

=====

I B I S C O N N E C T O R S P E C I F I C A T I O N

Last Updated: 07-13-2001, AP

- * End Cn Model was in the tree... but not the descriptions...
- * Incorporated Quiescent, Even_Mode, Odd_Mode into SLM
- * Updated [Begin Cn Model] examples
- * Included Cn_fork / Cn_EndFork per "3-port" requirement for connectors. As such, removed Cn_Stub

* THIS NEEDS REVIEW !!! Added [Cn Matrix Index] to replace [Cn Phys Map]. It is a better descriptor. Why even have this??? [Cn Pin Map} ties a connector pin number to a pin name. I think we need to tie a pin name to matrix value. Your thoughts please.

- * GSR removed... no longer needed with SLM matrix definition improvements.
- * Added some of the Conductance Matrix

Questions to address
~~~~~

\* Multiplier for cn\_section. Can it be "NOT required"? Will it be parsable if sometimes it is there... and sometimes it is not?

\* The [Date] and [File Rev] keywords requires a Text String. Wouldn't it be better to require specific types of field formats, so that this information could be processed automatically?

\* Should there be a "Connector split" (i.e. Standard ribbon cable... two 20 pin ribbons...)  
Cn\_split: Map out ONLY a portion of the matrix to new ports... Basically, Incorporate split with multi-size matrices..

\* Still need to address "What information needs to stay with the specific connector model..." especially if the connector model is to be eventually included in a larger file.

\* Dual purpose use of the [Source] keyword. It is used to record the manufacturer's name, and the place and method from whence the model was created. This mixes two pieces of information that are both useful. I would propose another keyword [Part Manufacturer] which can be used to contain the name of the manufacturer of the part. This will make it very easy to search for manufacturers in a database of connector models.

[Source] then becomes the source of the information for extraction, which might also be some person or organization other than the connector manufacturer. (For example, SiQual or Mentor.)

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Specification Revision level 0.971

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```
=====
REVISION HISTORY
xx-xx-200x, v1.0 Specification
=====
```

```
=====
1.0 GENERAL INTRODUCTION
=====
```

This section gives a general overview of the remainder of this document.

Sections 2 to 5 contain general information about the IBIS versions and the general rules and guidelines.

The remaining sections describe the connector keywords and usage rules.

```
=====
2.0 STATEMENT OF INTENT
=====
```

In order to enable an industry standard method to electronically transport IBIS connector modeling data between connector vendors, simulation vendors, and end customers, this template is proposed. The intention of this template is to specify a consistent format that can be parsed by software, allowing simulation vendors to derive models compatible with their own products.

One goal of this template is to represent the current state of IBIS data, while allowing a growth path to more complex models / methods (when deemed appropriate). This would be accomplished by a revision of the base template, and possibly the addition of new keywords or categories.

Another goal of this template is to ensure that it is simple enough for connector vendors and customers to use and modify, while ensuring that it is rigid enough for simulation vendors to write reliable parsers.

This template is meant to contain a complete description of the elements on an entire connector or family of connectors.

This template is intended to provide a basis for future versions which are expected to be backward compatible with this initial version.

```
=====
```

### 3.0 GENERAL SYNTAX RULES AND GUIDELINES

=====

1) Only ASCII characters, as defined in ANSI Standard X3.4-1986, may be used in an IBIS-Connector file. The use of characters with codes greater than hexadecimal 07E is not allowed. Also, ASCII control characters (those numerically less than hexadecimal 20) are not allowed, except for TAB characters and line termination sequences.

NOTE: the use of TAB characters is strongly discouraged.

2) Except for keywords (words enclosed by a square bracket []), the content of an Ibis Connector Model (ICM) file is case sensitive.

3) Keywords must be enclosed in square brackets, [], and must start in column 1 of the line. No space is allowed immediately after the opening bracket '[' or immediately before the closing bracket ']'. If used, only one space (' ') or underscore ('\_') character separates the parts of a multi-word keyword. Spaces and underscores are equivalent within square bracket. Some keywords may be followed by an argument. Keyword arguments are of three types: either a text string, a file name, or a text block. Text string and file name arguments start on the same line as the keyword and are terminated with a line termination sequence. A text block starts on the same line as the keyword, may extend over multiple lines, and is terminated by the occurrence of the next keyword.

4) Keywords and subparameters must begin with a letter, and shall consist only of alphanumeric characters and the underscore (\_). Spaces are not allowed in sub-parameter names.

5) Each IBIS Connector data file is divided into sections. Each section is delimited by keywords of the form [Begin "section name"] and [End "section name"]. Within each section only specific keywords are legal (note, however, a keyword may be legal in more than one section). Unless otherwise noted, a section's keywords can appear in any order.

6) To facilitate portability between operating systems, file names used in the IBIS Connector file must only have lower case characters. File names should have a basename followed by a period ('.'), followed by a file name extension of no more than three characters. There is no length restriction on the basename. The basename and extension must use characters from the following set (space, ' ', 0x20 is not included):

```
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 _ -
```

7) A line of the file may have at most 120 characters, followed by a line termination sequence. The line termination sequence must be one of the following two sequences: a linefeed character, or a carriage return followed by linefeed character.

8) Anything following the comment character is ignored and considered a comment on that line. The default "|" (pipe) character can be changed by the keyword [Comment Char] to any other character. The [Comment Char] keyword can be used throughout the file as desired.

9) Valid scaling factors are:

```
T = tera      k = kilo      n = nano
G = giga      m = milli     p = pico
M = mega      u = micro     f = femto
```

When no scaling factors are specified, the appropriate base units are assumed. (These are volts, amperes, ohms, farads, henries, and seconds.) The parser

looks at only one alphabetic character after a numerical entry; therefore it is enough to use only the prefixes to scale the parameters. However, for clarity, it is allowed to use full abbreviations for the units, (e.g., pF, nH, mA, mOhm). In addition, scientific notation IS allowed (e.g., 1.2345e-12).

10) All temperatures are represented in degrees Celsius.

11) Multiple definitions of a specific symbol are illegal. Specifically, multiple definitions (either redundant or alternate) of an object type of the same object class are illegal. Refer to section 8 for more information on object classes and object types.

12) All lines that occur before the [Begin Header] keyword or after the [End] keyword shall be treated as comments and ignored by the parser. The intent of this rule is to facilitate the inclusion of HTML tags, revision control headers, etc. at the beginning of the file.

13) The following words are reserved words and must not be used for any other purposes in the document:

- PWRGND- reserved model name, used with power or ground pins,
- POWER - reserved model name, used with power supply pins,
- GND - reserved model name, used with ground pins,
- RET - reserved word indicating either power or ground used as a high-frequency return path.
- NC - reserved model name, used with no-connect pins,
- NA - used where data not available.

---

#### 4.0 KEYWORD TREE DIAGRAM

---

```
/-- Start of File
|-----
| /-- [Begin Header]
| |  -- [Comment Char]
| |  -- [IBIS Cn Model Ver]
| |  -- [File Name]
| |  -- [File Rev]
| |  -- [Date]
| |  -- [Source]
| |  -- [Notes]
| |  -- [Disclaimer]
| |  -- [Copyright]
| |  -- [Support]
| |  -- [Redistribution]
| |  -- [Redistribution Text]
| \-- [End Header]
|
| /-- [Begin Cn Model Family] (Section 7)
| |  -- [Manufacturer]
| |  -- [Cn Family Description]
|
|    -- [Cn Model List]
|
|    /-- [Begin Cn Model]
|    |  -- [Cn Model Description]
|    |  -- [Cn Number of Conductors]
|    |  -- [Cn Col of Pins]
```

```

| | | -- [Cn Rows of Pins]
| | | -- [Cn Col Swath]
| | | -- [Cn Row Swath]
|
| | | -- /-- [Begin Cn Auto Map]
| | | |-- [Cn Col Range]
| | | |-- [Cn Row Range]
| | | \-- [End Cn Auto Map]
|
| | | -- [Cn Pin Map] | Pins to Physical
| | | -- [Cn Phy Map] | Physical to Matrix (Physical = Col/Row location)
| | \-- [End Cn Model]
| \-- [End Cn Model Family]
|
| /-- [Begin Cn Section] | (Section 8) Define Matrices
| |-- [Derivation Method]
| |-- [Resistance Matrix]
| | | /-- [Bandwidth]
| | | \-- [Row]
| | -- [Inductance Matrix]
| | | /-- [Bandwidth]
| | | \-- [Row]
| | -- [Capacitance Matrix]
| | | /-- [Bandwidth]
| | | \-- [Row]
| \-- [End Cn Section]
\-- [End]

```

---

## 5.0 HEADER KEYWORDS

---

**Keyword:** [Begin Header]  
**Required:** Yes  
**Argument:** None  
**Description:** This keyword denotes the beginning of the file header section.  
**Usage Rules:** [Begin Header] must be the first keyword in any ICM file.  
This keyword may be preceded by lines of general text and/or comments which should be treated as comments by the parser.

---

[Begin Header]

---

**Keyword:** [IBIS Cn Model Ver]  
**Required:** Yes  
**Argument:** Text String  
**Description:** This keyword allows electronic parsers to immediately determine that this file contains an IBIS connector model.  
The version number is used to inform the parser what keywords are valid for this model and to allow backward support as new keywords are added.  
**Usage Rules:** MUST BE THE FIRST KEYWORD in the file after {Begin Header}.

-----  
[IBIS Cn Model Ver] 1.0

=====  
Keyword: [File Name]  
Required: Yes  
Argument: Text String (file name)  
Description: Specifies the name of the IBIS Connector Model (ICM) file.  
Usage Rules: The purpose of this keyword is to document a single filename  
the file uses even if the file is transferred from one  
computer to another. The file name must conform to the rules  
given in section 4, "General Syntax Rules and Guidelines".

