

# NAG Library Routine Document

## F06SGF (ZTBMV)

**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

F06SGF (ZTBMV) computes the matrix-vector product for a complex triangular band matrix, its transpose or its conjugate transpose.

### 2 Specification

```
SUBROUTINE F06SGF (UPLO, TRANS, DIAG, N, K, A, LDA, X, INCX)
  INTEGER          N, K, LDA, INCX
  COMPLEX (KIND=nag_wp) A(LDA,*), X(*)
  CHARACTER(1)    UPLO, TRANS, DIAG
```

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

### 3 Description

F06SGF (ZTBMV) performs one of the matrix-vector operations

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

where  $A$  is an  $n$  by  $n$  complex triangular band matrix with  $k$  subdiagonals or superdiagonals, and  $x$  is an  $n$ -element complex vector.

### 4 References

None.

### 5 Arguments

- 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'  
 $x \leftarrow A^T x$ .  
 TRANS = 'C'  
 $x \leftarrow A^H x$ .  
*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:    K – INTEGER *Input*  
*On entry:*  $k$ , the number of subdiagonals or superdiagonals of the matrix  $A$ .  
*Constraint:*  $K \geq 0$ .
- 6:    A(LDA,\*) – COMPLEX (KIND=nag\_wp) array *Input*  
**Note:** the second dimension of the array  $A$  must be at least  $N$ .  
*On entry:* the  $n$  by  $n$  triangular band matrix  $A$   
 The matrix is stored in rows 1 to  $k + 1$ , more precisely,  
       if UPLO = 'U', the elements of the upper triangle of  $A$  within the band must be stored with  
       element  $A_{ij}$  in  $A(k + 1 + i - j, j)$  for  $\max(1, j - k) \leq i \leq j$ ;  
       if UPLO = 'L', the elements of the lower triangle of  $A$  within the band must be stored with  
       element  $A_{ij}$  in  $A(1 + i - j, j)$  for  $j \leq i \leq \min(n, j + k)$ .  
 If DIAG = 'U', the diagonal elements of  $A$  are assumed to be 1, and are not referenced.
- 7:    LDA – INTEGER *Input*  
*On entry:* the first dimension of the array  $A$  as declared in the (sub)program from which F06SGF  
 (ZTBMV) is called.  
*Constraint:*  $LDA \geq K + 1$ .
- 8:    X(\*) – COMPLEX (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 vector  $x$ .  
 If  $\text{INCX} > 0$ ,  $x_i$  must be stored in  $X(1 + (i - 1) \times \text{INCX})$ , for  $i = 1, 2, \dots, N$ .  
 If  $\text{INCX} < 0$ ,  $x_i$  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  $x$ .
- 9:    INCX – INTEGER *Input*  
*On entry:* the increment in the subscripts of  $X$  between successive elements of  $x$ .  
*Constraint:*  $\text{INCX} \neq 0$ .

## 6 Error Indicators and Warnings

None.

## **7 Accuracy**

Not applicable.

## **8 Parallelism and Performance**

F06SGF (ZTBMV) is not threaded in any implementation.

## **9 Further Comments**

None.

## **10 Example**

None.

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