Z.501/22

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NELSON RESEARCH LABORATORIES
STAFFORD
MATHEMATICS DEPARTMENT.

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Report No. NS t 260
Date 25.11.58.
Reference
Order No.

Front Sheet.

Data Sheets 1 - 2

Figure Sheets S6/11522-3 incl.

DEUCE Subroutine No. 290 (R21T/1).

Report by
M.R. Wetherfield.

SUMMARY.

The attached document contains details of a DEUCE Subroutine which has been prepared and tested by N.R.L. Blackheath.

M.R. Wetherfield

MATHEMATICS DEPARTMENT.

HEF

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NS t 260
Sheet No.: 1.

Description.

Reads six signed or unsigned nine digit decimal integers from a card, converts them to binary and stores them in the first six successive minor cycles of D.L. 4.

This subroutine uses slightly less storage space and less time after the last-row single shot than R21T.

First order.

Data.

Six decimal integers per card.
Signs (if any) in card cols. 17, 27, 37, 49, 59, 69.
Decimal digits in card cols. 18-26, 28-36, 38-46, 50-58, 60-68, 70-78.

NOTE: The subroutine tests for correct punching of signs by subtracting the sum of the Y and X rows of the β field from the corresponding sum for the α field. The numbers may therefore be read in all unsigned. A number is read as negative if and only if there is an X punched in the appropriate card column.

Uses. Automatic instruction modifier.

Result. Six integers converted to binary and stored in 4_{0-5}.

Failure. 3, 12-24X Card non-decimally punched (see note under Data).
Single shot to read corrected card.

Instructions for Use.

Stores Used.	13	14	15	16	17	18	19	20	21	TCB
Contents at Entry.	LINK	-	-	-	-	-	-	-	-	OFF
Contents at Exit.	-	-	-	ZERO	-	-	-	-	ZERO	OFF

Occupies. D.L.'s 2, 3, 4_{0-5} (for results) and 4_{21-31}.

D.L. $10_{1, 3, 5, 7, 9, 25, 27, 29, 31}$.

Entry. 3_{23}.

Time. $1\frac{5}{8}$ M.s. after last row single shot.

Waste Instruction. 1, 8-8, 0,2 in 3_{26}.

Constants Available.
$P_{2-10, 12-20, 22-30}$ in 3_5. $P_{4-12, 14-22, 24-32}$ in 3_6.
P_{1-8} in 3_{19}. $-999999999\ P_1$ in 3_{28}
P_{25} in 10_{25} $5P_{27}$ in 10_{27},
5^2 P.29 in 10_{29} } Digits in excess of single length
5^3 P.31 in 10_{31} } inserted x P1 at least significant end.
5^4 P.1 in 10_1 5^5 P.3 in 10_3 5^6 P.5 in 10_5
5^7 P.7 in 10_7 5^8 P.9 in 10_9

NOTES: (i) The subroutine leaves the reader called. It may be cleared by using the waste instruction in 3_2 6.

(ii) The subroutine cannot be expected to give the right answer if it is one-shotted through.

Method. Negative numbers are converted to binary by forming their nines complement and subtracting 999999999 from the result.
Positive numbers are converted in an orthodox manner. The conversion itself is made by operating TCA in conjunction with the multiplier, in order to multiply successive row digit patterns by appropriate powers of 10.

November, 1959.

D.L. 2 Track

Card Nos.

D.L. 3 Track

Card Nos.

mc	NIS	S	D	C	W	T		mc	NIS	S	D	C	W	T		
																Y
																X
																0
																1
0	2	26	21		0	0		0	3	3	18		0	29		2
1	2	3	24		0	7		1	4	21	32	1	1	20		3
2	3	18	15		1	6		2	2	16	4		6 (5)	4		4
3	2	3	21	2	0	1		3	3	0	21		1	2	X	5
4	2	21	22	1	0	17		4	3	0	21		1	2		6
5	2	20	13		0	0		5	P_2	-10, 12-	20,		22-30			7
6	2	17	23	2	0	1		6	P_4	-12, 14-22,			24-32			8
7	2	21	19	2	3	4		7	4	21	25		1	22		9
8	3	21	25		2	3		8	4	21	26		1	11		Y
9	2	21	18	2	1	22		9	2	21	18		0	1		X
10	2	0	14		0	2	X	10	3	0	14		0	0		0
11	2	18	21		2	3		11	3	22	14		1	3		1
12	3	3	18		0	1		12	2	26	31		1	1		2
13	2	19	14		0	3		13	2	22	14		0	5		3
14	4	24	14	2	0	6		14	2	20	4	2	6 (2)	11		4
15	3	2	24		0	0		15	2	18	21		0	0		5
16	2	17	18		1	1		16	3	23	17		1	2		6
17	2	3	15		0	0		17	3	21	18	2	1	3		7
18	2	25	25		0	1		18	3	17	23	2	0	1		8
19	2	0	24		0	3		19		P_{1-8}						9
20	2	25	25		0	0		20	3	21	22	1	0	19		Y
21	4	23	21		0	1		21	3	21	28	2	0	1		X
22	4	13	20		0	1		22	3	21	22	1	0	19		0
23	2	21	27		0	0		23	3	12	24		0	2		1
24	4	30	21		0	1		24	3	30	16		0	0		2
25	2	30	16		0	1		25	2	9	24		0	0		3
26	2	3	16		0	0		26	1	8	8		0	2		4
27	3	12	24		0	1	X	27	3	13	1		1	1		5
28	$6P_1$	15	0	1	0	0		28	1,	16, 13, 10,		6,	2, 3,			6
29	2	13	20		0	0		29	2	21	11	2	1	5		7
30	2	18	15		0	0		30	3	0	13		0	0	X	8
31	2	20	13		1	7		31	3	0	26		2	2		9