-----  
[File Name] iconm\_hdi\_202.icm

=====  
Keyword: [File Rev]  
Required: Yes  
Argument: Text String  
Description: Tracks the revision level of a particular .icm file.  
Usage Rules: Revision level is set at the discretion of the engineer  
defining the file. The following guidelines are suggested:  
  
0.x connector and/or file in development  
1.x pre-manufacturing connector and/or model  
2.x mature connector and or model, no more changes likely

-----  
[File Rev] 1.0 Used for .icm file versions

=====  
Keyword: [Date]  
Required: No  
Argument: Text String (Date)  
Description: Date this file was last modified.  
Usage Rules: This keyword is provided to insure the last changed date for  
this file is not lost if the file is transmitted between  
computer systems.

-----  
[Date] July 1, 2000 The latest file revision date

=====  
Keyword: [Source]  
Required: No  
Argument: Text Block  
Description: Records the originating source of model data.  
Usage Rules: Use this keyword to record how the model information was  
obtained (physical measurement of device, simulations, data  
book, etc.). This field contain the name of the company who  
created the model.

NOTE: It is recommended that the argument to the [Source]  
keyword be limited to a maximum of 24 lines of text.

-----  
[Source] Put originator and the source of information here. For example:  
Results from field simulation

-----  
**Keyword:** [Notes]  
**Required:** No  
**Argument:** Text Block  
**Description:** Optional notes regarding the file.  
**Usage Rules:** The keyword provides a place for the model maker to record important notes about the file or model data that are not included elsewhere. Such information may include notes on validation level, model limits, usage assumptions, etc.  
  
NOTE: It is recommended that the argument to the [Notes] keyword be limited to a maximum of 24 lines of text.  
  
The [Notes] keyword can only be used once.

-----  
[Notes] Use this section for any special notes related to the file.

-----  
**Keyword:** [Disclaimer]  
**Required:** No  
**Argument:** Text Block  
**Description:** Legal disclaimer and copyright information  
**Usage Rules:** This keyword provides a place for the user to add a legal disclaimer.  
  
NOTE: It is recommended that the argument to the [Disclaimer] keyword be limited to a maximum of 96 lines of text.

-----  
[Disclaimer] This information is for modeling purposes only, and is not guaranteed.

-----  
**Keyword:** [Copyright]  
**Required:** No  
**Argument:** Text Block  
**Description:** Legal copyright information  
**Usage Rules:** Because model writers may consider the information in these keywords essential to users, and sometimes legally required, design automation tools should make this information available. Any text following the [Copyright] keyword must be included in any derivative models verbatim.  
  
NOTE: It is recommended that the arguments to the [Copyright] keywords be limited to a maximum of 96 lines of text.

-----  
[Copyright] Copyright 2000, XYZ Corp., All Rights Reserved

-----  
**Keyword:** [Support]  
**Required:** No  
**Argument:** Text Block (URL path name)  
**Description:** Specifies a web site that can be visited to get the latest version of the file.  
**Usage Rules:** Following the [Support] keyword is the URL of a web site the user may visit for more information on the model or model(s). The entire link, including any file extension, is required. The [Support] keyword may appear only once between the [Begin



Header]/[End Header] keyword pair.

NOTE: It is recommended that a separate IBIS model web site (not page) be maintained to prevent accidental changes of page name from breaking this link.

-----  
[Support] <http://www.VendorNameIbisModels.com> |example ibis web site root

=====  
Keyword: [Redistribution]  
Required: Yes  
Argument: Text String (Yes, No, Specific)  
Description: Indicates to EDA tool companies and model users who may use and redistributed this file.  
Usage Rules: Following the [Redistribution] keyword is one of three arguments: "Yes", "No" and "Specific".

An argument value of "Yes" means that a EDA tool vendor or end user may freely distribute the model as long as no fee is charged. A fee may be charged if authorized by the model creator.

An argument value of "No" means that the model may not be redistributed or retransmitted in any form.

An argument value of "Specific" means that specific license information is contained in the [Redistribution Text] field.

Use of the "Specific" or "No" argument prevents automated redistribution.

-----  
[Redistribution] Yes

=====  
Keyword: [Redistribution Text]  
Required: Yes, ONLY if [Redistribution] value is "Specific", otherwise it is optional  
Argument: Text block  
Description: Allows model creator to supply specific redistribution information.  
Usage Rules: If the argument to the [Redistribution] keyword is 'Specific', then the user must include additional information on licensing details, or where to find them.

Note: It is recommended that the argument to the [Redistribution Text] keyword be limited to a maximum of 24 lines of text.

-----  
[Redistribution Text] Your text goes here.

=====  
Keyword: [End Header]  
Required: Yes  
Argument: None  
Description: Marks the end of an IBIS Connector header section.  
Usage Rules: [End Header] must be the last keyword in any IBIS Connector header section.

-----  
[End Header]

=====  
**6.0 GLOBAL KEYWORDS**  
=====

Keyword: [Comment Char]  
Required: No  
Argument: Text String  
Description: Defines a new comment character to replace the default  
"|" (pipe) character, if desired.  
Usage Rules: The new comment character to be defined must be followed by  
the underscore character and the letters "char". For example:  
"|\_char" redundantly redefines the comment character to be  
the pipe character. The new comment character is in effect  
only following the [Comment Char] keyword. The following  
characters MAY be used:

! " # \$ % & ' ( ) \* , : ; < > ? @ \ ^ ` { | } ~

If used, the [Comment Char] keyword can only appear after the  
Begin Header] and [IBIS-X Ver] keywords. A file may contain  
multiple [Comment Char] keywords

-----  
[Comment Char] |\_char

=====  
**7.0 CONNECTOR MODEL FAMILY KEYWORDS**  
=====

Keywords: [Begin Cn Model Family]  
Required: Yes, NA is the null string  
Argument: Test String  
Description: The name of the connector family in this file.  
Usage Rules: This command starts the wrapping of connector family information.  
Only a single occurrence of each [Cn Model Family]

-----  
[Begin Cn Model Family] NA

=====  
Keyword: [Manufacturer]  
Required: Yes  
Argument: Text String  
Description: Specifies the component manufacture's name  
Usage Rules: Blank characters are allowed.???

-----  
[Manufacturer] XYZ Corp.

=====  
Keywords: [Cn Family Description]  
Required: Yes

Argument: Text Block  
Description: Provides a concise yet easily human-readable description of this connector family.  
Usage Rules: It is recommended that a maximum of 4 lines be used.

Only a single occurrence of [Cn Family Description] is allowed in the file. This key word must be wrapped between Begin [Cn Model Family] and [End Cn Model Family]

-----  
[Cn Family Description]  
High density backplane interconnect system the IEEE9999 standard.

=====  
Keywords: [Cn Model List]  
Required: Yes  
Argument: Text Block  
Description: For each connector described in this file an entry is provided which names the connector specifies it's mating, minimum slew time (for which the model is valid), and provides a link to a picture of the connector.  
Usage Rules: Defines which models are present in the file. This key word must be wrapped between Begin Cn Model Family] and [End Cn Model Family]

-----  
[Cn Model List]  
|                   Name                   Mating                   Min\_Slew\_Time                   Image  
|-----

The order of the columns must remain in the left to right order as shown. The data fields are space delimited.

Description of the fields:

-----  
Name: This is the name associated with the "model name" sub-parameter in the [Begin Cn Model] keyword.

Mating: At least one of these "Mating" choices is required

Valid mating types are:

Mated  
UnMated\_Side\_A  
UnMated\_Side\_B

Mated: Both halves of the connector are mated together for the model.

UnMated\_Side\_A: A model of non-mated connector. Typically, this would be the connector half that is attached to a baseboard

UnMated\_Side\_B: A model of non-mated connector. Typically, this would be the connector half that is attached to a daughter card, cable, or edgecard.

Using two unmated models in series DOES NOT provide a correct model of a mated connector.

Unmated models are likely to be used in backplanes, motherboards, or buses.

Min\_Slew\_Time

Min\_Slew\_Time is required and specifies the minimum slew time (i.e. fastest edge) for any signal using this model. This is a 20% to 80% slew time. This term does not indicate the bandwidth of the actual connector. Rather, this term is used to define a usage limit of the model.

It is strongly recommended that a CAE tool to issue a warning if this parameter is exceeded in the simulation?

Image

Image is optional and specifies an associated image file. The image file shall be either a .jpg or .txt (ASCII) formatted picture.

It is suggested that EDA tools provide a viewer for the .jpg format and that model builders provide at least one picture for a connector.

The same image file may be repeated for all model types if desired.

Images if present should be maintained in the same directory with the connector model file or stored in the same compressed file with the connector to insure they files remained paired.

Suggested .jpg image attributes:

- size = 160 horizontal by 120 vertical (pixels)
- color = 24 bit
- Image quality = 85%

Larger or smaller images may be used but are not recommended. A standard image size will allow EDA tools to provide uniform look and feel for images from all vendors. The size was chosen to be a small disk file size and be useful as either a thumb-nail in a model selection window or scaled up to give a larger picture. The 160x120 was chosen as a perfect 4:1 scale in both axis of a 640x480 picture.

The connector model MUST be considered valid by EDA tools even if an image file is specified but is missing.

```
-----  
-----  
[Cn Model List]  
-----  
Name           Mating      Min_Slew_Time  Image  
-----  
MyModelExample6  Mated       100ps          MyModelExample6.jpg  
HDI_TEST_202_UnMatedA  UnMated_Side_A 100ps          HDI_TEST_202_UnMatedA.jpg  
HDI_TEST_202_UnMatedB  UnMated_Side_B 100ps          HDI_TEST_202_UnMatedB.jpg  
HDI_TEST_202_ThruHole_to_Cable Mated        25ps          HDI_TEST_202_Mated.jpg  
HDI_TEST_202_SMT_to_Cable  Mated        25ps          HDI_TEST_202_Mated.jpg  
HDI_TEST_202_SMT_to_ThruHole Mated        25ps          HDI_TEST_202_Mated.jpg
```

=====  
**Keywords:** [Begin Cn Model]  
**Required:** Yes  
**Argument:** none  
**Description:** Used to define the model name, model parameters and the assignment of single or multiple sections of connector models as defined in the [Begin Cn Model List]. These sections define the R,L,C information making up the actual simulation data for the connector.  
**Sub-Params:** Cn\_Model\_type, Model\_PinMap\_A, Model\_PinMap\_B, GSR, Cn\_Section, Cn\_Fork, Cn\_EndFork  
**Usage Rules:** The keyword [Begin Cn Model] must be followed by five required parameters in the following order:

Model Sub-Parameters:

**Model\_Name**

**Required:** Yes  
**Argument:** Text String  
**Description:** Used to define the model name.

**Cn\_Model\_Type**

**Required:** Yes  
**Argument:** SLM\_Quiescent, SLM\_EvenMode, SLM\_OddMode, or MLM  
**Description:** Used to define the type of connector model.  
**Usage Rules:** Must be located between [Begin Cn Model] and [End Cn Model]. Must be either SLM or MLM

**Options:** SLM\_Quiescent, SLM\_EvenMode, SLM\_OddMode

These option indicate this model is some type of "single-line model"

**SLM\_Quiescent:** SLM model matrix assumes that all other neighboring signals are not switching.

**SLM\_EvenMode:** SLM model matrix assumes that all other neighboring signals are switching in the even mode. (i.e. all neighbors transition at the same time and in the same edge direction as the modeled pin.)

