A CHART FOR EDP EXPERTS

AST SPRING Jack Gilmore, the vice president of our embryonic consulting firm, in heated discussion with several top-level representatives of an important client, was asked a very simple question: "What is the access time of the RCA-501?"

In common with all those who have a wide interest in electronic data processing, and particularly with those who have the gall to represent themselves as consultants in the field, Jack had looked over the extensive technical information which RCA had provided. Back at the office on the five-foot shelf there was a manual which gave not only the access time but almost all other pertinent information on the system. It happened, however, that Jack had not worked with the 501, had not anticipated any interest in the system by this particular client, had not yet taken a Dale Carnegie course on memory improvement, and did not have our five-foot shelf in his pocket.

"What we need," he told his unsympathetic associates later, "is a pocket-sized chart listing all of the important characteristics of all of the computers that we should be expected to know about." The work involved in preparing such a chart seemed so prodigious that his friends greeted him with silence. With sudden inspiration he added, "It would be just the thing to print on the back of our new brochure so that the people who receive it won't be quite so likely to throw it away." Thus unburdened, he turned his back on the quietness that often greets a good idea to go on about his business.

A few weeks later Norman Statland, Adams Associates' walking encyclopedia of computer facts, found himself with two free days; so with Allen Rousseau's help he put together a chart of the type Gilmore had suggested. Four months, 87 phone calls, 117 letters, eight visits by Alder Jenkins to Boston's best compositor, and 56 man-days of work later, the results of Norman's two-day effort appeared before the computer world in a privately-published brochure and simultaneously, in condensed form, in an article about it prepared by the editors of BUSINESS WEEK. The complete chart, brought up to date through October 15 and arranged in a format suitable to DATAMATION, is presented here.

which and what

The most immediate problem facing one who sets out to make a chart of computer characteristics is, of course, which computers to include and what data to present about them. Since the basic purpose of our chart was to serve as a convenient, compact reference for technically competent EDP people, a number of items of data were quite obviously needed. Arranging these data into columns served the dual purpose of making the chart more manageable in size and of permitting a rapid scanning of individual columns should one need to know which of the available computers have a fast on-line printer, built-in floating point, or any other feature desirable for a particular job.

Numbers standing unqualified in columns often lead to difficulties for the computer characteristics chartist. Frequently there are two or more devices available, optionally or in combination, so that a single number alone is misleading. Sometimes the speed, size, or even the existence of a particular feature becomes a question of semantics or a problem of averaging. This is no doubt the reason that few charts similar to the one presented here have ever been compiled and that fewer still have received widespread acceptance.

For better or worse, these problems were resolved by us in a combination of three ways: a second row of numbers for each computer was included wherever necessary; values which seemed to need qualification or clarification were referenced to footnotes; and the definitions of some of the column headings were deliberately left loose (**caveat emptor**). Most important of all, since each computer has unique or unusual features which cannot readily be expressed as numbers in columnar form, these features together with footnote information unique to one computer were put together into relatively terse sentences comprising a kind of editorial remark about each individual computer.

speed and price

What is an average monthly rental? What is the effective speed of a computer? For what uses is it primarily intended?

The reader, I am sure, will agree with us that there is no general answer to these questions. We hope he will agree that the data we have presented, while making no pretense of answering these questions, is useful information. No doubt he will feel, and perhaps we will agree, that other data could have been provided in place of or in addition to that which was actually chosen. For example, while detailed rental costs, option by option, seemed out of the question, minimum monthly rental might have been a valuable added column. There is no widely accepted criterion for measuring effective speed, but multiply time might have been useful.

On the other hand, average rental does at least establish the ball park in which each system can compete, and can be used as a criterion to bring systems of like size close to one another in the chart. The optimized add time and the average access time actually given in the chart, taken together with the number of instruction addresses and other information, should give the computer specialist a good multi-parametric feeling for the speed of the machine. And, in the final analysis, one must remember that this chart was never intended to replace completely the reference manuals available for each computer.

