

## CHART WATCH: WORKSTATION PROCESSORS

	Digital 21164	IBM P2SC	PowerPC 750	PowerPC 604e	Sun Ultra-2	Sun Ultra-2i	HP PA-8200	HP PA-7300LC	MIPS R10000	Intel Pentium II
Clock rate	600 MHz	160 MHz	300 MHz	350 MHz	300 MHz	300 MHz	236 MHz	160 MHz	250 MHz	333 MHz
Cache size	8K/8K/96K	32K/128K	32K/32K	32K/32K	16K/16K	16K/16K	None	64K/64K	32K/32K	16K/16K
Issue rate	4 issue	6 issue	3 issue	4 issue	4 issue	4 issue	4 issue	2 issue	4 issue	3 x86 instr
Pipe stages	7 stages	5 stages	6 stages	6 stages	6/9 stages	6/9 stages	7-9 stages	5 stages	5-7 stages	12-14
Out of order	6 loads	5 instr	5 instr	16 instr	None	None	56 instr	None	32 instr	40 ROPs
Rename regs	None	22 fp	6 int/6 fp	12 int/8 fp	None	None	56 total	None	32/32	40 total
BHT entries	2K x 2-bit	None	512 x 2-bit	512 x 2-bit	512 x 2-bit	512 x 2-bit	1K x 2-bit	None	512 x 2-bit	≥512
TLB entries	48 I/64 D	64 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	~400 MB/s	2.2 GB/s	~180 MB/s	~180 MB/s	1.3 GB/s	600 MB/s	768 MB/s	213 MB/s	539 MB/s	528 MB/s
Package	CPGA-499	SCC-1,088	CBGA-360	CBGA-255	PBGA-521	PBGA-587	LGA-1,085	CPGA-464	CPGA-527	PBGA-528
IC process	0.35µ 4M	0.25µ 5M	0.25µ 5M	0.25µ 5M	0.29µ 4M	0.29µ 4M	0.5µ 4M	0.5µ 4M	0.25µ 4M	0.25µ 4M
Die size	209 mm <sup>2</sup>	255 mm <sup>2</sup>	67 mm <sup>2</sup>	47 mm <sup>2</sup>	126 mm <sup>2</sup>	150 mm <sup>2</sup>	345 mm <sup>2</sup>	259 mm <sup>2</sup>	197 mm <sup>2</sup>	131 mm <sup>2</sup>
Transistors	9.3 million	15 million	6.4 million	5.1 million	3.8 million	4.1 million	3.9 million	9.2 million	6.8 million	7.5 million
Est mfg cost*	\$125	\$290	\$40	\$30	\$70	\$85	\$270	\$95	\$130	\$65
Power (max)	25 W	30 W	5 W	7 W	20 W	38 W	>40 W	15 W	16 W	15 W*
SPEC95†	17.0/27.0	7.1/23.6	13.2/7.76	14.0/12.1	10.4/17.2	9.6/12.0	16.4/25.3	7.3/7.4	13.7/22	12.3/8.32
Availability	2Q97	3Q96	3Q97	3Q97	2Q97	1Q98	3Q97	3Q96	3Q97	1Q98
1K list price	Not public	Not public	\$495	\$645	\$3,635§	\$470	Not public	Not public	Not public	\$583‡

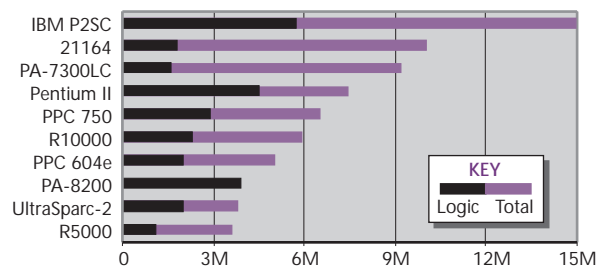
†SPEC95 baseline (int/fp)

‡includes 512K L2 cache

§includes 2M L2 cache

(Source: vendors except \*MDR estimates)

The table above gives the vital statistics for the key RISC processors available today. The table below provides the best reported SPEC95 results for each shipping processor. (Note that some vendors have submitted only SPECint95 or SPECfp95.) The graph compares transistor counts for these devices for the logic (noncache) portion and the complete design.



Processor	Digital 21164	HP PA-8200	MIPS R10000	PowerPC 604e	Intel Pentium II	Sun UltraSparc	HP 7300LC	Intel P55C	IBM P2SC	Sun Ultra-2i
System	AlphaServ. 4100 600	HP9000 K580	Siemens RM600 E60	RS/6000 H50	AL440LX m'board	Sun Ultra Enter. 450	HP Visual. Mod B160L	Intel LT430TX	IBM 397 RS/6000	"Darwin" Ultra 10
Clock rate	600 MHz	240 MHz	250 MHz	332 MHz	333 MHz	300 MHz	160 MHz	233 MHz	160 MHz	300 MHz
Ext. cache	2M	4M	8M	256K	512K	2M	1M	512K	none	512K
099.go	20.2	17.3	13.6	17.0	12.0	11.2	9.80	7.80	8.00&	10.5
124.m88Ksim	16.8	17.5	13.3	17.8	13.1	10.7	6.82	8.41	4.67&	10.1
126.gcc	15.2	14.8	13.7	12.8	12.1	11.0	7.16	7.13	6.20&	9.38
129.compress	14.9	16.2	15.5	9.63	9.57	11.8	6.24	4.84	5.55&	11.3
130.li	14.3	16.4	13.1	12.7	13.7	8.89	7.43	8.02	5.21&	8.38
132.ijpeg	18.5	14.1	13.1	16.8	13.2	10.6	5.81	4.66	7.44&	10.5
134.perl	19.5	14.0	14.4	14.6	15.2	9.22	8.08	10.3	5.33&	8.08
147.vortex	17.3	22.0	12.9	12.5	14.3	10.0	7.91	7.55	5.40&	8.81
SPECint95b*	17.0	16.4	13.7	14.0	12.8	10.4	7.32	7.12	5.88&	9.57
101.tomcatv	36.8	39.5	24.5†	15.1	11.4	26.0	11.1	7.36	46.9	17.3
102.swim	36.9	31.2	32.2†	24.4	17.1	35.7	17.9	8.29	56.5	23.6
103.su2cor	15.2	17.7	10.5†	5.68	5.25	11.5	3.66	3.05	10.5	6.13
104.hydro2d	20.2	14.3	10.4†	6.10	4.98	8.57	3.86	2.95	12.9	6.32
107.mgrid	35.8	21.2	18.5†	9.60	4.55	18.9	5.64	2.15	22.8	12.7
110.applu	11.8	18.7	12.2†	8.05	6.00	10.6	4.99	2.01	23.2	8.21
125.turb3d	26.8	19.1	12.1†	15.0	8.70	14.3	6.70	4.69	22.7	12.0
141.apsi	28.4	28.5	15.9†	9.22	9.98	21.5	7.69	4.81	11.5	12.2
145.fpppp	47.1	42.6	26.8†	36.9	14.0	19.2	12.4	5.65	35.1	16.6
146.wave5	32.6	37.7	25.3†	12.8	9.37	21.0	9.54	6.03	30.1	16.0
SPECfp95b*	27.0	25.3	17.4†	12.1	8.32	17.2	7.38	4.23	23.6	12.0

\*SPEC95 baseline

†SGI Origin w/R10000-200

‡SGI Indy R5000

&IBM 595 w/P2SC-135

(Source: SPEC)