**SLM\_OddMode:** SLM model matrix assumes that all other neighboring signals are switching in the odd mode. (i.e. - all neighbors transition at the same time and in the opposite edge direction as the modeled pin.)

ALL SLM sections MUST be specified using a matrix that is described by only the diagonal terms.

Only SLMs with a defined reference or return path can be created. The connector pins used as the return path should be specified as "GND" in the matrix.

Option: MLM  
MLM indicates this model is a "multi-line model" and is a coupled or partially coupled model. Any combination of Diagonal\_matrix, Sparse\_matrix, Banded\_matrix, or Full\_matrix may be used in an MLM model.

SPECIAL NOTICE: Only an MLM can include coupling effects

Example: Cn\_Model\_type = SLM\_Quiescent

#### Model\_PinMap

Required: Yes  
Argument: Text String  
Description: Used to define the name of the pin map for "side a" of the connector.  
Usage Rules: Must be located between [Begin Cn Model] and [End Cn Model]. The field ModelPinMap\_A be less than 20 characters. ModelPinMap\_A must appear before ModelPinMap\_B. This field is used to name one of the two ports of each connector terminal.

Under most conditions, these will be the same Name ModelPinMapA, however two variables are required to address crossover pin mapping.

Example: ModelPinMap = Baseboard\_side

#### Cn\_Section

Required: Yes  
Argument: Text String  
Description: Used to define a straight through section of a connector model. Matrix sections are interconnected, scaled and may be re-used to form a connector model.  
Usage Rules: Sub-parameters "multiplier" and "section name" must follow the Cn\_Section parameter.

The multiplier is a scale factor.

The "section name" is the name of the section as specified under the [Begin Cn Section] keyword.

The multiplier may be used to scale any named section. The multiplier may be any positive value greater than zero. The multiplier allows a matrix section to be re-used as a scaled value. The scale factor is applied to each parameter of all matrices resulting in scaled R,L, and C matrices.

Any number of Cn\_Section may be used, however only one keyword is allowed per line.

Each scale factor and section name MUST be separated by at least one space. Each sub-parameter pair MUST be separated by at least one space.

Cn\_Section must appear after the keyword [Begin Cn Model] and before the keyword [End Cn Model].

Example: Cn\_Section 1.0 SectionA

#### General Cn\_Section and Cn\_Fork Notes

Each Cn\_Section is connected in series with the previous Cn\_Section.

Named sections are NOT specified in per-unit-length. They are specified as unit-less total R,L,C values for the given section.

#### Cn\_Fork, Cn\_EndFork

Required: Yes, if there are forks in the connector being modeled.  
Argument: Text String  
Description: Used to define a branch current path in connector model. Thus allowing greater than two ports per any connector pin.

At a fork, a "tee" section is created. Matrix sections are connected to the previous section and interconnected to Zero or more sections between Fork and Endfork. If no pin map name is placed between a Fork and Endfork block, then the fork constitutes a stub. However, if a pin map name is placed within the Fork and Endfork block, an externally available port is created on the connector.

Usage Rules: Any number of Cn\_Fork statements may be used, however only one keyword is allowed per line.

Each scale factor and section name MUST be separated by at least one space. Each sub-parameter pair MUST be separated by at least one space.

Cn\_Fork must appear after the keyword [Begin Cn Model] and before the keyword [End Cn Model].

Example: Cn\_Fork  
Cn\_EndFork

=====  
"Cn Model" Examples  
=====

**Example 1: (a simple single line model with one section)**

```
[Begin Cn Model]
Cn_Model_Type = SLM_Quiescent
Model_Name = MyModelExample1
Model_PinMap = Baseboard_side
Model_PinMap = Daughtercard_side
GSR = 3:1
Cn_Section 1.0 Diagonal_matrix1
.
.
```

```
[End Cn Model] MyExample1
```

**Example 2: (2 ports per pin, 5 sections straight through)**

```
          SectA          SectB          SectC          SectD          SectE
Port1 >-----< >-----< >-----< >-----< >-----< Port2
[Begin Cn Model]
Cn_Model_Type = SLM_Quiescent
Model_Name = MyModelExample2
Model_PinMap = MyModelPinMapA
Model_PinMap = MyModelPinMapB
GSR = 3:1
MyModelPinMapA
Cn_Section 1.0 SectA
Cn_Section 1.0 SectB
Cn_Section 1.0 SectC
Cn_Section 1.0 SectD
Cn_Section 1.0 SectE
MyModelPinMapB
.
.
.
[End Cn Model]
```

**Example 3: (2 ports per pin, 2 series sections with one stub)**

```
          SectionA          SectionB
Port1 >-----< >-----< Port2
          |
          StubSection1

[Begin Cn Model]
Cn_Model_Type = MLM
Model_Name = MyModelExample3
Model_PinMap = MyModelPinMapA
Model_PinMap = MyModelPinMapB
MyModelPinMapA
Cn_Section 1.0 SectionA
Fork
Cn_Section 1.0 StubSection1
Endfork
Cn_Section 1.0 SectionB
MyModelPinMapB
.
.
.
[End_Cn_Model]
```

**Example 4: (2 ports per pin, 2 stub sections, one stub matrix is re-used)**

```
          A          B          C
Port1 >-----< >-----< >-----< Port2
          |          |          |
          |stub1      |stub4
          |stub2
          |stub3

[Begin Cn Model]
Cn_Model_Type = MLM
Model_Name = MyModelExample4
Model_PinMap = MyModelPinMapA
Model_PinMap = MyModelPinMapB
MyModelPinMapA
Cn_Section 1.0 A
```



```

Fork
Cn_Section 1.0 stub1
Cn_Section 1.0 stub2
Cn_Section 1.0 stub3
Endfork
Cn_Section 1.0 B
Fork
Cn_Section 1.0 stub4
Endfork
Cn_Section 1.0 C
MyModelPinMapB
.
.
.
[End_Cn_Model]

```

**Example 5: (2 ports per pin, 3 stubs)**

```

          A          B          C          D
Port1 >-----< >-----< >-----< >-----< Port2
          |Stub1   |Stub2   |Stub1
          |         |Stub3
          |         |Stub4

```

```

[Begin Cn Model]
Cn_Model_Type = MyModelExample5
Model_Name = MyModel4
Model_PinMap = MyModelPinMapA
Model_PinMap = MyModelPinMapB
MyModelPinMapA
Cn_Section 1.0 A
Fork
Cn_Section 1.0 Stub1
Endfork
Cn_Section 1.0 B
Fork
Cn_Section 1.0 Stub2
Cn_Section 1.0 Stub3
Cn_Section 1.0 Stub4
Endfork
Cn_Section 1.0 C
Fork
Cn_Section 1.0 Stub1
Fork
Cn_Section 1.0 D
MyModelPinMapB
.
.
.
[End Cn Model]

```

**Example 6: (3 ports per pin, 2 stubs)**

```

          A          B          C          D
Port1 >-----< >-----< >-----< >-----< Port 2
          |Stub1   |Stub2   |Stub1
          |         |Stub3
          |         |Stub4
                    Port3

```

```

[Begin Cn Model]
Cn_Model_Type = MLM
Model_Name = MyModelExample6
Model_PinMap = MyModelPinMapA

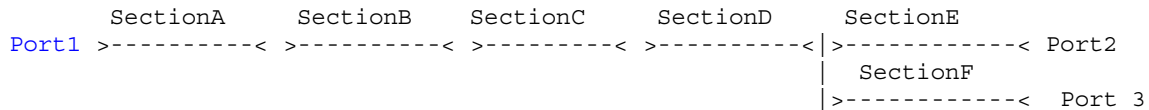
```

```

Model_PinMap = MyModelPinMapB
Model_PinMap = MyModelPinMapC
MyModelPinMapA
Cn_Section 1.0 A
Fork
Cn_Section 1.0 Stub1
Endfork
Cn_Section 1.0 B
Fork
Cn_Section 1.0 Stub2
Cn_Section 1.0 Stub3
Cn_Section 1.0 Stub4
MyModelPinMapC
Endfork
Cn_Section 1.0 C
Fork
Cn_Section 1.0 Stub1
Fork
Cn_Section 1.0 D
MyModelPinMapB
.
.
.
[End Cn Model]

```

**Example 7: (3 ports per pin, 5 sections straight through)**



```

[Begin Cn Model]
  Cn_Model_Type = SLM_Quiescent
  Model_Name = MyModelExample7
  Model_PinMap_A = MyModelPinMapA
  Model_PinMap_B = MyModelPinMapB
  Model_PinMap_B = MyModelPinMapC
  GSR = 3:1
  Cn_Section 1.0 SectionA
  Cn_Section 1.0 SectionB
  Cn_Section 1.0 SectionC
  Cn_Section 1.0 SectionD
  Cn_Fork
  Cn_Section 1.0 Cn_SectionF
  MyModelPinMapC
  Cn_EndFork
  Cn_Section 1.0 SectionE
.
.
.
[End Cn Model]

```

```

=====
Keywords: [Cn Model Description]
Required: No
Argument: Text Block
Description: Provides a concise yet easily human-readable description of
            this connector model

```

Usage Rules: This keyword may appear multiple times in the file however it may appear only once between each pair of [Begin\_Cn\_Model]/[End\_Cn\_Model] keywords.