In the chart, which follows on the next four pages, characteristics given for all but the first two machines have been confirmed by their respective manufacturers. CIRCLE 128 ON READER CARD

Following are the manufacturers and their computers represented in the chart: AUTONETICS, Recomp II; BENDIX, G-20 and G-15; BURROUGHS, 220, 205 and E-103; CON-TROL DATA, 1604 and 160; DIGITAL EQUIPMENT, PDP-3 and PDP-1; EL-TRONICS, Alwac III-E; GENERAL ELECTRIC, 210 and 225; IBM, Stretch (7030), 7090, 7080, 709, 705, 704, 7070, 7074, 650, 1401, 305 and 1620; HONEYWELL, H-S00 and H-400; MONROE, Monrobot XI; NCR, 304; PACKARD BELL, PB 250; PHILCO, 2000; RCA, 601, 501 and 301; REMINGTON RAND, Larc, 1105, 1103A, U II, U III, File Computer and SS 80/90; ROYAL MC BEE, RPC 9000, RPC 4000 and LGP-30.

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See remarks immediately beneath the computer data in question.
 The IBM 1401 system (entry #28 in the chart) is available for use as an off-line input-output device.

This peripheral equipment is available with the same characteristics both on-line and off-line.
 The cost of magnetic tape units has not been included.

