

## Sparse Matrix Mapping Draft 7

12/08/2009

### [Number of Sparse Labels]

Rules for Version 1.0-2.0 files:

[Number of Sparse Labels] is not permitted in Version 1.0-2.0 files.

Rules for Version 2.1 Files:

[Number of Sparse Labels] describes how many data pairs will appear for each frequency in [Network Data], and how many integer-labels will appear under the [Sparse Matrix Mapping] keyword. (Need to add words under [Network Data] keyword to reflect this.)

Note that, if [Number of Sparse Labels] is present, the number of entries under [Network Data] does NOT need to match the size of a matrix given by [Number of Ports] x [Number of Ports]. Instead, the number of integer-labels under the [Network Data] keyword must match the number of colon-separated groups under the [Sparse Matrix Mapping] keyword.

[Number of Sparse Labels] is required if [Sparse Matrix Mapping] is present. Otherwise, it is prohibited.

[Number of Sparse Labels] accepts a single integer argument with value greater than zero. The value must match the number of integer-labels used under [Sparse Matrix Mapping]. The argument may appear immediately after the keyword, or may they may be separated by a line termination sequence.

[Number of Sparse Labels] shall appear after the [Number of Ports] keyword and before any network data.

### [Sparse Matrix Mapping]

Rules for Version 1.0-2.0 files:

[Sparse Matrix Mapping] is not permitted in Version 1.0-2.0 files.

Rules for Version 2.1 files:

[Sparse Matrix Mapping] is an optional keyword describing how the data under [Network Data] maps into the n-port matrix (n by n, where n is given by [Number of Ports]).

[Sparse Matrix Mapping] shall appear after the [Number of Ports] keyword and before any network data. The [Network Data] keyword data given later in the file changes in

meaning from expressing data in a full matrix to expressing the data points remapped into the full matrix by the contents of the [Sparse Matrix Mapping] keyword.

[Sparse Matrix Mapping] contains two kinds of arguments: integer-labels and index-pairs. Integer-labels are integer numbers greater than or equal to 1 and less than or equal to  $n^2$ . Each integer-label is followed by the colon character without any whitespace. All index-pairs after an integer-label and before the next integer-label or the end of [Sparse Matrix Mapping] refer to the data pair under [Network Data] corresponding to the first integer-label and therefore force the corresponding entries in the full matrix to be identical.

An index-pair is a pair of positive integers between 1 and  $n$ , separated without any space by the comma character and enclosed, without whitespace, by parentheses. An index-pair specifies the row and column index in the  $n$ -port matrix mapped into the [Network Data] by [Sparse Matrix Mapping].

Integer-labels are required if [Sparse Matrix Mapping] is present, must be numerically increasing and the sequence must begin with 1.

Integer-labels may not be re-used. Index-pairs may not be duplicated either within an integer-label group or between two or more integer-label groups.

The last integer-label shall be the same as the [Number of Sparse Labels].

White space is not permitted between the integer-label and the colon character.

In each index-pair, the row index is always the first integer and the column index is always the second. Zero values are not permitted within an index-pair. The value for any row or column index in an index-pair must be no larger than the [Number of Ports] argument.

For example, if the very first index-pair under [Sparse Matrix Mapping] is (1,5) and the first row and column indices of [Network Data] contain the real/imaginary pair 7 -0.8, then the values 7 -0.8 are assumed to occupy row 1, column 5 of the  $n$ -port matrix described by [Number of Ports].

The row and column indices in an index-pair are separated by a comma, are preceded by an open parenthesis and followed by a close parenthesis.

White space is not permitted after the open parenthesis and before the closed parenthesis of an index-pair. White space is required between index-pairs.

Data in the  $n$ -port matrix that is not indicated by a matrix pair under [Sparse Matrix Mapping] is assumed to be zero-valued. For data in MA or RI format, a zero-valued pair is 0 0. As data in DB format cannot take on a zero value, DB format is assumed to apply only to the matrix data provided under [Sparse Matrix Mapping],

[Sparse Matrix Mapping] assumes that the matrix mapping between its entries and those of [Network Data] are unchanged across all frequency points given under [Network Data].

Multiple integer-labels may appear on the same line. Integer-labels and associated index-pairs may be separated by a line-termination sequence. Empty integer-labels (integer-labels followed by other integer-labels without an intervening index-pair) are not permitted.

[Sparse Matrix Mapping] must contain at least one integer-label. The number of integer-labels must agree with the argument used for [Number of Sparse Labels].

Lists of index-pairs may span multiple lines.

The maximum number of index-pairs under [Sparse Matrix Mapping] is given by the square of the argument to [Number of Ports].

Note that [Mixed-Mode Order], [Matrix Format], [Reference Impedance] and [Number of Ports] rules do not change in the presence of [Number of Sparse Labels]. [Mixed-Mode Order], [Matrix Format] and [Reference Impedance] describe the matrix populated by the contents of [Sparse Matrix Mapping] and [Network Data]. [Number of Ports] describes the matrix into which [Sparse Matrix Mapping] arguments map the data under [Network Data].

When [Matrix Format] is “Upper” then the row index of any index-pair must be less than or equal to column index of that pair. Similarly, when [Matrix Format] is “Lower” then the row index of any index-pair must be greater than or equal to the column index of that pair.

**Example xx (Version 2.0):**

```
[Version] 2.0
# GHz S M A R 50
[Number of Ports] 4
[Number of Frequencies] 1
[Reference] 50 75 0.01 0.01
[Matrix Format] Full
[Number of Sparse Labels]
4
[Sparse Matrix Mapping]
1: (1,1) (2,2) (3,3) (4,4) 2: (3,1) (4,2) 3: (4,1) 4: (2,1) (3,2) (4,3)
[End of Sparse Matrix Mapping]

[Network Data]
5.00000 0.60 161.24 0.40 -42.20 .999 .999 0.42 -66.58
```

[End]

This describes the 4x4 matrix shown below:

0.60	161.24	0 0	0 0	0 0
0.42	-66.58	0.60 161.24	0 0	0 0
0.40	-42.20	0.42 -66.58	0.60 161.24	0 0
0.42	-66.58	0.40 -42.20	0.42 -66.58	0.60 161.24

Other equivalent representations

[Sparse Matrix Mapping]

1: (1,1) (2,2) (3,3) (4,4)

2: (3,1) (4,2)

3: (4,1)

4: (2,1) (3,2) (4,3)

[End of Sparse Matrix Mapping]

[Network Data]

...

[Sparse Matrix Mapping]

1:

(1,1) (2,2) (3,3) (4,4)

2:

(3,1) (4,2)

3:

(4,1)

4:

(2,1) (3,2) (4,3)

[End of Sparse Matrix Mapping]

[Network Data]

[Sparse Matrix Mapping]

1:

(1,1)

(2,2)

(3,3)

(4,4)

2:

(3,1)

(4,2)

3:

(4,1)

4:

(2,1)

(3,2)

(4,3)

[End of Sparse Matrix Mapping]

[Network Data]

...

## [End of Sparse Matrix Mapping]

Rules for Version 1.0-2.0 Files:

[End of Sparse Matrix Mapping] is not permitted in Version 1.0-2.0 files.

Rules for Version 2.1 Files:

[End of Sparse Matrix Mapping] is a keyword denoting the end of the Sparse Matrix data section. [End of Sparse Matrix Mapping] is required if [Sparse Matrix Mapping] is present.