-----  
[Begin Cn Model Description]

High Density 0.1 center square pin with PCB effects

=====  
Keyword: [Cn Number of Conductors]

Required: Yes, when [Begin Cn Auto Map] is NOT used

Argument: Numeric Value

Description: Number of current carrying conductors used in the model. It is assumed that all matrices in for the associated connector model will have the SAME number of indices. This also defines the size of the expected Matrix(s) unless the optional [Begin Cn Swath] keyword is used.

Usage Rules: If the [Begin Cn Pin Map] keyword is in use in this model then a single numeric value from 1 to 100000 is recommended. Larger values shall create warnings by the parser. Smaller values shall create errors by the parser.

If the [Begin Cn Auto Map] keyword is in use in this model then a range MUST be specified from 1 to 100000 is recommended. Larger values shall create warnings by the parser. Smaller values shall create errors by the parser.

If the [Begin Cn Auto Map] keyword is also used for this connector model than a range MUST be specified as a minimum values to a maximum value (see example below). If the [Begin Cn Auto Map] is not used than a single fixed number of conductors must be specified.

This keyword MUST BE USED BETWEEN KEYWORDS  
[Begin Cn Model] and [End Cn Model].

Fixed sized connector example:

-----  
[Cn Number of Conductors] 8

=====  
Keyword: [Cn Col of Pins]

Required: Yes, when [Begin Cn Auto Map] is NOT used

Argument: Numeric Value

Description: The number of columns of pins for a non-rectangular connectors the maximum number of pins "across" the connector should be specified.

Usage Rules: If the keyword [Begin Cn Auto Map] is present in this connector model than the keyword VARIABLE MUST be used to indicate a variable width connector.

Else a numeric value from 1 to 100000 is recommended. Larger values shall create warnings by the parser. Smaller values shall create errors by the parser.

If the keyword VARIABLE is used it must be all upper case.

This keyword pair MUST BE USED BETWEEN KEYWORDS  
[Begin Cn Model] and [End Cn Model].

That is it MUST BE specified after the keyword  
[Cn Number of Conductors] for this model.

-----  
| For fixed sized connector models use a single numeric value as shown below  
[Cn Columns of Pins] 4

| For variable size connector models using the [Begin Cn Auto Map] keyword  
| the special keyword VARIABLE may be used to indicate this axis is variable  
| width.  
[Cn Col of Pins] VARIABLE

=====  
**Keyword:** [Cn Rows of Pins]  
**Required:** Yes, when [Begin Cn Auto Map] is NOT used  
**Argument:** Numeric Value  
**Description:** The number of rows of pins.  
For a non-rectangular connectors the maximum number of pins  
"down" the connector should be specified.  
**Usage Rules:** A numeric value is required following the keyword to specify  
the number of rows this connector model requires.  
A numeric value from 1 to 100000 is recommended. Larger  
values shall create warnings by the parser. Smaller values  
shall create errors by the parser.

This keyword pair MUST BE USED BETWEEN KEYWORDS  
[Begin Cn Model] and [End Cn Model].

That is it MUST BE specified after the keyword  
[Cn Number of Conductors] for this model.

-----  
[Cn Rows of Pins] 2

=====  
**Keywords:** [Cn Col Swath]; [Cn Row Swath]  
**Required:** No, except if [Define Cn Auto Map] is used or if the number  
of matrix entries does not match the number defined by  
[Cn Number of Conductors] for [Cn Pin Map].  
**Argument:** Numeric Values  
**Description:** Describes a "swath" which is a smaller matrix used to  
represent connectors of equal or larger size and the matrix  
order convention. To visualize this, consider the swath matrix  
being a smaller version of the connector. The edges of the  
matrix represent the same edge effects that exists in the full  
size connector. The center area of the matrix represents the  
same effects as the center of the full size connector.

It is the responsibility of the EDA tool to use the matrix and  
the required keyword information as a "mini" connector that is  
centered about the electrical paths of interest and/or to  
expand this information into a larger sized swath up to the  
full sized connector itself.

For example a 2x8 matrix might be expanded to represent a  
connector that is 2x100. The "swath" can also be combined with  
the [Begin Cn Auto Map] keyword to create multiple connector  
models from a single description. For example a 2x10 matrix  
might be used to represent connectors ranging from 2x10 to  
2x200 with a single descriptive model.

**Usage Rules:** Only one [Cn Column Swath] or [Cn Row Swath]

shall be used per connector model.

MUST BE USED between keywords [Begin Cn Model] and [End Cn Model].

MUST BE specified after

[Cn Number of Conductors], [Cn Rows of Pins], and  
[Cn Columns of Pins] have been specified for this  
connector model.

MUST be followed by 6 numbers in order as follows:

- 1) Rows in the swath matrix
- 2) Columns in the swath matrix
- 3) LEFT EDGE: Columns in the swath matrix used to represent  
left edge
- 4) RIGHT EDGE: Columns in the swath matrix used to represent  
right edge
- 5) TOP EDGE: Rows in the swath matrix used to represent top  
edge
- 6) BOTTOM EDGE: Rows in the swath matrix used to represent  
bottom edge

Please see the example below to see how these are used with  
the keyword

Note, the orientation is with respect to 'side A' of the  
connector.

Full sized swath: If the [Cn Number of Conductors] value is  
the same as the number of matrix pin entries for  
[Begin Cn Section] then neither [Cn Column Swath] nor  
[Cn Row Swath] are used. The matrices must be ordered  
exactly as the pins listed under [Begin Cn Pin Map].

Smaller sized swath: The swath matrix must contain a set of  
pins documenting a complete rectangular section organized by  
rows and columns. [Cn Row Swath] describe the pins ordered  
by rows (starting with the top row), and [Cn Column Swath]  
describe the same information ordered by columns (starting  
with the left column from a "side A" perspective).

For example, consider a swath that documents rows A and B  
and columns 1, 2, and 3 of a six pin rectangular  
[Cn Column Swath] describe pins ordered by columns (for  
example, A1, B1, A2, B2, A3, B3), and [Cn Row Swath] defines  
pins ordered by rows (for example, A1, A2, A3, B1, B2, and  
B3).

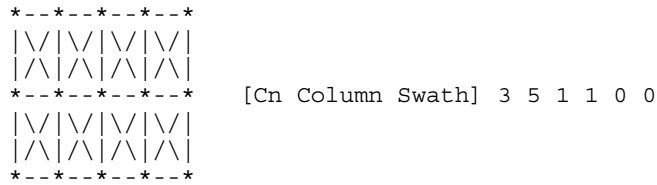
When a smaller sized swath is defined for a fixed pin map as  
defined by [Begin Cn Pin Map], the pin order must be grouped  
in the same order (by rows or by columns) as the given by  
EITHER [Cn Row Swath] or [Cn Column Swath]

The edge effects describe the edge rows or columns that do  
not contain all of the coupling effects (from both sides)  
that the centermost rows or columns. This information is  
useful for "swath expansion" when determining what larger  
size to use.

When the swath represents a SLM or else documents all of the  
pins in a physical connector, the off diagonal entries are 0  
by convention. If the swath describes a section with few  
columns, but the same number of rows as the physical

connector, then the row edge effects are 0 by convention. Similarly, if the swath describes a section with fewer rows, but the same number of columns as the physical connector, then the column edge effects are 0 by convention.

In a fully coupled swath where all pins couple to all others, all of the rows or columns except for the one designated as the centermost row or column can have edge effect simplification. So the number of rows or columns can extend to all but the center row or column. On the other hand, a coupling pattern that extends over a few columns may result in a smaller number of edges designated. Below is an example of a 3 row by 5 column swath, where the lines in a rectangular connector represent the electrical coupling:



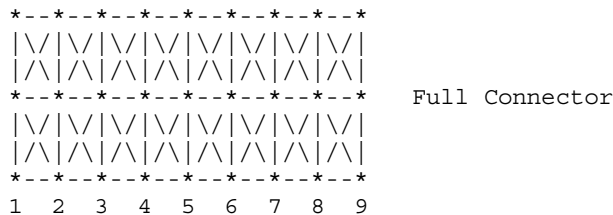
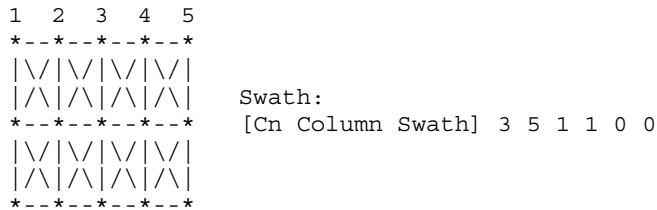
Notice that columns 2, 3, and 4 have the maximum amount of coupling from each side. In this case the edge effect columns 1 and 5 do not have coupling from both sides.

Application of Swath Matrices:

For the purposes of this discussion a 3 row by 5 column swath is used and the full sized connector is 3 rows by 9 columns. The swath matrix data can be organized by [Cn Column Swath] or [Cn Row Swath] pin ordering convention. However, the column expansion algorithms discussed later can be implemented using the [Cn Column Swath] format.

Three methods can be used to apply the Swath matrix information:

- (1) Centering the Swath around the pins of interest



The Swath above is centered about column 4. The paths of

interest including those of columns 3 and 5 are also described by swath matrix data that has coupling from both sides. However, because of edge effects, columns 2 and 6 are less accurately approximated.

The centering algorithm is a way to map the swath matrix pins directly into the corresponding pins of the actual connector.

When the signals of interest are at the left or right edges, the swath would normally be positioned just to the edges. For example, column 1 of the swath matrix would line up with column 1 of the connector.

- (2) Expansion and Centering: Expanding the Swath matrix into a larger sized Swath matrix and centering it about the paths of interest.

