

A Complex Arithmetic Package  
For the 3300-FORTRAN Library

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A COMPLEX ARITHMETIC PACKAGE  
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3300-FORTRAN does not do complex arithmetic. It does, however, provide for "type-other variables". These variables may have any definition that a programmer wants, provided sub-routines to perform the necessary operations are provided. The complex arithmetic package (CAP) makes use of these features of 3300-FORTRAN. Refer to pp. C-3 and C-4 of CDC publication No. 60057600, Rev. B, for an explanation of the use of type-other variables.

A complex number in CAP is a pair of floating-point numbers occupying consecutive storage locations. The first two words are the real part and the second two words are the imaginary part. All complex numbers must appear in a TYPE statement. So must all functions whose returned values are complex. Some examples are:

```
TYPE COMPLEX (4)           X,Y,I,CEXP,CLOG
TYPE CO(4)                 J3,CCOS,CSIN,CCOSH,CSINH
```

All the necessary routines to load, store, negate and mix modes in standard arithmetic expressions are provided except for the complex-to-character subroutines. The entry points in CAP are:

|         |         |         |         |
|---------|---------|---------|---------|
| R.PART  | I.PART  | CO.EXOO | CO.EXOI |
| CO.EXOR | CO.EXIO | CO.EXRO | CO.DVOO |
| CO.DVOI | CO.DVOR | CO.DVIO | CO.DVRO |
| CO.MUOO | CO.MUOI | CO.MUOR | CO.MUIO |
| CO.MURO | CO.SBOC | CO.SBOI | CO.SBOR |
| CO.SBIO | CO.SBRO | CO.ADOO | CO.ADOI |
| CO.ADOR | CO.ADIO | CO.ADRO | CO.STOO |
| CO.STOI | CO.STOR | CO.STIO | CO.STRO |
| CO.CMOO | CO.LNOO | CO.LDOO |         |

|        |       |       |        |
|--------|-------|-------|--------|
| ARCTAN | COMP  | EXPI  | NORM2  |
| CCOS   | COSH  | IM    | XNORM2 |
| CCOSH  | CSIN  | IMAG  | RAD    |
| CEXP   | CSINH | XIMAG | RE     |
| CLOG   | CSQRT | NORM  | REAL   |
| COM    | DIR   | XNORM | SINH   |
| CONJ   |       |       |        |

All the entries in the first group (ones with . in them), are standard except R.PART and I.PART. These two entries are actually the complex accumulator. The rest of the entries are functions to facilitate programming. These functions are described in the rest of this report.

#### ARCTAN

This is a real valued function of two real arguments. The results are ATAN(ARG2/ARG1) in radians, but in the proper quadrant.

#### CCOS

This is the complex cosine of a complex argument.

#### CCOSH

See CSINH

#### CEXP

This is the complex exponential of a complex argument.

#### CLOG

This is the complex log of a complex argument.

$CLOG(X) = ALOG(\sqrt{RE(X)^2 + IM(X)^2}) + COM(RAD(X))$

#### COM

This must be declared COMPLEX. COM(ARG) leaves in the complex accumulator a number in the form  $0+iARG$ . ARG should be REAL.

#### CONJ

This gives the conjugate of a complex number. It is equivalent to  $\text{COMP}(\text{RE}(X), -\text{IM}(X))$  in function.

#### COMP

This must be declared COMPLEX. A function of two real arguments  $\text{COMP}(\text{ARG1}, \text{ARG2})$  leave in the complex accumulator  $\text{ARG1} + i\text{ARG2}$ .

#### COSH, SINH

These are the cosh and sinh of a real argument. Their values are real. These functions are included because they are often useful when working with complex arithmetic.

#### CSIN

This gives the complex sine of a complex argument.

#### CSINH, CCOSH

These are the complex SINH and COSH of a complex argument.

#### CSQRT

This is the complex square root of a complex argument.

#### DIR

See RAD

#### EXPI

This is a complex function of a real argument.  $\text{EXPI}(\text{THETA})$  leaves  $\text{EXP}(i\text{THETA})$  in the complex accumulator.

#### IM, IMAG, XIMAG

The three names are entry points to the same routine. This routine leaves in AQ the imaginary part of a complex argument. IM and IMAG must be declared REAL.

#### IMAG

See IM

NORM, XNORM

These names are for computing  $\text{SQRT}(\text{NORM2}(\text{ARG}))$ . NORM must be declared REAL.

NORM2, XNORM2

These names are for a routine that leaves the sum of the squares of the real and imaginary parts of a complex argument in AQ. NORM2 must be declared REAL.

RAD, DIR

These are names that refer to a routine for computing the direction of a complex number in radians. Thus  $\text{RAD}(X) = \text{ARCTAN}(\text{RE}(X), \text{IM}(X))$ . See ARCTAN for a description of its procedure and results.

RE, REAL

These names are for a routine that leaves the real part of a complex argument in AQ.

REAL

See RE

SINH

See COSH

XIMAG

See IM

XNORM

See NORM

XNORM2

See NORM2

CAP is currently available under OS-3 in FTNLIB, the FORTRAN library.