	GENERA	L CHARAC	TERISTIC	S INTERNA	L MA	GNETIC T	APE	PERIP	HERAL E	QUIPMEN Output	SPECIAL FEATURES					
	Average Monthly Rental Solid-State	Storage Capacity and Type	Word Size Instruction Addresses	Add Time Average Access Time	Thousands of Char- acters per Second	Input-Output Channels Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Char- acters per Second Cards per Minute	Paper Tape Char- acters per Second Printer Lines per Minute	Index Registers Indirect Addressing	Floating Point Arith. Console Typewriter	Random Access File Random Inquiry			
12 IBM 705	\$30,000 A variabl Models I Model II character	20-80K core e-word leng and II by o I, a 767 Da field.	1a 1 gth compu- either a 75 ata Synchr	$86\mu^1$ 9μ $119\mu^1$ 17μ uter which ca 54 Tape Cont conizer is use	15-62 in be us trol, a 7 ed. The	6 RWC 10 sed as a fiv 77 Tape R use of mor	60 100 ve-digit tecord re than	2504 t word Coord n one 7	100 compute inator, or '67 allows	4 15 50 r. Magneti a 760 Cor MRWC.	0 ⁴ 0 0 ³ c tapes a atrol and Add time	/ O are control Storage ur e assumes a	led in nit. In a five-			
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HONEYWELL H-800	\$22,000 $$ A comput feature, c machine	4-32K core ter with faci- called Ortho with a word	12d 3 ility for run tronic cou l size of 48	$\begin{array}{ccc} 24\mu & 6\mu \\ \text{nning up to e} \\ \text{nt, when read} \\ 8 \text{ bits. Numer} \end{array}$	641 ight ind ding ma ic inforr	16 MRWC lependent p gnetic tape mation can	64 brogram es in ei be rea	2404 6504 ms cond ther di d at a r	2004 100 10004 250 currently. rection. T rate of 96,	4 60 15 4 90 It uses an a he comput 000 digits p	0 64 04 automatic er can be per secon	$\int_{-\infty}^{\infty} \sqrt{1/0}$ c error corrected used as a b d.	√ ection pinary			
BENDIX G-20	\$20,000 $$ All input- gated to rate of 24 70 input-	4-32K core -output unit control buff 40,000 digits output unit	32b 1 ts may ope fers. Varia s per secon s attached	$\begin{array}{ccc} 15\mu & 6\mu \\ \text{erate either o} \\ \text{ble instructiond. A program} \\ \text{l.} \end{array}$	1201 n- or of on lengt m interr	6 MRWC f-line unde h permits upt signal	500 Fr prog multip can be	8004 gram co ble inde e initiat	5004 250 ontrol. Inp exing. Nu ted by a c	4 100 4 100 but-output meric infor control buf	0 ⁴ 63 supervision of fer which	$\sqrt{\sqrt{I/O}}$ ion can be can be reac in can have	√ dele- d at a up to			
UNIVAC III	\$20,000 √ A comput instructio Numeric i tions are	8-32K core ter featuring n may proc information other feature	6d 1 g a flexible ess up to a can be rea res.	9μ 4.5μ e storage wor four data wo ad at a rate of	25 1331 rd which rds. Sta f 200,00	5 MRWC n may have ndard off-1 0 digits pe	e four a ine ing r secon	7001 alphab put-out nd. Pro	300 etic, six d put units gram inte	ecimal, or of the UN rrupt and	0 ¹ 15 27 binar IVAC lin scatter an	/ I/O y character ne are avai nd gather o	√ √ rs. An ilable. opera-			
BURROUGHS	\$17,000 A comput hundred Burrough	2-10K core ter featuring million digi s Model 29	10d 1 g a magne ts of rand 03 and 299	$\begin{array}{ccc} 200\mu & 10\mu \\ \text{tic tape syste} \\ \text{om access me} \\ 2. & \text{A line prime} \end{array}$	25 m whic emory a nter, M	1 none h can sear ure availabl odel 289, i	10 ch and le. Car is also	300 l scan d inpu availa	1000 100 independe t-output o ble.	60 15 150 ently of the can be obt	0 1 04 e central ained thr	$\sqrt{I/O}$ computer.	$\sqrt{}$ Five use of			
RCA 501	\$16,000 √ A variable and rever a five-cha	16-262K core e-word leng rse read and tracter field	1a 2 th compu d dual rec and uses	$360\mu^1$ 15μ ter featuring cording. Indir duplicate add	22-66 four-ch cect add der circ	8 RC, W or RW aracter (te lressing is l uits to perr	C 63 (trad) r limited nit che	4004 parallel to sca ecking o	1000 150 transfer, tter and g of arithme	and mag ather oper tic operati	04 8 ³ netic tap- ations. A ons.	$/^1$ o es with for dd time ass	√ rward sumes			
GENERAL Electric 210	\$14,000 v A compute per minute encoded	4-8K core ter which for te sorter-rea characters	6d 1 eatures on iders (of w	64μ 32μ	30 50 -line ha ocket or used in	2 RWC ndling of r r a twelve-j	13 nagnet pocket	400 1500 tically of unit is	200 500 encoded d available	60 100 ocuments . The print	04 1 through ter can pr	I/O 1200-docur rint magnet	√ ment- tically			
21 NCR 304	\$12,500 √ A comput repertoire tion with RWC is a	2-4K core ter which u e of microfle the magnet achieved.	10a 3 ses two w ow, single- tic tape sy	$\begin{array}{ccc} 600\mu & 60\mu \\ 120\mu^1 \\ \text{vords per inst} \\ \text{address instr} \\ \text{vstem which u} \end{array}$	30 ructions uses tap	8 R₩ ¹ . The inter . Pack and es without	64 nal co unpac a spac	2000 ⁴ ommand ek can l ce bety	1800 ⁴ 250 ³ ds include be used to ween reco	³ 60 ⁴ 85 120 e sort, mei o condense rds. In pro	04 10 04 numeric ocessing	$\sqrt{I/O}$ k, unpack a data in co inactive ree	√ and a onnec- cords,			
UNIVAC File Computer I	\$12,000 A comput A search through 3	20 core 1K drun ter which ca command fo 32 possible	12a 3 n an have u or locating input-out	8.6m .9m 3.1m p to ten gene g records on t put units. An	10.4 eral stor the drur off-line	10 RWC rage drums n is incorp e sort-colla	31 of 180 orated te unit	150 240 ³),000 cl . The c is avai	200 150 120 haracters computer ilable.	60 60 each (avera can be use)4 0 age acros d in a sca	I/O s time is 17 an mode to	√ √ 7.6m). cycle			
23 UNIVAC SS 80/90	\$9,000 √ The last coded dec acters are	4K drun 1K fast part of the cimal, some available.	n 10d 1 ¹ instruction operation It can be	1.7m 85 μ .425m n word indic s can be perfused as a sa	25 ates the ormed i tellite c	1 RC, WO e address o n binary. I computer fo	c 10 f the r Randor or any o	600 450 next ins m acce of the U	150 120 struction. ss drums UNIVAC	60 In addition (Randex) a series.)4 3 n to work nt six to	king with b 24 million	√ oinary char-			