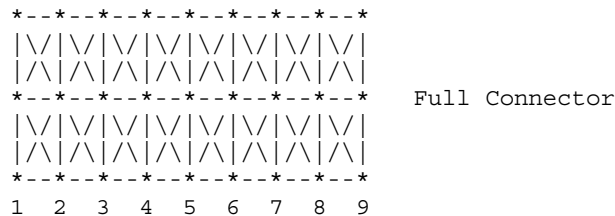
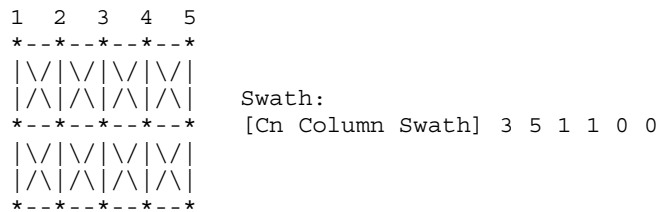
This approach is the same as centering. However, the signal pins of interest might have more columns than the non-edge section of the swath. One solution is to expand the swath to a larger swath and then use the larger swath for centering. This is a subset of expanding the swath into the full sized connector.

Some EDA tools work with the a larger swath, and other tools work with full sized connectors. A larger swath might be constructed to span the number of columns of interest plus the edge effect columns to assure that the most accurate coupling information from both sides is used for the columns of interest.

- (3) Expansion to Full Sized Connector: Expanding the swath matrix to the full sized connector matrix. the Full-sized matrix

There are three steps to this procedure (a, b, and c below). This is illustrated using the 3 row, 5 column swath and showing how it is expanded into a 3 row, 9 column full sized connector

- (a) Copy the left column pattern



The matrix data for swath columns 1 and 2 (including forward references) copied into the new full connector matrix.

(b) repeat the center pattern,

```

1 2 3 4 5
*--*--*--*--*
|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|
*--*--*--*--*
|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|
*--*--*--*--*

```

Swath:  
[Cn Column Swath] 3 5 1 1 0 0

```

*--*--*--*--*--*--*--*--*--*
|\|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
*--*--*--*--*--*--*--*--*--*
|\|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
*--*--*--*--*--*--*--*--*--*
1 2 3 4 5 6 7 8 9

```

Full Connector

Starting at the center of the swath, the coupling pattern of just the center column (column 3 in this example) is copied for the connector matrix. In this case, the coupling pattern extends forward to the next column. The pattern is copied by mapping the swath pin numbers into the connector pin numbers and copying the center column forward referenced data. In this example, the operation starts at the full connector column 3 and ends upon completion at the full connector column 7.

(c) Copy the right column patterns

```

1 2 3 4 5
*--*--*--*--*
|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|
*--*--*--*--*
|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|
*--*--*--*--*

```

Swath:  
[Cn Column Swath] 3 5 1 1 0 0

```

*--*--*--*--*--*--*--*--*--*
|\|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
*--*--*--*--*--*--*--*--*--*
|\|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
|/|\|/|\|/|\|/|\|/|\|/|\|/|\|
*--*--*--*--*--*--*--*--*--*
1 2 3 4 5 6 7 8 9

```

Full Connector

The final step is similar to Step (a), but concluded using the right side of the swath. When the swath is positioned against the right edge as shown, then the coupling patterns for the swath columns are duplicated for the final columns of the full sized connector. So the patterns of swath columns 4 and then 5 are duplicated for the full sized connector columns 8 and 9.



A similar process could be created for expanding the number of rows. Some details are left to the EDA tool to implement. For example, if the swath contains an even number of columns, then either the left of center or the right of center column may be used for center section expansion.

```
-----
                SwathRows SwathCols LeftEdge RightEdge TopEdge BottomEdge
[Cn Column Swath]      2         8         1         1         0         0
```

```
=====
***** For Variable size connectors ONLY *****
```

```
Keywords:  [Begin Cn Auto Map]
Required:  If the [Begin Cn Pin Map] keyword is NOT present than this
           keyword is required else it shall not be used.
Argument:  None
Description: Using the [Begin Cn Auto Map] keyword indicates that this
            connector is variable size and will be automatically created by
            a EDA tool such as a simulator using the algorithm defined
            below.
```

This keyword allows a tool like a simulator to create the pin map and connector map automatically for a connector by first determining the total number of pins need for the particular schematic/PCB layout or requested from the user interface and then executing the algorithm until the desired number of pins is created.

The Auto Map section contains a simple program function that provides the algorithm for generating the signal and pin names. The function must be written in a simplified form of the 'C' programming language.

The function may include:

- The built in variables ROW and COLUMN the result variables SIGNAL\_NAME and PIN\_NAME
- Integer variables, simply created on usage.
- Integer constants e.g 55
- String constants enclosed by double quotes e.g. "example"
- Character constants enclosed in forward single quotes e.g. 'a'
- The mathematical operators + - \* / %
- Boolean operators > < >= <= == AND OR
- Statements terminated by a semicolon
- The formatting function printf(<template string>, <list of variables>) the conditional statements if (<expression>) { <statement> } else { <statement> }

The formatting template string may include the following substitution sequences:

```
%d  decimal number
%c  character
%s  string
%%  a percent character
```

Notes:

- 1) Variable map creation should only be used for connectors that are non-industry standard pin outs. For example an ISA, SCSI, or PCI bus connector should not use the [Begin Cn Auto Map] keyword as the signal names would not match generally defined signal names. It may be desired to create multiple models for some connectors for example: The model for a square pin connector might have two industry standard pin outs like 34 pin floppy and 50 pin SCSI and also a generic 8 to 100 pin model. The Generic version could use the variable size model and the 34 and 50 pin connectors would use fixed size models.
- 2) Signal names are automatically generated and may not be useful for identifying nets. The EDA tools should give priority to identifying connectivity with pin names if this keyword is used.

Usage Rules: 1) The keyword [Begin Cn Auto Map] replaces the {Begin Cn Pin Map} keywords. These other keywords are not valid in the same model as the [Begin Cn Auto Map] keyword.  
 2) If the keyword [Begin Cn Auto Map] is used than the connector model must be defined using the [Begin Cn Swath] keyword.

Usage Context: MUST BE USED after keywords [Begin Cn Model] and [End Cn Model].

Example one:

```
-----
row_letter = 'a' + ROW - 1;
SIGNAL_NAME = sprintf("Signal_%c%d", row_letter, COLUMN);
PIN_NAME = sprintf ("%c%d", row_letter, COLUMN);
```

| This function results in pin and signal names as follows:

| Pin Name | Signal Name |
|----------|-------------|
| a1       | Signal_a1   |
| a2       | Signal_a2   |
| ....     | ....        |
| b1       | Signal_b1   |
| ....     | ....        |

Example one can be condensed to:

```
SIGNAL_NAME = sprintf("Signal_%c%d", ROW + 'a' - 1, COLUMN);
PIN_NAME = sprintf ("%c%d", ROW + 'a' - 1, COLUMN);
```

Example Two (with conditional)

```
if ((ROW < 5) OR (ROW > 7))
{
    SIGNAL_NAME = sprintf("Signal_%c%d", ROW + 'a' - 1, COLUMN);
    PIN_NAME = sprintf ("%c%d", ROW + 'a' - 1, COLUMN);
}
else
{
    SIGNAL_NAME = "NA";
    PIN_NAME = "NA";
}
```

-signal names may also be defined by either algorithm or using one of the fixed reserved names:

- PWRGND- reserved model name, used with power or ground pins,
- POWER - reserved model name, used with power supply pins,
- RET - reserved word indicating either power or ground used
- GND - reserved model name, used with ground pins,
- NC - reserved model name, used with no-connect pins,
- NA - used where data not available.

=====

**Keywords:** [Cn Col Range]

**Required:** If the [Begin Cn Auto Map] keyword is present than this keyword is required else it shall not be used.

**Argument:** Numeric Values

**Description:** Used to define the minimum and maximum number of columns of pins for the connector represented by this model. The simulator will not expand or reduce the matrix beyond the limits defined by this parameter.

**Usage Rules:** [Cn Col Range] Must be followed by two numbers. The first number relates to the minimum number of conductor columns. The second number is the maximum number of conductor columns

**Usage Context:**

MUST BE USED after keywords [Begin Cn Auto Map] and [End Cn Auto Map].

**Example:** This example is of a connector that may have 9 to 25 columns

[Cn Col Range] 9 25

=====

**Keywords:** [Cn Row Range]

**Required:** If the [Begin Cn Auto Map] keyword is present than this keyword is required else it shall not be used.

**Argument:** Numeric Value

**Description:** Used to define the minimum and maximum number of rows of pins for the connector represented by this model. The simulator will not expand or reduce the matrix beyond the limits defined by this parameter.

**Usage Rules:** [Cn Row Range] Must be followed by two numbers. The first number relates to the minimum number of conductor columns. The second number is the maximum number of conductor columns

**Usage Context:** MUST BE USED after keywords [Begin Cn Auto Map] and [End Cn Auto Map].

**Example:** This example is of a connector that may have 2 to 5 rows

[Cn Col Range] 2 5

=====

**Keywords:** [End Cn Auto Map]

**Required:** If the [Begin Cn Pin Map] keyword is NOT present than this keyword is required else it shall not be used.

**Argument:** None

**Description:** Provides end to [Begin Cn Auto Map]

```

=====
Keywords: [End Cn Model]
Required: Yes
Argument: Text Block
Description: Used to define the end of the connector model
=====

```

```

=====
Keywords: [Cn Matrix Index]
Required: If the [Cn Auto Map] keyword is NOT present
          this keyword is required else it shall not be used.
Description: Relates connector pin number to matrix location.
=====

```

Physical Connector

```

P1 X X X X X X X X X X P10
P11 X X X X X X X X X X P20

```

|       | Col1 | Col2 | Col3 | Col4 | . . . | Col20 |
|-------|------|------|------|------|-------|-------|
| Row1  | 1,1  | 1,2  | 1,3  | 1,4  | . . . | 1,20  |
| Row2  | 2,1  | 2,2  | 2,3  | 2,4  | . . . | 2,20  |
| Row3  | 3,1, | 3,2  | 3,3  | 3,4  | . . . | 3,20  |
| Row4  | 4,1  | 4,2  | 4,3  | 4,4  | . . . | 4,20  |
| .     | .    | .    | .    | .    | .     | .     |
| Row20 | 20,1 | 20,2 | 20,3 | 20,4 | . . . | 20,20 |

Describes the physical layout of the connector for use with Non-Swath matrices.

