National

ELLIOTT

803

ELECTRONIC DIGITAL COMPUTER

FACTS FOR ENGINEERS

The 803 is a small, medium speed, digital computer flexible in application and economical to run. It need be switched on only when required for work, and is immediately available.

The machine is contained in a single cabinet 4 ft 8 in. high by 5 ft 6 in. wide by 1 ft 4 in. deep (144 × 168 × 41 cm.), weighing about 5¼ cwt (280kg). This cabinet is fitted with double doors at front and rear, and contains the entire control and arithmetic logic, the store and the power supply units. The power required by the basic machine with paper tape input and output equipment is less than one kilowatt, obtained from a single-phase 50 or 60 c.p.s. supply. Due to the low power consumption no special ventilation is necessary.

The 803 is a solid-state computer, and printed wiring has been used extensively in its construction. All plug and socket connections have gold plated contacts.

One word is read from the store or written into it in parallel, the time taken being one digit period, i.e. 6 microseconds. The logic is serial and so designed that the current instruction, the number in the accumulator and the address of the next instruction circulate within a single Operation Register of 120 digits length. During each cycle time (except in multiplication and division) the instruction and the other operand are successively copied from the store into the operation register, and either one operand or the result is stored after the function specified has been performed. Facilities are also provided for double-length working in multiplication and division.

The element which forms the basis of the complete logic design depends for its operation upon the rectangular hysteresis characteristic of ferrites, small toroidal wound cores of the material being used. Similar cores, threaded on wires and arranged in a 64 × 64 matrix, are used in the store to contain the same digit position of each of the 4096 locations. There are altogether 40 such matrix planes in the store. Core selection in each matrix is by a simple coincident current technique. Reading is inherently destructive, so that data to be retained in the store must be rewritten.

FACTS FOR PROGRAMMERS

Five-hole paper tape is used as the input and output medium for the basic 803, being read by the Elliott High-Speed Tape Reader at speeds up to 140 characters per second, or more in special cases, and punched on the Creed HS 25 Punch at up to 25 characters per second. Additional equipment is available to employ other input and output media, such as punched cards or 35 mm magnetic film.

The machine contains a set of fixed instructions by which a simple tape code may be read. The more elaborate input routines are read in by these fixed instructions as a preliminary to the input of programmes and data for particular tasks.

Fixed-point binary representation is standard, numbers being held in the range $-1 \leq x < +1$, with two's complement notation for negative numbers. Additional equipment is available for direct floating-point computation, without recourse to special subroutines.

A 39-bit serial word is used in the control and arithmetic parts of the machine, a 40th bit being included as a parity check in the 4096-word immediate access parallel store. Two single-address instructions occupy one word. By means of a single B-digit placed between the two instructions, the second instruction may be modified without loss of speed by adding to it the content of the location specified in the address portion of the first, wherever this location may be. Any instruction other than one specifying multiplication or division may be completely extracted, decoded and obeyed in one cycle time of 0·72 milliseconds. Multiplication and division take up to 29·5 milliseconds.

The keyboard of the basic machine carries three control keys and a number generator. The control keys enable the operator to start the machine, to cause it to stop in accordance with certain conditions, and to bring it under manual control. The number generator may be used as an input channel, as a source of instructions external to the store, as a set of programme switches, or as a method of selectively stopping the 803. A loudspeaker, driven from one of the control signals, is also provided, which indicates to the practised ear the progress of a computation.

FOR COMMERCIAL APPLICATIONS

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FOR SCIENTIFIC APPLICATIONS

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FACTS FOR USERS OF THE 803 ELECTRONIC DIGITAL COMPUTER

INSTRUCTION CODE

The contents of the accumulator and specified location are termed a (or C(A)) and n (or C(N)). a′ and n′ indicate these contents after the function has been performed.

Function	a′	n′	Function	a′	n′
00	a	n	20	a	a
01	−a	n	21	a	−a
02	n + 1	n	22	a	n − 1
03	a & n	n	23	a	a & n
04	a + n	n	24	a	a + n
05	a − n	n	25	a	a − n
06	0	n	26	a	0
07	n − a	n	27	a	n − a
10	n	a	30	n	n
11	−n	a	31	n	−n
12	n + 1	a	32	n	n + 1
13	a & n	a	33	n	a & n
14	a + n	a	34	n	a + n
15	a − n	a	35	n	a − n
16	0	a	36	n	0
17	n − a	a	37	n	n − a

Function	Operation
40, 44	Transfer unconditionally.
41, 45	Transfer if C(A) negative.
42, 46	Transfer if C(A) zero.
43, 47	Transfer if overflow indicator set and clear overflow indicator.

(40–43 transfer to the first instruction of a pair and 44–47 transfer to the second instruction.)

50	Halve, double-length.
51	Right shift C(A). Clear aux. register.
52	Multiply (double-length product).
53	Multiply (single-length product). Clear aux. register.
54	Double, double-length.
55	Double C(A). Clear aux. register.
56	Divide (double-length dividend, single-length quotient). Clear aux. register.
57	Read aux. register.
70	Read number generator.
71	Channel 1.
72	Channel 2.
73	Write the address of this instruction.
74	Punch specified character on Channel 1.
75	Channel 2.
76	Channel 2.
77	Channel 2.

