

# NAG Library Routine Document

## F01VBF (ZTRTTP)

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

### 1 Purpose

F01VBF (ZTRTTP) copies a complex triangular matrix, stored in a full format array, to a packed format array.

### 2 Specification

```
SUBROUTINE F01VBF (UPLO, N, A, LDA, AP, INFO)
  INTEGER          N, LDA, INFO
  COMPLEX (KIND=nag_wp) A(LDA,*), AP(N*(N+1)/2)
  CHARACTER(1)     UPLO
```

The routine may be called by its LAPACK name *ztrtp*.

### 3 Description

F01VBF (ZTRTTP) packs a complex  $n$  by  $n$  triangular matrix  $A$ , stored conventionally in a full format array, into an array of length  $n(n+1)/2$ . The matrix is packed by columns. This routine is intended for possible use in conjunction with routines from Chapters F06, F07, F08 and F16 where some routines use triangular matrices stored in the packed form. Packed storage format is described in Section 3.3.2 in the F07 Chapter Introduction.

### 4 References

None.

### 5 Arguments

- |    |  |              |
|----|--|--------------|
| 1: | UPLO – CHARACTER(1)<br><i>On entry:</i> specifies whether $A$ is upper or lower triangular.<br>UPLO = 'U'<br>$A$ is upper triangular.<br>UPLO = 'L'<br>$A$ is lower triangular.<br><i>Constraint:</i> UPLO = 'U' or 'L'. | <i>Input</i> |
| 2: | N – INTEGER<br><i>On entry:</i> $n$ , the order of the matrix $A$ .<br><i>Constraint:</i> $N \geq 0$ .   | <i>Input</i> |
| 3: | A(LDA,*) – COMPLEX (KIND=nag_wp) array<br><b>Note:</b> the second dimension of the array $A$ must be at least $N$ .<br><i>On entry:</i> the triangular matrix $A$ .  | <i>Input</i> |

If UPLO = 'U',  $A$  is upper triangular and the elements of the array below the diagonal are not referenced.

If UPLO = 'L',  $A$  is lower triangular and the elements of the array above the diagonal are not referenced.

4: LDA – INTEGER *Input*

*On entry:* the first dimension of the array  $A$  as declared in the (sub)program from which F01VBF (ZTRTTP) is called.

*Constraint:*  $LDA \geq \max(1, N)$ .

5: AP( $N \times (N + 1)/2$ ) – COMPLEX (KIND=nag\_wp) array *Output*

*On exit:* the  $n$  by  $n$  triangular matrix  $A$ , packed by columns.

More precisely,

if UPLO = 'U', the upper triangle of  $A$  is stored with element  $A_{ij}$  in AP( $i + j(j - 1)/2$ ) for  $i \leq j$ ;

if UPLO = 'L', the lower triangle of  $A$  is stored with element  $A_{ij}$  in AP( $i + (2n - j)(j - 1)/2$ ) for  $i \geq j$ .

6: INFO – INTEGER *Output*

*On exit:* INFO = 0 unless the routine detects an error (see Section 6).

## 6 Error Indicators and Warnings

INFO < 0

If INFO =  $-i$ , argument  $i$  had an illegal value. An explanatory message is output, and execution of the program is terminated.

## 7 Accuracy

Not applicable.

## 8 Parallelism and Performance

F01VBF (ZTRTTP) is not threaded in any implementation.

## 9 Further Comments

None.

## 10 Example

This example reads in a triangular matrix and copies it to packed format.

### 10.1 Program Text

```

Program f01vbfe

!      F01VBF Example Program Text

!      Mark 26 Release. NAG Copyright 2016.

!      .. Use Statements ..
!      Use nag_library, Only: nag_wp, x04dbf, ztrttp
!      .. Implicit None Statement ..
```

```

      Implicit None
!      .. Parameters ..
      Integer, Parameter          :: incl = 1, indent = 0, ncols = 80,      &
                                     nin = 5, nout = 6
      Character (1), Parameter    :: brac = 'B', diag = 'N',                &
                                     intlabeled = 'I', matrix = 'G',          &
                                     nolabel = 'N'
      Character (4), Parameter    :: form = 'F5.2'
!      .. Local Scalars ..
      Integer                     :: i, ifail, info, lda, lenap, n
      Character (18)              :: title
      Character (1)               :: uplo
!      .. Local Arrays ..
      Complex (Kind=nag_wp), Allocatable :: a(:, :), ap(:)
      Character (1)               :: clabs(1), rlabs(1)
!      .. Executable Statements ..
      Write (nout,*) 'F01VBF Example Program Results'
!      Skip heading in data file
      Read (nin,*)
      Write (nout,*)
      Flush (nout)
      Read (nin,*) n, uplo
      lda = n
      lenap = (n*(n+1))/2
      Allocate (a(lda,n),ap(lenap))

!      Read a triangular matrix of order n
      Do i = 1, n
         Read (nin,*) a(i,1:n)
      End Do

!      Print the unpacked matrix
      title = 'Unpacked Matrix A:'
      ifail = 0
      Call x04dbf(uplo,diag,n,n,a,lda,brac,form,title,intlabeled,rlabs,intlabeled, &
                  clabs,ncols,indent,ifail)

      Write (nout,*)
      Flush (nout)

!      Convert to packed vector form
!      The NAG name equivalent of ztrttp is f01vbf
      Call ztrttp(uplo,n,a,lda,ap,info)

!      Print the packed vector
      title = 'Packed Matrix AP: '
      ifail = 0
      Call x04dbf(matrix,diag,lenap,incl,ap,lenap,brac,form,title,intlabeled, &
                  rlabs,nolabel,clabs,ncols,indent,ifail)

      End Program f01vbfe

```

## 10.2 Program Data

F01VBF Example Program Data

```

4 'U'                                : n, uplo
(1.1,1.1) (1.2,1.2) (1.3,1.3) (1.4,1.4) : Unpacked Matrix A
(0.0,0.0) (2.2,2.2) (2.3,2.3) (2.4,2.4)
(0.0,0.0) (0.0,0.0) (3.3,3.3) (3.4,3.4)
(0.0,0.0) (0.0,0.0) (0.0,0.0) (4.4,4.4)

```

## 10.3 Program Results

F01VBF Example Program Results

Unpacked Matrix A:

```

      1          2          3          4
1 ( 1.10, 1.10) ( 1.20, 1.20) ( 1.30, 1.30) ( 1.40, 1.40)
2           ( 2.20, 2.20) ( 2.30, 2.30) ( 2.40, 2.40)
3                ( 3.30, 3.30) ( 3.40, 3.40)

```

4

( 4.40, 4.40)

Packed Matrix AP:

```
1 ( 1.10, 1.10)
2 ( 1.20, 1.20)
3 ( 2.20, 2.20)
4 ( 1.30, 1.30)
5 ( 2.30, 2.30)
6 ( 3.30, 3.30)
7 ( 1.40, 1.40)
8 ( 2.40, 2.40)
9 ( 3.40, 3.40)
10 ( 4.40, 4.40)
```

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