Relates connector pins to matrix position. This keyword is used to map the pin name to the Pin number to matrix position

Usage Rules: This keyword MUST be placed outside the [Begin Cn Model]/ [End Cn Model] keywords to allow it to be reused. if desired.

This keyword may only be used once in a file

```

=====
[Cn Matrix Index]

```

```

|  ??? ?  !!!Cn_Name = 20PinHdiPhy

```

| Pin | Matrix Index |                                                  |
|-----|--------------|--------------------------------------------------|
| A1  | 1            |                                                  |
| A2  | 2            |                                                  |
| A3  | 3            |                                                  |
| A4  | 5            |                                                  |
| A5  | 4            | <---- Allows the pins to map to what ever matrix |
| A6  | 6            | order generated by a field simulator             |
| .   | .            |                                                  |
| .   | .            |                                                  |
| .   | .            |                                                  |

-----  
**Keywords:** [Cn Pin Map]  
**Required:** If the [Begin Cn Auto Map] keyword is NOT present than this keyword is required else it shall not be used.  
**Argument:** Text String  
**Description:** Describes the index into the matrix for which a given pin Applies and the reference to the physical map.  
**Sub-Params:** Pin, ModelPinMapName  
**Usage Rules:** The ModelPinMapName fields are required and must be less than 20 characters. The ModelPinMapName fields MUST appear after the [Cn Pin Map]. This name is used by the [Begin Cn Model] keyword to reference a connector pin map.

More than one [Begin Cn Model] record may reference the same pin map.

The keyword NA indicates that there is not a pin in the location (e.g. PGA socket with corner pin missing)  
An end of line character indicates the end of the information for the row

There shall be one line for each pin in this connector model.

The 'Pin' name allows EDA tools to align pin names in the model with pin names in the net list.

The "Signal" name can be based on application but recommended if applicable. NA should be used to indicate this field is not available.

Maximum of 20 characters allowed for Pin Name  
Maximum of 20 characters allowed for Signal Name  
Pin or Signal names longer than 20 should be truncated to 20 to fit this specification.

It is acceptable to have more than one pin map in a file. Therefore the keywords [Cn Pin Map] may appear as a pair more than once in a file.

This keyword pair MUST be placed outside the keyword pair [Begin Cn Model] / [End Cn Model] keywords to allow it to be reused.

There must be a [Cn Pin Map] that is correct for each port.

#### Special Reserved Pin Names

POWER, RET, GND, and PWRGND  
Used to indicate that this pin should be connected to either a decoupled power source (POWER), a ground node (RET or GND), or either a power or ground pin (PWRGND). The keyword RET is available to indicate it is a return pin and could be either power or ground.

-----  
[Cn Pin Map] Baseboard\_side  
|Pin ModelPinMapName  
A1 GND  
A2 D0  
A3 CLK  
A4 D1  
B1 STROBE1

```
B2      A0
B3      POWER
B4      PWRGND
```

```
[Cn Pin Map] Daughtecard_side
```

```
|Pin      ModelPinMapName
```

```
A1      GND
A2      D0
A3      CLK
A4      D1
B1      STROBE1
B2      A0
B3      POWER
B4      PWRGND
```

```
=====  
Keywords: [End Cn Model]
```

```
Required: Yes  
Argument: None
```

```
Description: Defines the end of the connector models for the connector family.
```

```
-----  
[End Cn Model]
```

```
=====  
Keywords: [End Cn Model Family]
```

```
Required: Yes  
Argument: None
```

```
Description: Defines the end of the connector model family.
```

```
Usage Rules: These commands wrap the entire model in this file.
```

```
-----  
[End Cn Model Family]
```

```
=====  
8.0 MATRIX KEYWORDS
```

```
=====  
Keyword: [Begin Cn Section]
```

```
Required: No  
Argument: Text String
```

```
Description: Indicates the beginning and the name of a set of R,L,C matrix data.
```

```
Usage Rules: Each matrix used for given connector model MUST have exactly the same number conductors.
```

```
If the swath method is used the matrix may have fewer conductors than the connector model.
```

```
If the swath method is not used the matrix MUST have exactly the same number of conductors as the connector has pins.
```

```
The matrices used for the R,L,C description can be defined using any of the matrix description methods allowed in the specification. The matrix description methods can also be mixed within a given section. For example the resistance matrix might use the Diagonal_matrix and the inductance matrix might use a Full matrix.
```

MUST be placed outside the context of keywords  
[Begin Cn Model] and [End Cn Model] as sections may be  
reused by more than one connector model.

MUST be placed inside the context of the family

Every pin in the SLM matrix is a separate matrix value.

The following keywords are optional:  
[Resistance Matrix], [Bandwidth], [Row]

Must include [Derivation Method]

For an example of [Begin Cn Section] see matrix examples that follow.

-----

=

=====

```
Derivation Method = xxxxx
  Required: Yes
  Argument: Lumped or Distributed
  Description: Describes the type of model that should be
               enerated from the Matrices.
  Usage Rules: Must be between [Begin Cn Section] and [End Cn
               Section]
```

The [Derivation Method] keyword is required for  
each section.

"Lumped" or "Distributed"

For LUMPED models any single, any pair, or all  
of the following keywords could be used:  
[Inductance Matrix], [Capacitance Matrix] ,  
[Resistance Matrix]

For DISTRIBUTED models BOTH the [Inductance  
Matrix] and [Capacitance Matrix] keywords are  
required. The [Resistance Matrix] keyword is  
optional.

All three matrices within the same section  
share the same derivation method

If ModelType is SLM then simulators should use  
this data to create a non-coupled fully  
distributed transmission line model.  
It may be also be used to create a multi-  
section ladder RLC-LCR model as is often used  
with SPICE simulators.

If a ladder network is substituted for  
a fully distributed transmission line model the  
simulator vendor should insure enough sections  
are provided to insure the bandwidth specified  
by the Min\_Slew\_Time of this model is achieved.  
The symmetric RLC-LCR method should be used as  
opposed to the non-symmetric RLC-RLC method if  
a ladder network is used.

-----

[Derivation Method] LUMPED

=====

Keywords: [Resistance Matrix], [Inductance Matrix], [Capacitance Matrix],  
[Conductance Matrix]

Required: Yes, If a simple single line model is defined then the following matrices are required:

case 1: [Resistance Matrix] only (Not to be used with distributed models

OR

case 2: [Inductance Matrix] and [Capacitance Matrix] only for which the [Resistance Matrix] is assumed to be zero ohms

OR

case 3: [Resistance Matrix] and [Inductance Matrix] and [Capacitance Matrix]

NOTE: In case 1,2,3 the matrices must be Diagonal\_matrix.

If a coupled model is defined then the following matrices are required:

case 4: [Inductance Matrix] and [Capacitance Matrix] only for which the [Resistance Matrix] is assumed to be zero ohms

OR

case 5: [Resistance Matrix] and [Inductance Matrix] and [Capacitance Matrix]

case 6: [Resistance Matrix] and [Inductance Matrix] and [Capacitance Matrix] and [Conductance Matrix]

NOTE: In case 4,5, and 6 the matrices shall be any combination of matrix types (Diagonal, Banded, Sparse, Full).

Argument: Matrix Type

Description: The sub-parameters mark the beginning of a matrix, and specify how the matrix data is formatted.

Usage Rules: For each matrix keyword, use only one of the sub-parameters.

After each of these sub-parameters, insert the matrix data in the appropriate format. (These formats are described in detail below.)

MUST BE USED between keywords [Begin Cn Section] and [End Cn Section].

If the model type in SLM, then only the diagonal matrix is allowed.

Matrix Type Options:

[Diagonal\\_matrix](#), [Banded\\_matrix](#), [Sparse\\_matrix](#), or [Full\\_matrix](#)

[Diagonal\\_matrix](#)

Required: No

Argument: None

Description: The [Diagonal\\_matrix](#) is used to specify uncoupled models.

This sub-parameter is exactly the same as using the [Banded\\_matrix](#) described below with a Bandwidth=0. It has the added benefit of requiring half as many lines.

A [Diagonal\\_matrix](#) is one whose entries are



guaranteed to be zero if they are not on the main diagonal.

Specify the Diagonal\_matrix one row at a time, starting with row 1 and working up to higher rows. Diagonal elements are entered one per line. MUST be used between keywords [Begin Cn Section] and [End Cn Section].

#### Banded\_matrix

Required: No  
Argument: None  
Description: The Banded\_matrix is used to specify the coupling effects up to "X" pins on either side for a given pin.

A Banded\_matrix is one whose entries are guaranteed to be zero if they are farther away from the main diagonal than a certain distance, known as the "bandwidth."

The bandwidth for a Banded\_matrix must be specified using the [Bandwidth] keyword.

Specify the banded matrix one row at a time, starting with row 1 and working up to higher rows. Mark each row with the [Row] keyword.

Symmetry is exploited. Entries other than the main diagonal are not required.

#### Sparse\_matrix

Required: No  
Argument: None  
Description: A Sparse\_matrix is expected to consist mostly of zero-valued entries, except for a few nonzero. Unlike the Banded\_matrix, there is no restriction on where the nonzero entries can occur.

Symmetry can be exploited to reduce the amount of data by eliminating from the matrix any entries below the main diagonal.

An N x N Sparse\_matrix is specified one row at a time, starting with row 1 and continuing down to row N. Each new row is marked with [Row] keyword, as in the other matrix formats.

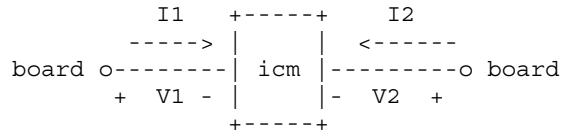
#### Full\_matrix

Required: No  
Argument: None  
Description: When the Full\_matrix format is used, the couplings between every Pair of elements is specified explicitly. Assume that the Matrix has N rows and N columns.

The Full\_matrix is specified one row at a time, starting with Row 1 and continuing down to Row N. Each new row is identified with the [Row] keyword.