	GENERAL CHARACTERISTICS						SPEED MAGNETIC TAPE							Input Output						SPECIAL FEATURES				
	Average Monthly Rental	Solid-State	Storage Capacity and Type	Word Size	instruction Addresses	Add Time	Average Access Time	Thousands of Char- acters per Second	Input-Output Channels	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Char- acters per Second	Cards per Minute	Paper Tape Char- acters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing Floating Point Arith.	Console Typewriter	Random Access File Random Inquiry				
24 IBM 650	\$9,000 The la BCD in Selecto can be	ast pa mode or as e a ma	1-4K dru 60 core rt of the (six-bit of an off-lin aximum off-lin	m 10d instru charac ie tapo of four	tion (tion (ters) (ters) (ters) (ters)	.7m n word) or str itor. Tl ts.	2.4m .1m indica raight r he Ram	15 tes the numeric nac uni	1 add c for its c	RC, WC lress of rm (four an store	6 the ne r-bit c up to	155- 250 ext ins charac o twe	60 structio eters). lve mi	100- 250 on. T It is Ilion	ape re possib charac	1504 cords le to cters p	3 can b use th per un	v e wri ne 77- nit, of	tten i 4 Taj whic	$\sqrt{}$ in either pe Data ch there				
HONEYWELL H-400	\$8,700 A com word f can be	√ flexib e read	1-4K core having s ility, i.e., at a rate	some of 96	3 alpł 3,000	220µ e same habetic) digits	8 μ feature charac per see	64 ¹ es as th cters, t cond.	3 ne H welv	RW I-800. If ve decin	6 t offer nal cł	650 rs Ort naract	1000 hotron ers, ar	100 250 nic co nd 48	60 ount, n 3 bina	900 nagnet ry bits	3 tic tar s. Nui	pes, a meric	nd th info	ne same rmation				
GENERAL ELECTRIC 225	\$8,000 Doubl netical connec	√ e hyj lly er cted y	2-16K core 8-32K drur ohen pre- acoded d with a tra	20b n cision ocume ansmi	1 operents tter-p	40μ rations are av receive	20 μ are ir vailable er unit	15 55 neluded throu for cos	7 d as igh mm	MRWC part of 1200-do unication	64 the pocume n pur	400 instruent-per poses	100 1000 ction r-minu	100 reper ite so	60 rtoire. orter-re	600 Facili aders	3 ties fo . The	√ √ or ha	C Indlin puter	$\sqrt{\sqrt{\sqrt{2}}}$ mag- can be				
BURROUGHS 205	\$8,000 A com tape fo netic t	puter or up ape s	4K dru 80 fast system to one m ystem fea	m 10d with f nillion atures	l 1 200- add	1.7m buffere -charac ressabl	8.5m .85m ed and cter rec e block	6 edited cords, a cs.	1 car	none d input- a full pa	10 outpu aper-ta	300 at and ape sy	540 line p stem a	100 printe are fe	60 er. Inde atures	150 epend of thi	1 ent se is equ	v earch ipme	on m nt. Tl	$\sqrt{\sqrt{\sqrt{\gamma}}}$				
28 IBM 1401	\$7,500 A varia as an o charac with c	$\sqrt{1}$ able- off-line eter p	.4-16K core word leng e input-o er second tting.	gth co output l pape	21 ompu devi er-taj	230 µ ¹ iter usi ice for pe read	11.5μ ng vari the 70' der and	7.2-62 iable-le 70, 708 d outpu	1 30, a ut ty	none ¹ h instruct and 7090 ypewrite	10 etions) syste er are	800 . With ems. A avail	n the 1 Add tir able. M	250 403 ne as Magn	Chain sumes letic ta	600 Printe a five ape sta	3 er, this e-chara art tin	s syste acter ne ma	em ca field. ay be	an serve A 500- e shared				