803 TELECODE

Tape Punching	*Binary*	*Decimal*	*Character* *Figure Shift*	*Letter Shift*
·	00000	0	bl	
· o	00001	1	1	A
· o	00010	2	2	B
· oo	00011	3	•	C
·o	00100	4	4	D
·o o	00101	5	8	E
·oo	00110	6		F
·ooo	00111	7	7	G
o·	01000	8	8	H
o· o	01001	9	`	I
o· o	01010	10	,	J
o· oo	01011	11		K
o·o	01100	12	:	L
o·o o	01101	13	−	M
o·oo	01110	14	.	N
o·ooo	01111	15	"₀	O
o ·	10000	16	0	P
o · o	10001	17	(	Q
o · o	10010	18	)	R
o · oo	10011	19	3	S
o ·o	10100	20	?	T
o ·o o	10101	21	5	U
o ·oo	10110	22	6	V
o ·ooo	10111	23	/	W
oo·	11000	24	₀	X
oo· o	11001	25	9	Y
oo· o	11010	26	£	Z
oo· oo	11011	27	fs	
oo·o	11100	28	sp	
oo·o o	11101	29	cr	
oo·oo	11110	30	lf	
oo·ooo	111.1	31	ls	

FACTS FOR USERS OF THE 803 ELECTRONIC DIGITAL COMPUTER

POWERS OF 2 IN DECIMAL

2^n	n	2^{-n}
2	1	·5
4	2	·25
8	3	·125
16	4	·062 5
32	5	·031 25
64	6	·015 625
128	7	·007 812 5
256	8	·003 906 25
512	9	·001 953 125
1 024	10	·000 976 562 5
2 048	11	·000 488 281 25
4 096	12	·000 244 140 625
8 192	13	·000 122 070 312 5
16 384	14	·000 061 035 156 25
32 768	15	·000 030 517 578 125
65 536	16	·000 015 258 789 062 5
131 072	17	·000 007 629 394 531 25
262 144	18	·000 003 814 697 265 625
524 288	19	·000 001 907 348 632 812 5
1 048 576	20	·000 000 953 674 316 406 25
2 097 152	21	·000 000 476 837 158 203 125
4 194 304	22	·000 000 238 418 579 101 562 5
8 388 608	23	·000 000 119 209 289 550 781 25
16 777 216	24	·000 000 059 604 644 775 390 625
33 554 432	25	·000 000 029 802 322 387 695 313
67 108 864	26	·000 000 014 901 161 193 847 656
134 217 728	27	·000 000 007 450 580 596 923 828
268 435 456	28	·000 000 003 725 290 298 461 914
536 870 912	29	·000 000 001 862 645 149 230 957
1 073 741 824	30	·000 000 000 931 322 574 615 479
2 147 483 648	31	·000 000 000 465 661 287 307 739
4 294 967 296	32	·000 000 000 232 830 643 653 870
8 589 934 592	33	·000 000 000 116 415 321 826 935
17 179 869 184	34	·000 000 000 058 207 660 913 467
34 359 738 368	35	·000 000 000 029 103 830 456 734
68 719 476 736	36	·000 000 000 014 551 915 228 367
137 438 953 472	37	·000 000 000 007 275 957 614 183
274 877 906 944	38	·000 000 000 003 637 978 807 092
549 755 813 888	39	·000 000 000 001 818 989 403 546
1 099 511 627 776	40	·000 000 000 000 909 494 701 773

SOME USEFUL CONSTANTS

π	= 3·141 592 653 590	$1/\pi$	= 0·318 309 886 184
$\log_{10} e$	= 0·434 294 481 903	$\log_e 10$	= 2·302 585 092 994
$\log_{10} 2$	= 0·301 029 995 664	e	= 2·718 281 828 459
$\sqrt{2}$	= 1·414 213 562 373	$\sqrt{3}$	= 1·732 050 807 569
1 radian	= 57·295 779 513 082	1	= 0·017 453 292 520 radian

MULTIPLES OF 64

The purpose of this table is to assist in the setting of binary addresses on the number generator keys. Select the highest multiple of 64 less than the required address and set the six most significant address keys to the binary equivalent of the corresponding factor. Set the six least significant address keys to the binary equivalent of the residue (required address minus highest multiple) which is taken from the column of factors.

Factor	*Binary equivalent*	*Multiple*	*Factor*	*Binary equivalent*	*Multiple*
1	000001	64	33	100001	2112
2	000010	128	34	100010	2176
3	000011	192	35	100011	2240
4	000100	256	36	100100	2304
5	000101	320	37	100101	2368
6	000110	384	38	100110	2432
7	000111	448	39	100111	2496
8	001000	512	40	101000	2560
9	001001	576	41	101001	2624
10	001010	640	42	101010	2688
11	001011	704	43	101011	2752
12	001100	768	44	101100	2816
13	001101	832	45	101101	2880
14	001110	896	46	101110	2944
15	001111	960	47	101111	3008
16	010000	1024	48	110000	3072
17	010001	1088	49	110001	3136
18	010010	1152	50	110010	3200
19	010011	1216	51	110011	3264
20	010100	1280	52	110100	3328
21	010101	1344	53	110101	3392
22	010110	1408	54	110110	3456
23	010111	1472	55	110111	3520
24	011000	1536	56	111000	3584
25	011001	1600	57	111001	3648
26	011010	1664	58	111010	3712
27	011011	1728	59	111011	3776
28	011100	1792	60	111100	3840
29	011101	1856	61	111101	3904
30	011110	1920	62	111110	3968
31	011111	1984	63	111111	4032
32	100000	2048	64	000000	4096