### Matrix Descriptions

The resistance, inductance, and capacitance matrices may also be referred to as "RLC matrices" within this specification. When measuring the entries of the RLC matrices, either with laboratory equipment or field-solver software, currents are defined as ENTERING the pins of the package from the board. The corresponding voltage drops are to be measured with the current pointing "in" to the "+" sign and "out" of the "-" sign.



It is important to observe this convention in order to get the correct signs for the mutual inductance and resistances.

For each [Resistance Matrix], [Inductance Matrix], or [Capacitance Matrix] a different matrix type can be used for the data.

### Resistance Matrix Description

```
=====
UNITS: OHMS
DESCRIPTION: The resistance matrix represents the total DC resistance
              between the two ends of this section of the connector.

NOTES:
The resistance matrix is optional. Simulation tools shall
use 0.0 ohms for all diagonal entries and "infinite" for all
off diagonal entries if this matrix is not present.

DO NOT USE ohms/meter as this is the total value and
includes the length of this section.

Values should all appear in the diagonal terms of the
matrix. For example: value 1,1 is the resistance for pin 1
and value 2,2 is the resistance for pin 2.

A "Diagonal_matrix" matrix type is the best choice for
describing the resistance matrix. Diagonal elements
may be dominant. Comparably, the off diagonal elements may
be negligible thus leading to off diagonal element values
of zero leading to the [Diagonal_matrix] format
```

### Inductance Matrix Description

```
=====
UNITS: HENRIES
DESCRIPTION: Two inductance matrix methods are supported:
              Loop-Inductance Matrix for SLMs ONLY (non-coupled)
              Partial-Inductance Matrix for MLMs ONLY (coupled)

If ModelType is SLM then all sections must use loop-inductance
and capacitance matrices.

If ModelType is MLM then all sections must use partial-inductance
```

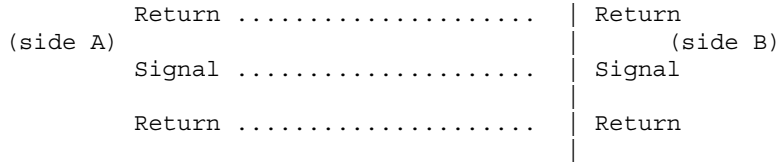
and capacitance matrices.

Loop-Inductance Matrix Description (SLMs ONLY):

=====

DESCRIPTION: To define inductance requires a loop. The loop consists of a closed path including a signal and all possible return paths. The inductance is a coefficient between the emf induced in the loop and the change of magnetic flux through the loop.

connector or section



The return path must include all pins that are power or ground. In a loop inductance matrix, the diagonal terms represent the loop inductance of a specific pin with return currents assumed returned through all pins defined to be power or ground.

NOTES (Single-Line Loop-Inductance Matrix):

This method must be used if the ModelType is SLM.

Loop inductance can be experimentally measured.

Loop inductance matrices can be created using field solvers.

An SGR value is normally specified for an SLM model that indicates the ratio of signal pins to return path pins (i.e. power or ground) pins.

SLM models make have zero values for power or ground R,L,C values which prevents there use in analyzing connector ground bounce effects.

Typical uses for SLM model might include for example a 2x17 header connector where the bottom row is all grounded. The SGR would be specified in this case as 1:1. A model would be developed with these assumptions made. Then all pins would be filled with average values. To further expand this example see the figure below:

Pin out:

|    |       |    |
|----|-------|----|
| 1  | ..... | 17 |
| 18 | ..... | 34 |

Measurement or Field solver connection:

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| Sig | Sig | Sig | ... | Sig | Sig |
| Gnd | Gnd | Gnd | ... | Gnd | Gnd |

Measured or Computed values:

3nH 4nH 4nH ....4nH 3nH

Matrix data:

|     |     |     |         |     |
|-----|-----|-----|---------|-----|
| 3nH | 4nH | 4nH | ....4nH | 3nH |
| 3nH | 4nH | 4nH | ....4nH | 3nH |

This allows the user to specify any of the following power/ground connections and still use this model:

Simulator Connection A:  
Sig Sig Sig ... Sig Sig  
Gnd Gnd Gnd ... Gnd Gnd

Simulator Connection B:  
Gnd Gnd Gnd ... Gnd Gnd  
Sig Sig Sig ... Sig Sig

Simulator Connection C:  
Sig +5V Sig ... Gnd Sig  
Gnd Sig Gnd ... Sig +5V

Given the following connection a simulation should generate a warning to the user indicate the ground-signal-ratio has been violated.

Simulator Connection D:  
Sig Sig Sig ... Sig Sig  
Gnd Sig Sig ... Sig Sig

All connector pins must be specified with non-zero L and C values in at least one of the sections. The simulator will zero out portions of all sections corresponding to the ground or power pins.

SLM models are most useful where coupling analysis is not critical and where the rise time of the signal is long compared to the electrical delay through the connector.

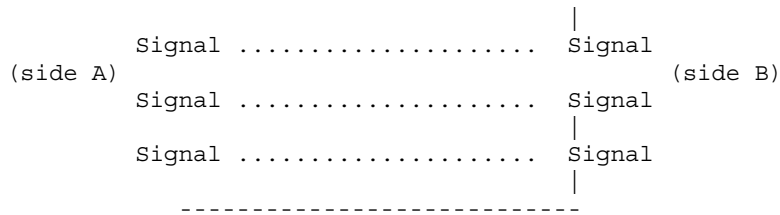
#### Partial Self Inductance Matrix Description (MLMs ONLY):

=====

DESCRIPTION: A partial self inductance is an approximation of the loop inductance in situations where the current return path cannot be explicitly stated in the field extraction stages. Partial self inductance can be numerically calculated by introducing a current in a circuit element that originates on one end and terminates on the other end. There is no physical loop per se, instead charges will build up on each side of the circuit element. In practice, this situation cannot exist more than instantaneously. For the purposes of simulation the condition does not affect the resultant loop inductance values. Then from the currents found the magnetic fields and inductance's can be calculated. In this way, the self and mutual inductances of any section of a closed circuit can be calculated.

This representation of inductance in terms of partial self and mutual inductance allows the analysis of any combination of current paths. The signal and return current paths can be defined in circuit after the model is established. Assuming that the self inductance is included in the return path, the circuit under simulation can account for the impact on signal-integrity, cross-talk and ground-bounce from currents passing through any combination of pins.

connector or section



There are many ways to create this information using either 2D or 3D field solvers. It may also be possible to create this information using other methods which are left to the model developer.

For an MLM model it is required that at least one section include partial inductance and capacitance matrices.

### Capacitance Matrix Description

=====

UNITS: FARAD  
 DESCRIPTION: A capacitance is an approximation of the capacitance in situations where the return path cannot be explicitly stated in the field extraction stages.

See "Multi-Line Capacitance Matrix" section above for more information on Multi-Line Matrices.

USAGE RULES: Two Maxwell capacitance matrix methods are supported:

SLM, Single-Line, Loop-capacitance Matrix (non-coupled)  
 MLM, Multi-Line, Capacitance Matrix (coupled)

If ModelType is SLM then all sections must only contain a single capacitance value per line.

If ModelType is MLM then all sections must use a Maxwell Capacitance as stated below.

#### Single-Line Capacitance Matrix Description:

-----

To define capacitance requires conductors separated by a dielectric. The conductors are those found in a loop consisting of a closed path including a signal and all possible return paths. The Maxwell Capacitance matrix relates the total charges on the conductors to the voltages applied to them.  $[Q]=[C_m][V]$  Where  $[C_m]$  is the Maxwell matrix,  $[Q]$  is the vector of total conductor charges, and  $[V]$  is a vector of applied voltages. The negative values of the off-diagonal entries can be explained on physical grounds: if you put +1 Volt on a single conductor and 0 Volts on the others, then you induce negative charges on those other conductors to terminate the field lines emanating from the conductor at 1 Volt.

In the Maxwell Capacitance matrix, the diagonal term is the maximum capacitance that the conductor encounters, meaning the capacitance to ground plus the capacitances to all the other conductors.

In the Maxwell Capacitance matrix, the OFF-diagonal term is the capacitance that the conductor encounters relative to a second

conductor. This capacitance value is effected by other nearby conductors during the field extraction phase. As such it should not normally be used by itself to determine the capacitance of a random pair of conductors in a given structure.

#### Conductance Matrix Description

=====  
Units: Siemens (mhos)  
Description: The Conductance maxtrix represents the energy transfer between the conductor and its surroundings, including the return path. Conductance includes dielectric and radiation losses, as well as any DC conductance.  
  
Notes: The conductance matrix is optional. Simulation tools shall use 0.0 Siemens for all entries if this matrix is not present.  
  
Do NOT use Siemens/meter as this is the total value and includes the length of this section.

#### Loss Matrix Description

=====  
This release does not support frequency dependent loss matrices. A future release is expected to add support for frequency dependent loss matrices.

#### Un-Coupled Models:

=====  
Single-Line-Models or SLM models are used for un-coupled models. These models are useful for most simulations where coupled effects can be ignored safely. These models are most accurate if closely spaced ground pins or a ground plane is present.  
  
A "Diagonal\_matrix" matrix type is the best choice for describing all matrices R,L and C for SLM models. (see matrix descriptions below).  
  
Several methods can be used:  
Field solvers with return path pins defined. Only the diagonal matrix data is used. The coupling information is ignored. The R,L,C matrices should represent the electrical parameters for a specific section.  
  
2D field solver with a specific return path or ground. Only the diagonal matrix data is needed. No coupling data is present in the final matrix  
  
Closed form round wire inductance equation.  
  
Experimental lab data may be obtained from TDR, VNA or other means

#### Coupled Models:

=====  
Multi-Line-Models or MLM models are used for coupled models.  
  
A "Full\_matrix" matrix type is the best choice for describing all matrices R,L and C for MLMs. (see matrix descriptions below)  
  
Several methods can be used:  
3D field solver can be used to create partial inductance and capacitance matrices that allow accurate simulations without

the need to pre-define the ground pins.

Field solvers without specific return path pins. A return plane  
May be specified as a reference only and is placed far field.