29 RCA 301	\$5,000 A vari access featuri assume	√ able- is av ing fa es a fi	10-20K core word len ailable th ster spee ve-chara	gth, cl arough ds in a cter fie	2 hara hara diso arithi eld.	189 μ ¹ cter-ad c Reco metic a	7μ ldressal rd File and dat	7.5 ble sys s (up t a trans	2 tem o fiv fer o	RC, WC or RW featurin re, each operation	12 ng ma with a ns plu	600 gnetic a capa is float	100 tapes acity of ting po	100 with f 4.6 oint a	100 forwa million rithme	600 ard and a char etic is a	1 d reve acters also av	erse ro s). A s vailat	ead. I pecia ble. A	√ Random Il model .dd time				
DEC PDP-3	\$4,400 ⁵ A com (25 mi display	√ iputer icrose y unit	4-32K core which for conds co with lig	eature mplet ht per	1 es 51 e), an	10 μ 1 word nd the	5μ ls of ma memor	15 ain me ry is ex	4 mor apan	RC, WC y as ind idable to	128 ex reg 262,	gisters 144 w	400 s. The yords. A	mult An op	60 iplicat ptional	ion ra featu	511 te is 4 re is a	$\sqrt[]{40,00}$ a cath	I/C 0 per ode-r	second say tube				
IBM 305	\$3,600 ⁵ The co which sions a panel	ompu is av and c for fo	100 core 2000 drut ter has a ailable in haracter prmat cor	n ¹ 200- modu analys atrol.	2 instrules sis ar The	30m uction of five te usua "Stick"	10m capaci to 40 n illy ma " printe	15 ity dru million de thro er prin	1 ma cha ough ts o	RC, WC nd the a tracters the 30 ne chara	4 ability (avera 5 Cor acter a	125 y to ca age ac atrol I at a tir	20 60 all in a ccess ti Panel. ne.	100 200 additi me is Each	ional i s 250m i outpu	30-50 ¹ 150 nstruc n). Inp nt unit	0 etions out edi t has	from iting, a sep	I/C the c logic arate					
EL-TRONICS ALWAC III-E	\$3,600 ⁵ Two, t the op	hree	4-8K drun or four in on of the	n 33b nstruc comp	1 1 tions uter.	1m may b Magn	4m be conta letic ta	21 ained v pe unit	1 vith s ca	RC, WC in one w n be sea	16 vord. archec	100 Hexac l simu	200 lecima iltaneo	100 l not ously	60 ation r with c	150 nay be compu	1 e used ter op	l with perati	I/C lout a ons.) Iffecting				
AUTONETICS RECOMP II	\$3,000 A desl output fixed a	√ c-size t. The	4K disc 16 fast d compute 49 com pating po	40b ter wi mand int op	1 th m s are perati	9.5m 1.49m agnetic e store ions.	9m .95m c disc i d two	memor per w	y, co ord	ontrol co and fea	onsole ture s	e with square	400 decim e root	al re and	20 adout, absolu	and l te val	0 ogical lue in	v l echo struc	/ I/C o chee tions	o cking of in both				
34 RPC 9000	\$2,500 A com memor output culated	√ nputer ry con t unit d sea	72 dela susing m nsists of r s allow n rch rate.	n <mark>agnet</mark> nickel nutiple Renta	tic ta wire e-inp l inc	.23m ape loo e magn out-out cludes	.8m ops for etrostri put and one ma	521 extern ictive of d searc agnetic	15 al n lelay ch-or tap	MRWC nemory, y lines a n-conter pe unit.	120 each and is nt ope	400 loop s easil eration	60 500 storing y expans. The	g up andal e 52,	30 300 to one ble. Se 000 ch	150 1000 e milli eparate haracte	0 ion cl e buff ers pe	 haracters f er sec	I/C ters. or in ond i	$D \sqrt{\sqrt{1}}$ Internal put and is a cal-				
DEC PDP-1	\$2,200 ⁵ A para memor tape at	allel- α ry is nd ot	1-4K core circuit co expandat hers.	e 18b mpute ole to	1 er wi 28,6	10 μ hich fe 72 wo	5 μ eatures rds. Op	15 logica otional	2 1 ins dev	RC, WC struction ices inc	64 ns, tw lude a	elve a cath	400 types ode-ra	of sh iy tul	60 ifts, an be disp	nd ter blay w	0 n test vith lig	√ instr ght p	I/C ructio en, n	ons. The nagnetic				

