TITLE   Square Root (DOI or SADOI)

TYPE   Closed

NUMBER OF WORDS   9

TEMPORARY STORAGE 0, 1, 2

ACCURACY $\pm 2^{-39}$

DURATION   1.3 n milliseconds, where n is defined by

$$[(1 - \sqrt{a}) / (1 + \sqrt{a})]^{2n} < 2^{-39}$$

DESCRIPTION   The argument a may consist of 39 digits or of 78 digits. The sign and 39 most significant digits should be in A but may be in address 1 if the routine is entered at the right hand side of the first word instead of at the normal left hand side. The 39 least significant digits (if any) must be in address 0.

The program uses Newton's method by means of the relations

$$x_0 = a/2 + 1/2$$

$$x_{n+1} = x_n + [a/x_n - x_n] / 2$$

and convergence is assumed to have occurred when

$$(a/x_n) - x_n = 2 (x_{n+1} - x_n) \geq 0.$$

NOTE   The Illiac will stop if $a < 0$ or if $a = 1 - 2^{-39}$.

LOCATION	ORDER		NOTES
	OOK (R1)		
0	40 1F		Store a
	K5 F		
1	42 8L		Plant link
	51 1F		
2	10 1F		$x_0 = a/2 + 1/2$
	SJ F		
3	40 2F	From 7	to 2F
	50 F		
4	L5 1F		a to A and Q
	66 2F		
5	S5 F		
	LO 2F		$x_{n+1} - x_n$ to A
6	10 1F		
	36 8L		End test
7	L4 2F		
	26 3L		Re-enter loop
8	L5 2F		$\sqrt{a}$ to A
	22 F	by 1	Link