

ELLIOTT

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Volume 2: PROGRAMMING INFORMATION
Part 2: PROGRAM DESCRIPTIONS
Section 16: QDAATAN (B. 105A)

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Chapter 1: INTRODUCTION

1. 1 Purpose

To calculate, as a double-length fraction

$$t = \frac{1}{\pi} \tan^{-1} (x/y)$$

and $b = \frac{1}{2\pi}$ true bearing,

where x, y are double-length fractions.

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 entered as a sub-routine. It can be run at any program level and in any store-module.

When QDAATAN is used QDLA must also be held in store.

1. 4 Accuracy

The maximum error is 2^{-34} (0.6×10^{-10})

Chapter 2: FUNCTIONS

2. 1 Notation

$x(m. s.)$ = most significant half of x
 $x(l. s.)$ = least significant half of x
 x, t are as defined in 1. 1

2. 2 Format

A double-length fraction, x , is held in two consecutive store locations, X and $X+1$.

Bit 18 of X gives the sign of x
 Bits 17-1 of X give the 17 most significant bits of x
 Bit 18 of $X+1$ must be 0
 Bits 17-1 of $X+1$ give the 17 least significant bits of x .

Negative number representation is by the usual 2's complement notation (except that bit 18 of $X+1$ must be 0).

2. 3 Number Type

All numbers must be treated by the programmer as pure fractions.

To enable this to be done QDAATAN calculates

$$t = (1/\pi) \tan^{-1} (x/y)$$

Note, therefore, that t is the value of an angle as a fraction of π radians (180°).

2. 4 Entry and Exit

A double-length number occupies two consecutive locations; only the first is given below.

Entry (for assembly by SIR)

Place x in	QDAATAN+136
y in	QDAATAN+138
and enter	11QDAATAN
	8QDAATAN+1

Exit

t in QDAATAN+142
b in QDAATAN+146
b(m. s.) in the accumulator

Note. The true bearing is found by taking
x along the easterly axis
y along the northerly axis

and measuring the angle in a clockwise direction.

N. B. The instruction pair must not form part of a pseudo-program interpreted by QDLA.

2. 5 Identifiers

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

Chapter 3: ERROR INDICATION

If $x=y=0$
then 00000.001 is output continuously.

Chapter 4: METHOD USED

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

- a) The program computes

$$a = \begin{cases} |x/y| & \text{if } |x/y| < 1 \\ |y/x| & \text{if } |x/y| \geq 1 \end{cases}$$

and applies the transformation

$$z = \frac{a - (\sqrt{2} - 1)}{(3 - 2\sqrt{2})a + (\sqrt{2} - 1)}$$

Note $|z| < 1$

- b) $s = 1/\pi \tan(\sqrt{2}-1)z$

is calculated by a Chebyshev series.

- c) The final result is found by forming

$$u = (1/\pi) \tan^{-1} |x/y| = \begin{cases} \frac{1}{s} + s & \text{for } |x| < |y| \\ \frac{1}{2} - (\frac{1}{s} + s) & \text{for } |x| \geq |y| \end{cases}$$

and t is found according to the table below

	$y \geq 0$	$y < 0$
$x/y \geq 0$	u	$u-1$
$x/y \leq 0$	$1-u$	$-u$

and $b = \begin{cases} \frac{1}{2}t & \text{if } x \geq 0 \\ \frac{1}{2}t+1 & \text{if } x < 0 \end{cases}$

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Chapter 5: TIME TAKEN

Approximately 42.4 milliseconds.

Chapter 6: STORE USED

QDAATAN uses 167 consecutive locations and the appropriate B-register.