	18.5	22.0	20.1	12.4	13.8	13.4	12.9	11.2
SPECint95b*	26.0	24.4	19.2	16.4	14.9	14.5	14.0	13.7	12.5	11.9
101.tomcatv	90.0†	21.0	34.9	39.5	27.8	10.8	32.3	26.9	45.2	23.7
102.swim	120†	30.1	49.1	31.2	39.3	17.1	43.0	24.0	50.6	32.4
103.su2cor	17.1†	10.1	15.6	17.7	14.2	4.76	15.3	11.2	16.9	11.5
104.hydro2d	35.0†	9.64	19.5	14.3	16.0	4.29	15.5	12.4	22.0	9.32
107.mgrid	49.8†	10.3	37.3	21.2	24.5	7.81	25.3	20.2	27.9	16.8
110.applu	34.8†	9.52	9.4	18.7	14.9	5.60	12.8	15.4	18.0	10.6
125.turb3d	27.9†	14.4	25.9	19.1	19.3	12.6	19.0	23.0	34.0	15.4
141.apsi	44.6†	19.3	26.2	28.5	23.4	11.7	28.8	17.7	22.3	23.7
145.fpppp	71.0†	27.8	43.2	42.6	39.7	35.6	23.4	36.9	37.3	17.3
146.wave5	55.7†	16.9	33.0	37.7	34.4	9.07	27.4	26.5	20.8	22.7
SPECfp95b*	47.2†	15.5	26.6	25.3	23.7	9.76	22.8	20.2	27.6	17.1

*SPEC95 baseline †results from 500-MHz 21264 in AlphaServer ES40

(Source: SPEC)