ELLIOTT 900

Volume 2: PROGRAMMING INFORMATION

Part 2: PROGRAM DESCRIPTIONS

Section 15: QDASIN (B.104A)

Contents

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Chapter 1: INTRODUCTION

1.1 Purpose

To calculate, as double-length fractions,

$$\tfrac{1}{2} \sin \pi x$$

and

$$\tfrac{1}{2} \cos \pi x$$

where x is a double-length fraction.

1.2 Form of Distribution

The program is distributed as a SIR mnemonic tape.

1.3 Method of Use

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

When QDASIN is used, QDLA must also be held in store.

1.4 Accuracy

The maximum error is $2^{-31}(0.5 \times 10^{-9})$.

Chapter 2: FUNCTIONS

2. 1 Notation

x(m. s.) = most significant half of x
x(l. s.) = least significant half of x

A fraction $x = \frac{1}{2}(n+y)$
such that n is an integer and

$-\frac{1}{2} \leq y < +\frac{1}{2}$

$Z = \tan(\pi y/4)$
$S = \frac{1}{2}\sin(\pi y/2)$
$C = \frac{1}{2}\cos(\pi y/2)$

2. 2 Format

A double-length number, x, is held in two consecutive store locations, X and X+1:

Bit 18 of X+1 must be zero;
Bit 18 of X gives sign of x;
Bits 17-1 of X give 17 most significant numerical bits of X;
Bits 17-1 of X+1 give 17 least significant numerical bits of X;

Negative number representation is by the usual 2's complement notation (except that bit 18 of X+1 must be zero).

2. 3 Number Type

The operand, x, and the result must be treated by the programmer as pure fractions.

To enable this to be done, QDASIN calculates

$\frac{1}{2}\sin \pi x$ and $\frac{1}{2}\cos \pi x$

Note: therefore, that x is the value of an angle as a fraction of π radians (180^{o}).

2.4 Entry and Exit

A double-length number is held in two consecutive store-locations, the description below gives only the first of the two.

Entry (for assembly by SIR)

place x in QDASIN+98
and x(m.s.) in the accumulator
and enter 11 QDASIN
8 QDASIN+1

Exit $\frac{1}{2}$ sin π x in QDASIN+102
and in QDLA+16
$\frac{1}{2}$ cos π x in QDASIN+104

N.B. The instruction pair 11 QDASIN
8 QDASIN+1
must not be part of a pseudo-program interpreted by QDLA.

2.5 Identifiers

QDASIN must be declared as a global identifier in all blocks of a SIR program which refer to it.

Chapter 3: METHOD USED

QDASIN uses QDLA to interpret some of the double-length calculations.

a) The program computes

$$z = \frac{4y}{4-y^2} P(y^2)$$

where P is a power series which converges rapidly when y is in the defined range.

b)

$$S = \frac{Z}{1+Z^2}$$

$$C = \frac{1}{2}\frac{(1-Z^2)}{(1+Z^2)}$$

and the values are found according to the table below.

n	$\frac{1}{2}\sin \pi x$	$\frac{1}{2}\cos \pi x$
-2	-S	-C
-1	-C	S
0	S	C
+1	C	-S

Chapter 4: TIME TAKEN

The time taken is approximately 50 milliseconds.

Chapter 5: STORE USED

QDASIN uses 106 consecutive locations.