	GENERAL	CHARACT	s IN	TERNAL SPEED	MA	GNE	TIC TAP	PE -	PERIF	PHERA	LEC	Outo	IENT	SPE	CIAL	FEAT	URES	
36	Average Monthly Rental Solid-State	Storage Capacity and Type	Word Size Instruction Addresses	Add Time	Average Access Time	Thousands of Char- acters per Second	Input-Output Channels	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Char- acters per Second	Cards per Minute	Paper Tape Char- acters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing Floating Point Arith.	Console Typewriter	Random Access File Random Inquiry
RPC 4000	\$ 1,8 00 v	8K drum	32b 1 ¹	1.0m	8.5m						60		30		1		I/O	
37	The last h repeat exe by one cor	alf of the i cution com nmand at h	nstructio mand wl igh spee	n wor hich al	d indica llows gro	tes the oups of	add fror	ress of t n one to	the r 128	next in succe	istruct essive v	ion. word	A des s to be	k-size e oper	d com ated o	puter on wit	featu hin n	uring a nemory
IBM 1620	\$1,600 \checkmark A variable resented b	20K core -word leng y two deci	1d 2 th comp mal digi	560 μ ¹ uter w ts. Ma	20 μ vith over gnetic ta	lapped apes m	1 mer ay be	nory ba e added	nks f . Ade	250 for ind d time	150 creased e assur	125 d spe nes a	15 eed. A	lphab charac	0 etic cl eter fie	harac eld.	I/O ters a	re rep-
BENDIX G-15	\$1,500 ⁵ One part of differential	2K drum 16 fast of instruction l analyzer a palog system	29b 1 ¹ on word tre availa	1.08m indica able. A	14.5m .54m tes addr Alphanur	.43 ess of meric in	1 next nput	RC, WC instructi -output	4 ion. is con	100 Magn mplet	400 etic ta ely but	100 pes, ffered	60 cards, 1. Spec	100 grapl cial ac	0 n plot ccessor	ters, a ries po	I/O and a ermit	digital on-line
39	\$1.500 ⁵		12h 1	12 8,,	6 4	15	1	none1	20	1300	350		60	1000	0		I/O	
160	A desk-siz The instru time may l	ed comput ction code a be shared w	er featu allows no vith com	ring p o addre puting	arallel c ess, direc	30 circuitr ct addr	y an ess, i	d versat indirect	tile i addr	nput- ess, a	output nd rela	capative	abiliti addre	es for ss mod	perip des. M	v heral lagne	equi tic tap	pment. pe start
PACKARD BELL	\$1,200 ⁵ \checkmark	1.8-16K delay	22b 1	24	1.5m	2	1	none	6		10		10		1		I/O	
41	The comm ment inclu tive delay	ands includ ides card eq lines.	e double juipmen	e-preci t and a	sion arit analog-to	hmetic o-digita	, vari 1 an	iable-len d digita	ngth l-to-a	multij analog	ply, di g conv	vide, erter	and s s. Inte	quare ernal s	root. storag	Perip e is n	heral nagne	equip- tostric-
RPC LGP-30	\$1,100 A desk-siz time. An o	4K drum ed compute scilloscope	31b 1 er featur displays	2.26m ¹ ring and conte	8.5m interlac nts of co	ced pat ontrol r	ttern egist	of word er, instr	d ado uctio	dresse on reg	200 s on tl gister,	he dr and a	20 rum, v	vhich ulator	0 reduc	es me	I/O emory	access
BURROUGHS E-101	\$900 A desk-size are option being mar	220 drum ed compute al. Simplici keted as the	12d 1 rusing p ty of pro e E-103.	50m pinboar ogrami)	10m d progra ming and	amming d opera	g. Mi ator c	ultiple p control a	oapei ire m	r-tape ajor c	20 input haract	and eristi	10 outpu cs of t	60 it and his eq	2 card uipme	input ent. (N	I/O t and Machi	output ne now
MONROBOT XI	\$700 $$ Limited rate any con	1K drum	ss inqui	9m ry is av	6m vailable	via the	e dru	m and o	one	15 or two	20 pape	15 er-tap	20 e loop	ps. Inj	put-ou	itput	I/O facilit	√ ties, up