Experimental lab data may be obtained from multichannel  
measurements that incorporate TDR, VNAs or other means as long as  
the resulting inductance matrix contains partial inductance values.

#### Common to Coupled and Un-Coupled Models

=====

One common aspect of all the different formats is that they exploit  
the symmetry of the matrices they describe. This means that the  
entries below the main diagonal of the matrix are identical to the  
corresponding entries above the main diagonal. Therefore, only  
roughly one-half of the matrix needs to be described. By convention,  
the main diagonal and the UPPER half of the matrix are provided.

In the following text, we use the notation [I, J] to refer to the entry  
in row I and column J of the matrix. Note that I and J are allowed  
to be alphanumeric strings as well as integers.

The ordering of these strings is determined by the row/column ordering  
convention given by the [Cn Row Swath] or [Cn Column Swath] convention,  
or else matches exactly the [Cn Pin Map] order when the pin map contains  
the same number of pins as the Swath.

In the following text, "Row 1", means the row corresponding to the first  
pin.

Also note that the numeric entries of the RLC matrices are standard  
IBIS floating point numbers. As such, it is permissible to use  
metric "suffix" notation. Thus, an entry of the C matrix could be  
given as 1.23e-12 or as 1.23p or 1.23pF.

Each new row is identified with the Row keyword.

=====

**Keyword:** [Bandwidth]

**Required:** Yes, if a Banded\_matrix matrix is being defined.

**Argument:** Numeric Value

**Description:** Indicates the size of the width of the coupling matrix....

of the matrix. This has nothing to do with electrical bandwidth. The  
bandwidth field

must be a nonnegative integer. This is the number of off-  
diagonal matrix rows for which data is provided.

**Usage Rules:** MUST be used between keywords [Begin Cn Section] and  
[End Cn Section].

MUST follow any usage of one of the following keyword:  
Banded\_matrix

-----

See example "Matrix Example" lower in this document.

=====

**Keyword:** [Row]

**Required:** Yes if a matrix is being defined.

**Argument:** None

Description: Indicates the beginning of a new row of the matrix.  
Usage Rules: The argument must be a sequential number beginning at 1 and continuing to the last row for the matrix

Following a [Row] keyword is a block of numbers that represent the entries for that row. Suppose that the current row is number M. Then the first number listed is the diagonal entry, [M,M]. Following this number are the entries of the upper half of the matrix that belong to row M: [M, M+1], [M, M+2], ... up to [M,N].

For even a modest-sized matrix, this data will not all fit on one line. You can break the data up with new-line characters so that this limit is observed.

Example: Suppose the matrix has 40 conductors and that we are currently working on Row 19. There is 1 diagonal entry, plus  $40 - 19 = 21$  entries in the upper half of the matrix to be specified, for 22 entries total.

Row 1 always has the most entries, and that each successive row has one fewer entry than the last; the last row always has just a single entry.

Usage Context:

MUST be used between keywords [Begin Cn Section] and [End Cn Section].

MUST follow any usage of one of the following keywords:  
Banded\_matrix, Sparse\_matrix, Full\_matrix

-----  
See example "Matrix Example" lower in this document.

=====  
Keyword: [End Cn Section]  
Required: Yes  
Argument: Text String  
Description: Indicates the end of [Begin Cn Section]

### Matrix Examples

=====  
The resistance matrix for this package has no coupling

```
[Begin Cn Section]      ExampleMatrix00
[Derivation Method]    Distributed
[Resistance Matrix]     Diagonal_matrix
10.0
15.0
15.0
10.0
10.0
15.0
15.0
10.0
[End Cn Section] ExampleMatrix00
```



[Begin Cn Section]            ExampleMatrix01

The resistance matrix for this package does not have coupling and is exactly the same as the Diagonal\_matrix shown above it is described using a trivial version of the Banded\_matrix as an example only. The Diagonal\_matrix should be used for this example to conserve file size.

```
[Resistance Matrix]        Banded_matrix
[Bandwidth]                0
[Row]    1
10.0
[Row]    2
15.0
[Row]    3
15.0
[Row]    4
10.0
[Row]    5
10.0
[Row]    6
15.0
[Row]    7
15.0
[Row]    8
10.0
```

The inductance matrix has coupling between pins

```
[Inductance Matrix]        Full_matrix
[Row]    1
3.04859e-07        4.73185e-08        1.3428e-08        6.12191e-09
1.74022e-07        7.35469e-08        2.73201e-08        1.33807e-08
[Row]    2
3.04859e-07        4.73185e-08        1.3428e-08        7.35469e-08
1.74022e-07        7.35469e-08        2.73201e-08        7.35469e-08
[Row]    3
3.04859e-07        4.73185e-08        2.73201e-08        7.35469e-08
1.74022e-07        7.35469e-08        2.73201e-08        7.35469e-08
[Row]    4
3.04859e-07        1.33807e-08        2.73201e-08        7.35469e-08
1.74022e-07        7.35469e-08        2.73201e-08        7.35469e-08
[Row]    5
4.70049e-07        1.43791e-07        5.75805e-08        2.95088e-08
[Row]    6
4.70049e-07        1.43791e-07        5.75805e-08        2.95088e-08
[Row]    7
4.70049e-07        1.43791e-07        5.75805e-08        2.95088e-08
[Row]    8
4.70049e-07        1.43791e-07        5.75805e-08        2.95088e-08
```

The capacitance matrix has sparse coupling

```
[Capacitance Matrix]        Sparse_matrix
[Row]    1
1        2.48227e-10
2        -1.56651e-11
5        -9.54158e-11
6        -7.15684e-12
[Row]    2
2        2.51798e-10
3        -1.56552e-11
5        -6.85199e-12
```

```

6      -9.0486e-11
7      -6.82003e-12
[Row]  3
3      2.51798e-10
4      -1.56651e-11
6      -6.82003e-12
7      -9.0486e-11
8      -6.85199e-12
[Row]  4
4      2.48227e-10
7      -7.15684e-12
8      -9.54158e-11
[Row]  5
5      1.73542e-10
6      -3.38247e-11
[Row]  6
6      1.86833e-10
7      -3.27226e-11
[Row]  7
7      1.86833e-10
8      -3.38247e-11
[Row]  8
8      1.73542e-10

```

[End Cn Section] ExampleMatrix01

=====  
**9.0 End Keyword**  
=====

```

Keyword:  [End]
Required: Yes
Argument: None
Description: Specifies end of file
-----

```

[End]

=====  
**10.0 ICM EXAMPLES**  
**!!!! NEEDS MAJOR REVISION !!!!!**  
**INCLUDE IN DIFFERENT DOCUMENT????**  
=====

```

[IBIS Cn Model Ver]  1.0
[File Rev]           1.0           1.0 -> design data, no verification
[Date]              July 1, 2000   The latest file revision date

```

```

[Begin Cn Model Family]
[Begin Cn Model List]
DB9      Mated      10ns      db9mated.jpg
Header2x5 Mated      500ps     Header100.jpg
Header2x5s Mated     500ps     Header100.jpg
[End Cn Model List]

```

EXAMPLE: single SLM DB9 connector

(NOTE: DATA IS "MAKE BELIEVE")

```
[Begin Cn Model] DB9 PinMapDB9a PinMapDB9b SLM 1:9
[Cn Number of Conductors] 9
[Cn Columns of Pins] 5
[Cn Rows of Pins] 2
Cn_Section SectionDB9
[End Cn Model] DB9
```

EXAMPLE: single SLM DB9 connector with swath

(NOTE: DATA IS "MAKE BELIEVE")

```
[Begin Cn Model] DB25swath PinMapDB25_in PinMapDB25_out SLM 1:25
[Cn Number of Conductors] 25
[Cn Columns of Pins] 13
[Cn Rows of Pins] 2
Cn_Section SectionDBSwath
          SwathRows SwathCols RightEdge LeftEdge TopEdge BottomEdge
[Begin Cn Swath] 2 3 1 1 0 0
[End Cn Swath]
[End Cn Model] DB25swath
```

Pin maps for DB9

```
[Begin Cn Pin Map] PinMapDB9
|Index Pin Signal
1 1 CD
2 2 RXD
3 3 TXD
4 4 DTR
5 5 GND
6 6 DSR
7 7 RTS
8 8 CTS
9 9 RI
[End Cn Pin Map]
```

```
[Begin Cn Pin Map] PinMapDB25
|Index Pin Signal
1 1 CD
2 2 RXD
3 3 TXD
4 4 DTR
5 5 GND
6 6 DSR
7 7 RTS
8 8 CTS
9 9 RI
10 10 CD
11 11 CD
12 12 RXD
13 13 TXD
14 14 DTR
15 15 GND
16 16 DSR
17 17 RTS
18 18 CTS
19 19 RI
20 20 RI
```

```

21      21      CD
22      22      RXD
23      23      TXD
24      24      DTR
25      25      GND

```

```
[End Cn Pin Map]
```

#### SECTION EXAMPLES WITH MATRICES

```

[Begin Cn Section] SectionDB9
[Derivation Method] Distributed
[Resistance Matrix] Diagonal_matrix
.05
.05
.05
.05
.05
.05
.05
.05
.05
[Inductance Matrix] Diagonal_matrix
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
[Capacitance Matrix] Diagonal_matrix
0.3pF      |Edge pin has less capacitance
0.5pF
0.5pF
0.5pF
0.3pF      |Edge pin has less capacitance
0.3pF      |Edge pin has less capacitance
0.5pF
0.5pF
0.3pF      |Edge pin has less capacitance
[End Cn Section] SectionDB9

```

```

[Begin Cn Section] SectionDBswath
[Resistance Matrix] Diagonal_matrix
.05
.05
.05
.05
.05
[Inductance Matrix] Diagonal_matrix
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
1.5nH
[Capacitance Matrix] Diagonal_matrix
0.3pF      |Edge pin has less capacitance
0.3pF      |Edge pin has less capacitance
0.5pF
0.5pF

```

```
0.3pF          |Edge pin has less capacitance
0.3pF          |Edge pin has less capacitance
[End Cn Section] SectionDBswath
```

```
[End Cn Model Family]
```

```
[End]
```