3_{28} 12 - 24

3_{27} 13 - 1_{30}

$\rightarrow 3_{30}$ 0_{α} - 13 X

3_{0} 3_{2} - 18_{2}

3_{31} 0_{β} - 26

3_{3} 0_{α} - 21_{2} X

3_{7} 21_{2} - 25

4_{31} 21 - 22 (e, o, e,) (Shift α-field up 2 places)

3_{4} 0_{β} - 21_{3}

3_{8} 21_{3} - 26

4_{21} 13 - 28 (Signs punching check.)

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4_{24} 9 - 24

2_{27} 12 - 24 X

4_{28} 21 - 20 (d) Negative signs (α field shifted up two places)

3_{1} 21 - 22 (20m.c's) } Form digit pattern NOT

4_{23} 20 - 23 (4m.c's) } (0's for positive numbers. 1's for negative numbers)

3_{29} 21 - $17_{0,1}$ Store final pattern.

$\rightarrow 2_{4}$ 21 - 22 (18m.c's)

2_{23} 21_{3} - 27 Is number positive?

yes + / - NO

2_{25} 30 - 16 2_{26} 3_{28} - 16 (−999999999)

Sign Correction

2_{28} (6P₁) 18_{2} - 0 1 (−P₁₇, P₂₂)

Q_{30} (3_{2}) 16 - $4_{5,4,3,2,1,0}$ (Set initial values)

Spill after 16-4_0

2_{3} $3_{5,6}$ - 21 ($P_{4-12, 14-22, 24-32, 34-42, 44-52, 54-62}$)

2_{6} $17_{0,1}$ - 23 Form starting pattern.

2_{9} 21 - $18_{0,1}$

2_{1} 3 - 24

2_{10}

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DEUCE Subroutine No. 290 (R21T/1)

Read 6 Signed or Unsigned Nine-Digit Decimal Integers.

Date

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D.L. 4	Track					
Card Nos.						

mc	NIS	S D	C	W	T	
0		α_1				
1		α_2				
2		α_3				
3		β_1				
4		β_2				
5		β_3				
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21	4	13 25		0	5	
22	2	4 17		6	6	
23	3	10 23	1	1	4	
24	4	20 21		0	0	
25	7P1	18 0	1	3	3	
26	2	14 25		0	1	
27	11P1	17 0	1	1	1	
28	3	21 20	2	0	3	
29	2	9 24		0	28	
30	2	4 20	2	6	5	
31	3	21 22	1	1	3	

D.L. 10	Track						
Card Nos.							

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

$2_1 \rightarrow 2_{10}$ 0_α - 14 X

2_{14} 24 - 14 (d) (Shift α field up two places)

4_{22} 4_{30} - 17_2

2_{30} 18_0 - 15

2_0 20 - 21_2

2_1 18_1 - 15

3_{10} 0_β - 14

3_{12} 26 - 21_3

2_{15} 2 - 24

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3_{18} $17_{0,1}$ - 23 (Subtract final digit pattern)

3_{21} 21 - 28 (d) (Decimal punching check)

NZ

3_{25} 9 - 24

2_{27} 12 - 24 X

3_{30}

Z

3_{24} 30 - 16 (Clear T.C.A.)

3_{26} Waste

1_{30} LINK

3_{17} 21 - $18_{0,1}$

3_{22} 21 - 22 (20 m.c.)

3_{11} 22_2 - 14

3_{16} 23 - 17_3 (3rd multiplier)

3_{20} 21 - 22 (20m.c.)

3_9 21_3 - 18_3 (2nd multiplier)

2_{12} 3_{14} - 18_2

3_5 18_1 - 21_3 (1st multiplier)

2_{17} 3_{14} - 15 (P_1-8)

2_{19} 0 - 24 (m.c. 21)

2_{24} 30 - 21_2 (m.c. 26)

4_{27} 17_2 - 0 (d) (-P.18) ($11P_1$)

Q_{30} $4_{4,5}$ - 20 (4_{30})

2_5 20_3 - 13 Partial sum

2_7 21 - 19 (d) Extract partial product (m.c.12,13) and shift up multiplier.

2_{13} 19_3 - 14

2_{18} 25 - 25

2_{21} 23 - 21_3 (m.c.23) Replace multiplier for 2nd half of multiplication

4_{24} 30 - 21_2 (m.c.26)

4_{26} 19_2 - 25

2_{29} 13 - 20_3 New partial sum

2_{31} 20_2 - 13 Partial sum

2_8 21_2 - 25 (mc.12) } Extract partial product.

3_{13} 22_3 - 14 (m.c.15) }

2_{20} 25 - 25

2_{23} 13 - 20_2 New partial sum.

4_{25} 18_2 - 0 d (-P18, 22) ($7P_1$)

Q_{30} 20 - $4_{4,5}$ (3_{14})

(3) (1,2.)

Spill after
20 - $4_{0,1}$

2_{11} 18_3 - 21_3 (New multiplier)

2_{16} 17_3 - 18_3 (Replace 2nd by 3rd multiplier)

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Read 6 Signed or Unsigned Nine-Digit Decimal Integers.

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