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Front Sheet.
Data Sheets 1 - 2
Figure sheet S6/10116

DEUCE Subroutine No. 44 (S03D)

Report by

G.J. Hutton.

SUMMARY.

The attached document contains the working details of a DEUCE subroutine which forms the double length sum of a series in ascending powers of a variable, given a specific double length value of the variable and the double length coefficients of the series.

The subroutine was prepared and tested at N.R.L.

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Description.

Forms the double length sum $\sum_{r=0}^{n-1} a_r x^r$, a_r and x_r double length.

The n double length coefficients are stored consecutively, starting with a_o in A_{t}, $_{t+1}$ (t even), overflowing into successive delay lines if necessary, Of third order, using M10D and B01, it employs the method of nested multiplication and is compactly coded.

Data.

n double length coefficients $a_o \dots a_{n-1}$

x the double length variable

p the number of binary places in x ($32 \leqslant p \leqslant 64$)

Result.

$c = a_o + a_1x + a_2x^2 + \dots a_{n-1}x^{n-1}$ given to the same number of binary places as the coefficients.

Instructions for Use.

Stores Used.	13	14	15	16	17_1	17_2	17_3
Contents at Entry.	Link	-	-	-	tP_{17}	$2(n-1)P_{17}$	I_o
Contents at Exit.	-	-	-	-	tP_{17}	zero	I_o

Stores Used.	19_2	19_3	20	21
Contents at Entry.	-	-	x	-
Contents at Exit.	-	zero	x	c

Occupies.

D.L.C m.c's 6,9,12,15-25 with M10D in D.L.B m.c's 0-31 and D.L.C m.c's 7,8,10,11,13,14 and B01 in D.L.1 m.c's 16,21, 23-28

Entry.

m.c.16

Time.

(2+Time of M.10D)(n-1)+$2\frac{1}{2}$m.s.
Add n m.s. if coefficients in more than one delay line.
In both cases add 1 m.s. for each coefficient outside the range m.c. 0-5.

Time of M10D	
$p = 64$	14 m.s.
$47 \leqslant p \leqslant 63$	16 m.s.
$p = 46$	17 m.s.
$32 \leqslant p \leqslant 45$	18 m.s.

Parameters.

tP_{17} in 17_1

$2\ (n-1)\ P_{17}$ in 17_2

(I_o) C, A-22 d 0, 6 in 17_3

D.L.B		$32 \leqslant p \leqslant 47$	$48 \leqslant p \leqslant 63$	$p = 64$
	m.c. 7	$22P_{10} + P_{17}$	$22P_{10} + (2p-95)P_{17}$	$21P_{10}$
	m.c. 9	$22P_{10} + (2p-59)P_{17}$	$21P_{10}$	$21P_{10}$
	m.c.17	$22P_{10} + P_{17}$	$22P_{10} + (2p-95)P_{17}$	$21P_{10}$
	m.c.19	$22P_{10} + (2p-61)P_{17}$	$21P_{10}$	$21P_{10}$
D.L.C	m.c.21	$3P_{26}$ or P_{26}	according as coefficients in one delay line only or more than one delay line.	
	m.c.25	BP_2		

Constants available. Waste Instruction 1, 0-0, 0, 10 in D.L.C m.c. 20.

2nd Edition.

D.L. C Track

Card Nos.

mc	NIS	S	D	C	W	T	
							Y
							X
							0
							1
0							2
1							3
2							4
3							5
4							6
5							7
6	C	17	13		2	4	8
7							9
8							Y
9	C	30	13		0	4	X
10							0
11							1
12	C	28	26	2	0	3	2
13							3
14							4
15	C	17	25	2	0	1	5
16	C	30	21	2	0	5	6
17	C	13	27		0	0	7
18	C	13	14		0	1	8
19	C	13	17		1	1	9
20	1	0	0		0	10	Y
21	1	17	13		0		X
22	C	C	13		0	1	0
23	C	13	1		7	16	1
24	C	30	13		0	14	2
25	B	21	19	2	0	2	3
26							4
27							5
28							6
29							7
30							8
31							9

C_{16} 30 - $21_{2,3}$ $q_n = 0$

C_{23} 13 - 1_0

C_9 30 - 13

C_{15} $17_{1,2}$ - 25 Form $(t+2N)$ P17 and

C_{18} 13 - 14 use to fetch a_N

C_{21} 17_3 - 13 $(N = n-1$ initially).

$\boxed{8.01}$

1_{24} or 1_{26}

Q_{30} $A_{t+2N,\, t+2N+1} - 22$ Form $q_N = a_N + x q_{N+1}$

C_6 17_2 - 13

C_{12} 28 - 26 (2m.c.) $\}$ $2N \rightarrow (2N-2)$ P17

C_{17} 13 - 27 $2N - 2 <$ zero?

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C_{20} 0 - 0

1_0

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C_{19} 13 - 17_2

C_{22} C_{24} - 13 [C 30 - 13 0 14]

C_{25} 21 - $19_{3,2}$ Plant q_N

B_{29} $\boxed{\text{M10.D}}$ Form xq_N

1_{31} (C_{24} 30 - 13)

NOTE. If $q_{n-1} = a_{n-1}$ and $q_{r-1} = a_{r-1} + x q_r$ $(1 \le r \le n-1)$

then $q_{n-2} = a_{n-2} + x a_{n-1}$

$q_{n-3} = a_{n-3} + x(a_{n-2} + x a_{n-1})$

and finally $q_0 = a_0 + x(a_1 + x a_2 + \cdots\cdots + x^{n-2} a_{n-1})$.

FLOW DIAGRAM AND CODING FOR SUBROUTINE NO 44 (S.03.D). Double Length Sum Series.

Date

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