

# X04BZFP

## NAG Parallel Library Routine Document

**Note:** before using this routine, please read the Users' Note for your implementation to check for implementation-dependent details. You are advised to enclose any calls to NAG Parallel Library routines between calls to Z01AAFP and Z01ABFP.

### 1 Description

X04BZFP outputs a complex dense matrix  $B$  of dimension  $m \times n$ , distributed in row block fashion on a one-dimensional logical grid of processors, to an external file.

### 2 Specification

```
SUBROUTINE X04BZFP(NOUT, M, N, B, IDESCB, FORMAT, WORK, IFAIL)
COMPLEX*16          B(*), WORK(*)
INTEGER            NOUT, M, N, IDESCB(*), IFAIL
CHARACTER*(*)      FORMAT
```

### 3 Usage

#### 3.1 Definitions

The following definitions are used in describing the data distribution within this document:

- $m_p$  – the number of rows in the Library Grid, for this routine  $m_p = 1$  or  $m_p = p$ ;
- $n_p$  – the number of columns in the Library Grid, for this routine  $n_p = 1$  or  $n_p = p$ .
- $p$  –  $m_p \times n_p$ , the total number of processors in the Library Grid.
- $M_b$  – the blocking factor for the distribution of the rows of the matrix.
- $N_b^X$  – the blocking factor for the distribution of the columns of a matrix  $X$ .

#### 3.2 Global and Local Arguments

The following global **input** arguments must have the same value on entry to the routine on each processor and the global **output** arguments will have the same value on exit from the routine on each processor:

Global input arguments:        M, N, some elements of IDESCB (see IDESCB description in Section 4),  
IFAIL

Global output arguments:      IFAIL

The remaining arguments are local.

**Note:** NOUT and FORMAT are only referenced on the root (or  $\{0,0\}$ ) processor since it is only the root (or  $\{0,0\}$ ) processor which performs output.

#### 3.3 Distribution Strategy

The user must use a one dimensional processor grid and the matrix  $B$  must be partitioned into  $M_b$  row blocks and stored in an array B. This data distribution (**row block distribution**) is described in more details in the F07 Chapter Introduction.

#### 3.4 Related Routines

F01YZFP can be called prior to this routine, to generate the matrix. This routine can be also called after F07HSFP (PZPBTRS) or F07JSFP (PZPTTRS), to print the output solution of a banded or a tridiagonal system respectively.

## 4 Arguments

1: NOUT — INTEGER *Local Input*

*On entry:* the unit number to which the output will be directed.

*Constraint:*  $0 \leq \text{NOUT} \leq 99$ .

2: M — INTEGER *Global Input*

*On entry:*  $m$ , the number of rows of the matrix  $B$ .

*Constraint:*  $M \geq 0$ .

3: N — INTEGER *Global Input*

*On entry:*  $n$ , the number of columns of the matrix  $B$ .

*Constraints:*  $N \geq 0$ .

4: B(\*) — COMPLEX\*16 array *Local Input*

**Note:** the array B is formally defined as a vector. However, you may find it more convenient to consider B as a two-dimensional array of dimension  $(\text{LDB}, \gamma)$  where  $\text{LDB} = \text{IDESCB}(9)$  if  $\text{IDESCB}(1) = 1$ , or  $\text{LDB} = \text{IDESCB}(6)$  if  $\text{IDESCB}(1) = 502$ ; and  $\gamma \geq n$ .

*On entry:* the local part of the matrix  $B$  stored in row block fashion.

5: IDESCB(\*) — INTEGER array *Local Input*

**Note:** the dimension of the array IDESCB must be at least 6 when  $\text{IDESCB}(1) = 502$ , or at least 9 when  $\text{IDESCB}(1) = 1$ .

*Distribution:* if  $\text{IDESCB}(1) = 1$ , the array elements  $\text{IDESCB}(3:8)$  must be global to the processor grid. If  $\text{IDESCB}(1) = 502$ , then only the array elements  $\text{IDESCB}(3:5)$  must be global. In either case  $\text{IDESCB}(2)$  is local to each processor.

*On entry:* the description array for the matrix  $B$ . This array must contain details of the distribution of the matrix  $B$  and the logical processor grid.

IDESCB(1), the descriptor type.