EXPLANATION OF COLUMN HEADINGS

Average Monthly Rental: Rough approximation of what a customer might expect to pay for a complete system with basic peripheral equipment and tapes when available. With so many options available on every system, no precise standard of cost measurement is possible. The figures given should not be used for direct comparison of competitive equipments.

Solid-State: Checkmark indicates that the central system contains few, if any, vacuum tubes. Presumably this, in turn, implies greater reliability, smaller size, lower power requirement, and less heat generation than would be the case were vacuum tubes used.

Storage Capacity and Type: Number of words of addressable internal storage available, K representing "thousand" (e.g., "16-262K core" for the RCA 501 indicates that the internal storage consists of magnetic cores and that from 16,000 to 262,000 words are available at the user's option, a word in this case being a single alphabetic character as shown in the Word Size column). "Fast" indicates a serial-type, fast-access secondary storage, found primarily in drum computers.

Word Size: Number and type of digits comprising one word in storage. (a = alphanumeric, d = decimal, b = binary)

Instruction Addresses: Number of separate storage addresses in a conventional instruction.

Add Time: Time required to acquire and execute one add instruction, in millionths ($\mu = \text{microseconds}$) or thousandths (m = milliseconds) of a second. In the case of drum machines, where the add time is lower than the average access time, maximum optimization has been assumed. Average Access Time: Storage cycle time (including, for example, half of the drum revolution time in the case of drum storage) in millionths (μ) or thousandths (m) of a second.

Thousands of Characters per Second: Transfer rate from computer to tape or vice versa, measured in six-bit characters (one alphabetic, one decimal, or six binary digits) unless otherwise noted.

Input-Output Channels: Number of separate groups of magnetic tapes, usually with a separate buffer for each channel.

Buffering: Combinations of the three operations of reading magnetic tape (R), writing it (W), and computing (C), that can be performed simultaneously. MRWC indicates that multiple reading and writing is possible simultaneously with computing.

Maximum Tape Units: Maximum number of tape units connectable to and addressable by the computer, without regard to simultaneity.

Peripheral Equipment: Speed of each available punched card, punched tape, and printer equipment available. See footnotes for meaning of superscript numbers.

Special Features: Checkmark indicates that some form of the special feature in question is obtainable. In the case of index registers, the maximum available number of such registers is shown, while in the case of console typewriters, O and I/O are used to represent typewriters usable for output or both input and output. Floating point arithmetic can, of course, be programmed in any system in which it is not available as a built-in feature; only built-in features are marked here.