[Sparse Matrix Mapping]

Rules for Version 1.0 Files:
[Sparse Matrix Mapping] is not permitted in Version 1.0 files.

Rules for Version 2.0 Files:
[Sparse Matrix Mapping] is an optional keyword describing how the data under [Network Data] maps into a larger matrix (n by n, where n is given by [Number of Ports]). The [Network Data] keyword data given later in the file changes in meaning from expressing data in a full matrix to expressing the unique data points remapped into the full matrix by the contents of the [Sparse Matrix Mapping] keyword.

The arguments of [Sparse Matrix Mapping] are "index pairs" of integers, plus separators and integer labels. Each pair corresponds to a row and column in the full matrix to which the data in the corresponding *position by column* in the [Network Data] keyword is mapped. For example, if the very first index pair under [Sparse Matrix Mapping] is (1,5) and the first row and column of the [Network Data] contains the real/imaginary pair 7 - 0.8, then the values 7 -0.8 are assumed to occupy row 1, column 5 of the full, final matrix described by [Number of Ports].

Index pairs are grouped by colon characters and integer labels. All index pairs between a pair of colon characters refer to the *same* element in [Network Data] and therefore force the corresponding entries in the full matrix to be identical.

Integer labels are required and must begin with 1. Labels may be re-used. Duplicate labels simply match additional duplicate pairs to the same column of data under [Network Data]. Index *pairs* may not be duplicated either within a label group or across label groups.

[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].

Permitted characters in the arguments include alphanumerics for the index pairs and:

- the colon character (required to separate a group of pairs of indices and the integer label from other groups of indices and labels)
- the comma character (required to separate the row and column integers in an index pair)
- open and close parentheses (required to group index pairs)
- numeric characters (integers, required to label a group of identical pairs)

White space is permitted between pairs, around the colon character and around integer labels.

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

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

[Sparse Matrix Mapping] must contain at least one index pair with one label. Labels and

The maximum number of index pairs under [Sparse Matrix Mapping] is given by the value given by [Number of Ports] x [Number of Ports].

Data in the full matrix which is not indicated by a matrix pair under [Sparse Matrix Mapping] is assumed to be zero.

Example xx (Version 2.0):
[Version] 2.0
GHz S MA R 50
[Number of Ports] 4
[Number of Frequencies] 1
[Reference] 50 75 0.01 0.01
[Matrix Format] Full
[Network Data]
5.00000   0.60 161.24   0.40 -42.20   0.42 -66.58
[Sparse Matrix Mapping]
1 : (1,1) (2,2) (3,3) (4,4) 2 : (3,1) (4,2) 3 : (4,1) (2,1) (3,2) (4,3)

This describes the 4x4 matrix shown below:

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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
```

Note that [Reference Impedance] and [Number of Ports] rules do not change . [Reference Impedance] and [Number of Ports] describe the full matrix to which [Sparse Matrix Data] maps, not the [Network Data] reduced data set.

Interaction with [Matrix Format]
No special adjustments to [Sparse Matrix Mapping] contents are required to support [Matrix Format]. [Sparse Matrix Mapping] information and mapping applies to the data

as presented under the [Network Data] keyword, regardless of whether [Matrix Format] is "Full", "Upper" or "Lower". The [Sparse Matrix Mapping] keyword is organized by columns, and the upper- and lower-half matrices under [Network Data] will always have a consistent ordering of columns per row. In the case of lower-half, the first row will have a single column, the second row will have two columns, and so on. For upper-half matrices, the first row has as many columns as ports are defined in the sparse matrix, the second row has one fewer columns, and so on.

Because the upper- and lower-half matrix representations already use symmetry to reduce the size of the [Network Data], [Sparse Matrix Mapping] should not contain any information about matrix pairs which are assumed but not present under [Network Data].

Interaction with [Mixed-Mode Order]
No special adjustments to [Sparse Matrix Mapping] contents are required to support [Mixed-Mode Order]. Where [Sparse Matrix Mapping] is present, [Mixed-Mode Order] applies only to the matrices under [Network Data]. This assumes that [Network Data] and [Mixed-Mode Order] describe a reduced matrix of mixed-mode data, which is mapped to a larger matrix by the [Sparse Matrix Mapping] keyword. The mixed-mode relationships described under [Mixed-Mode Order] and [Network Data] map into the larger matrix according to [Sparse Matrix Mapping].

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Some change is here required to [Mixed-Mode Order] to ensure matching between [Number of Ports] and the ports named under [Mixed-Mode Order] do *not* have to be consistent when [Sparse Matrix Mapping] is present.
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