ELLIOTT 903

Volume 2: PROGRAMMING INFORMATION

Part 2: PROGRAM DESCRIPTIONS

Section 7: QSQRT(B6)

Contents

Chapter 1: DESCRIPTION

1.1 INTRODUCTION

1.1.1. Purpose.

QSQRT(B6) is used to calculate the single-length square-root of a single-length or double-length fraction.

1.1.2 Form of Distribution.

The program is distributed as a machine-code program for input by Elliott SIR or by T2.

1.1.3 Method of Use.

QSQRT is assembled as a block of the user's program and entered as a sub-routine. It may be run at any program-level and in any store-module.

Two entry points are provided for single-length and double-length working.

1.1.4 Accuracy.

The maximum error is $\pm 2^{-17}$.

1.1.5 Notation.

The operand is denoted by a and, if the operand is double-length, the most significant half is denoted by a (m. s.), and the least significant half by a (l. s.).

1.2 FUNCTIONS

1.2.1 Entry and Exit.

1.2.1.1 Double-length Working.

			For (SIR)	For (T2)
Entry	Place a (l. s.)	in	QSQRT+3	3;N
	Place a (m. s.) in the accumulator			
	Place link	in	QSQRT	0;N
	Jump to		QSQRT+1	1;N
Exit	The result is held, single-length, in the accumulator			
	and also in		QSQRT+45	45;N
	a (m. s.) is in		QSQRT+4	4;N
	a (l. s.) is in		QSQRT+3	3;N

1.2.1.2 Single-length Working

Entry	Place a in the accumulator		
	Place link in	QSQRT	0;N
	Jump to	QSQRT+2	2;N
Exit	The result is held, single-length, in the accumulator		
	and also in	QSQRT+45	45;N
	a is in	QSQRT+4	4;N

1.2.2 Identifiers.

In a SIR program, QSQRT must be declared as a global identifier in all blocks which refer to it. On the library tape, a mnemonic label and identifier list are separated from the coding by several inches of blank tape. The mnemonics must not be loaded into the tape-reader if the tape is to be translated by T2.

1.3 ERROR INDICATION

If a<0 then - is output continuously.

1.4 METHOD USED

1.4.1 General Case.

The single-length entry causes +0 to be held as a(l. s.).

QSQRT uses Newton's method to calculate the square-root of a double-length number. The formula used for iteration is

$$X_{n+1} = \tfrac{1}{2}(X_n + a/X_n)$$

If $a < 2^{-17}$ then $X_o = \sqrt{2^{-17}}$

If a 2^{-17} then $X_o = 1 - 2^{-17}$

When X_{n+1} X_n then X_n is the best approximation to a

1.4.2 Special Cases

If $a = 0$ then $\sqrt{a} = 0$

If a $1-2^{-17}$ then $\sqrt{a} = 1-2^{-17}$

1.5 TIME TAKEN

(The time for the single-length entry is in brackets).
If the final approximation (see Paragraph 1.4) is X_n then the time taken is 680(805)+375n microseconds
The maximum time is 5.3(5.5) milliseconds
If a=0 the time taken is 250(375) microseconds
If $a \geq 1-2^{-17}$ the time taken is 300(450) microseconds.

1.6 STORE USED

52 consecutive locations and the appropriate B register.