If  $\text{IDESCB}(1) = 502$ , then  $p = 1 \times n_p$  or  $p = m_p \times 1$ , and the remaining elements of IDESCB must be set as follows:

IDESCB(2), the Library context, usually returned by a call to the Library Grid initialisation routine Z01AAFP;

IDESCB(3), the number of rows,  $m$ , of the matrix  $B$ ;

IDESCB(4), the blocking factor,  $M_b$ , used to distribute the matrix  $B$ ;

IDESCB(5), the processor column index over which the first element of the matrix  $B$  is distributed;

IDESCB(6), the leading dimension of the conceptual two-dimensional array B;

IDESCB(7:9) are not referenced.

If  $\text{IDESCB}(1) = 1$ , then  $p = m_p \times 1$  and the remaining elements of IDESCB must be set as follows:

IDESCB(2), the Library context, usually returned by a call to the Library Grid initialisation routine Z01AAFP;

IDESCB(3), the number of rows,  $m$ , of the matrix  $B$ ;

IDESCB(4), the number of columns,  $n$ , of the matrix  $B$ ;

IDESCB(5), the blocking factor,  $M_b$ , used to distribute the rows of the matrix  $B$ ;

IDESCB(6), the blocking factor,  $N_b^B$ , used to distribute the columns of the matrix  $B$ ;

IDESCB(7), the processor row index over which the first row of the matrix  $B$  is distributed;

IDESCB(8), the processor column index over which the first column of the matrix  $B$  is distributed;

IDESCB(9), the leading dimension of the conceptual two-dimensional array  $B$ .

*Suggested value:* IDESCB(1) = 502 and  $p = 1 \times n_p$ .

*Constraints:*

IDESCB(1) = 1 or 502;

if IDESCB(1) = 1, then  $p = 1 \times n_p$ ;

if IDESCB(1) = 502; then  $p = m_p \times 1$  or  $p = 1 \times n_p$ ;

if IDESCB(1) = 502, then

IDESCB(4)  $\geq 2$  and  $p \times \text{IDESCB}(4) \geq M$ ;

IDESCB(3)  $\geq M$ ;

IDESCB(5)  $\geq 0$ ;

if IDESCB(1) = 1, then

IDESCB(6)  $\geq 2$  and  $p \times \text{IDESCB}(6) \geq M$ ;

IDESCB(4)  $\geq M$ ;

IDESCB(7)  $\geq 0$ ;

**6:** FORMAT — CHARACTER\*(\*)

*Local Input*

*On entry:* the format which will be used for output of the elements of the matrix  $A$ .

*Constraint:* any legal Fortran format for the output of floating-point numbers.

**7:** WORK(\*) — COMPLEX\*16 array

*Local Workspace*

**Note:** this array has the same dimension as the array  $B$ .

**8:** IFAIL — INTEGER

*Global Input/Global Output*

The NAG Parallel Library provides a mechanism, via the routine Z02EAFP, to reduce the amount of parameter validation performed by this routine. For a full description refer to the Z02 Chapter Introduction.

*On entry:* IFAIL must be set to 0, -1 or 1. For users not familiar with this argument (described in the Essential Introduction) the recommended values are:

IFAIL = 0, if multigridding is **not** employed;

IFAIL = -1, if multigridding is employed.

*On exit:* IFAIL = 0 (or -9999 if reduced error checking is enabled) unless the routine detects an error (see Section 5).

## 5 Errors and Warnings

If on entry IFAIL = 0 or -1, explanatory error messages are output from the root processor (or processor {0,0} when the root processor is not available) on the current error message unit (as defined by X04AAF).

### 5.1 Full Error Checking Mode Only

IFAIL = -2000

The routine has been called with an invalid value of ICNTXT on one or more processors.

IFAIL = -1000

The logical processor grid and library mechanism (Library Grid) have not been correctly defined, see Z01AAF.

IFAIL =  $-i$

On entry, one of the arguments was invalid:

if the  $k$ th argument is a scalar IFAIL =  $-k$ ;

if the  $k$ th argument is an array and its  $j$ th element is invalid, IFAIL =  $-(100 \times k + j)$ .

This error occurred either because a global argument did not have the same value on all logical processors, or because its value on one or more processors was incorrect. An explanatory message distinguishes between these two cases.

## 6 Further Comments

After the communication of the local portion of the matrix by the other processors, the printing is performed sequentially by the root (or  $\{0,0\}$ ) processor if the root processor is not available.

## 7 References

None.

## 8 Example

See Section 8 of the document for F01YZFP.

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