

# NAG Library Routine Document

## F06HQF

**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

F06HQF generates a sequence of complex plane rotations.

### 2 Specification

```
SUBROUTINE F06HQF (PIVOT, DIRECT, N, ALPHA, X, INCX, C, S)
  INTEGER                N, INCX
  REAL (KIND=nag_wp)    C(N)
  COMPLEX (KIND=nag_wp) ALPHA, X(*), S(N)
  CHARACTER(1)          PIVOT, DIRECT
```

### 3 Description

F06HQF generates the parameters of a complex unitary matrix  $P$ , of order  $n + 1$ , chosen so as to set to zero the elements of a supplied  $n$ -element complex vector  $x$ .

If PIVOT = 'F' and DIRECT = 'F', or if PIVOT = 'V' and DIRECT = 'B',

$$P \begin{pmatrix} \alpha \\ x \end{pmatrix} = \begin{pmatrix} \beta \\ 0 \end{pmatrix};$$

If PIVOT = 'F' and DIRECT = 'B', or if PIVOT = 'V' and DIRECT = 'F',

$$P \begin{pmatrix} x \\ \alpha \end{pmatrix} = \begin{pmatrix} 0 \\ \beta \end{pmatrix}.$$

Here  $\alpha$  and  $\beta$  are complex scalars.

$P$  is represented as a sequence of  $n$  plane rotations  $P_k$ , as specified by PIVOT and DIRECT;  $P_k$  is chosen to annihilate  $x_k$ , and its 2 by 2 plane rotation part has the form

$$\begin{pmatrix} c_k & \bar{s}_k \\ -s_k & c_k \end{pmatrix},$$

with  $c_k$  real. The tangent of the rotation,  $t_k$ , is overwritten on  $x_k$ .

### 4 References

None.

### 5 Arguments

- 1: PIVOT – CHARACTER(1) *Input*  
*On entry:* specifies the plane rotated by  $P_k$ .  
 PIVOT = 'V' (variable pivot)  
 $P_k$  rotates the  $(k, k + 1)$  plane.  
 PIVOT = 'F' (fixed pivot)  
 $P_k$  rotates the  $(1, k + 1)$  plane if DIRECT = 'F', or the  $(k, n + 1)$  plane if DIRECT = 'B'.  
*Constraint:* PIVOT = 'V' or 'F'.

- 2: DIRECT – CHARACTER(1) *Input*  
*On entry:* specifies the sequence direction.  
DIRECT = 'F' (forward sequence)  
 $P = P_n \cdots P_2 P_1$ .  
DIRECT = 'B' (backward sequence)  
 $P = P_1 P_2 \cdots P_n$ .  
*Constraint:* DIRECT = 'F' or 'B'.
- 3: N – INTEGER *Input*  
*On entry:*  $n$ , the number of elements in  $x$ .
- 4: ALPHA – COMPLEX (KIND=nag\_wp) *Input/Output*  
*On entry:* the scalar  $\alpha$ .  
*On exit:* the scalar  $\beta$ .
- 5: 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  $n$ -element vector  $x$ .  $x_i$  must be stored in  $X(1 + (i - 1) \times \text{INCX})$ , for  $i = 1, 2, \dots, N$ .  
Intermediate elements of X are not referenced.  
*On exit:* the referenced elements are overwritten by details of the plane rotations.
- 6: INCX – INTEGER *Input*  
*On entry:* the increment in the subscripts of X between successive elements of  $x$ .  
*Constraint:*  $\text{INCX} > 0$ .
- 7: C(N) – REAL (KIND=nag\_wp) array *Output*  
*On exit:* the values  $c_k$ , the cosines of the rotations.
- 8: S(N) – COMPLEX (KIND=nag\_wp) array *Output*  
*On exit:* the values  $s_k$ , the sines of the rotations.

## 6 Error Indicators and Warnings

None.

## 7 Accuracy

Not applicable.

## 8 Parallelism and Performance

F06HQP is not threaded in any implementation.

## 9 Further Comments

None.

## **10 Example**

None.

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