

# NAG Library Routine Document

## F06PHF (DTPMV)

**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

F06PHF (DTPMV) computes the matrix-vector product for a real triangular matrix, or its transpose, stored in packed form.

### 2 Specification

```
SUBROUTINE F06PHF (UPLO, TRANS, DIAG, N, AP, X, INCX)
```

```
INTEGER          N, INCX
REAL (KIND=nag_wp) AP(*), X(*)
CHARACTER(1)     UPLO, TRANS, DIAG
```

The routine may be called by its BLAS name *dtpmv*.

### 3 Description

F06PHF (DTPMV) performs one of the matrix-vector operations

$$x \leftarrow Ax \quad \text{or} \quad x \leftarrow A^T x,$$

where  $A$  is an  $n$  by  $n$  real triangular matrix, stored in packed form, and  $x$  is an  $n$ -element real vector.

### 4 References

None.

### 5 Parameters

- 1: UPLO – CHARACTER(1) *Input*  
*On entry:* specifies whether  $A$  is upper or lower triangular.  
 UPLO = 'U'  
 $A$  is upper triangular.  
 UPLO = 'L'  
 $A$  is lower triangular.  
*Constraint:* UPLO = 'U' or 'L'.
- 2: TRANS – CHARACTER(1) *Input*  
*On entry:* specifies the operation to be performed.  
 TRANS = 'N'  
 $x \leftarrow Ax$ .  
 TRANS = 'T' or 'C'  
 $x \leftarrow A^T x$ .  
*Constraint:* TRANS = 'N', 'T' or 'C'.

- 3: DIAG – CHARACTER(1) *Input*  
*On entry:* specifies whether  $A$  has nonunit or unit diagonal elements.  
 DIAG = 'N'  
 The diagonal elements are stored explicitly.  
 DIAG = 'U'  
 The diagonal elements are assumed to be 1, and are not referenced.  
*Constraint:* DIAG = 'N' or 'U'.
- 4: N – INTEGER *Input*  
*On entry:*  $n$ , the order of the matrix  $A$ .  
*Constraint:*  $N \geq 0$ .
- 5: AP(\*) – REAL (KIND=nag\_wp) array *Input*  
**Note:** the dimension of the array AP must be at least  $N \times (N + 1)/2$ .  
*On entry:* the  $n$  by  $n$  triangular matrix  $A$ , packed by columns.  
 More precisely,  
     if UPLO = 'U', the upper triangle of  $A$  must be stored with element  $A_{ij}$  in  
     AP( $i + j(j - 1)/2$ ) for  $i \leq j$ ;  
     if UPLO = 'L', the lower triangle of  $A$  must be stored with element  $A_{ij}$  in  
     AP( $i + (2n - j)(j - 1)/2$ ) for  $i \geq j$ .  
 If DIAG = 'U', the diagonal elements of  $A$  are assumed to be 1, and are not referenced; the same storage scheme is used whether DIAG = 'N' or 'U'.
- 6: X(\*) – REAL (KIND=nag\_wp) array *Input/Output*  
**Note:** the dimension of the array X must be at least  $\max(1, 1 + (N - 1) \times |\text{INCX}|)$ .  
*On entry:* the  $n$ -element vector  $x$ .  
 If INCX > 0,  $x_i$  must be stored in X( $1 + (i - 1) \times \text{INCX}$ ), for  $i = 1, 2, \dots, N$ .  
 If INCX < 0,  $x_i$  must be stored in X( $1 - (N - i) \times \text{INCX}$ ), for  $i = 1, 2, \dots, N$ .  
*On exit:* the updated vector  $x$  stored in the array elements used to supply the original vector  $x$ .
- 7: INCX – INTEGER *Input*  
*On entry:* the increment in the subscripts of X between successive elements of  $x$ .  
*Constraint:* INCX  $\neq 0$ .

## 6 Error Indicators and Warnings

None.

## 7 Accuracy

Not applicable.

## 8 Further Comments

None.

## **9 Example**

None.

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