

=====

# IBIS CONNECTOR SPECIFICATION

Last Updated: 06-25-2001, AP

\* Move "Revision History" per email. Renumber Sections as required

\* 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.

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Specification Revision level 0.968

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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 compatibility 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 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]
|   \-- [End Cn Model]
|-- [End Cn Model Family]
|
|-- [Begin Cn Section] (Section 8)
|   |-- [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 proceeded 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: [IBIS Cn Model Ver] MUST BE THE FIRST KEYWORD in the file.  
It is normally on the first line of the file, but can be  
Receded by comment lines that must begin with a "|".

Context:

- 1) MUST BE THE FIRST KEYWORD in the file after {Begin Header}.
- 2) It is normally on the first line of the file, but can be  
receded by comment lines that must begin with a "|".

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

=====  
Keyword: [File Name]

=====  
Keyword: [File Name]  
Required: Yes  
Argument: Text String (file name)  
Description: Specifies the name of the IBIS Connector Model 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.).

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 0.1 center square pin connector designed for use on IEEE 99999  
buses.

=====  
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.

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                     |
| HDI_TEST_202                   | Mated          | 100ps         | HDI_TEST_202_Mated.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_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:** Text String  
**Description:** Used to define the start of single or multiple sections for a connector model 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.  
**Usage Rules:** The keyword [Begin Cn Model] must be followed by five required parameters in the following order: ModelName, ModelPinMap\_A, ModelPinMap\_B, Model Type. An optional SGR (signal to ground ratio) parameter may be included if the ModelType is SLM.  
e.g. [Begin Cn Model] ModelName ModelPinMap\_A ModelPinMap\_B ModelType SGR

The field ModelName is required and must be less than 40 characters. The ModelName MUST appear after the [Begin\_Cn\_Model] and may optionally appear as a parameter following the [End\_Cn\_Model] keyword.

The field ModelPinMap\_A and ModelPinMap\_B are required and must be less than 20 characters. The ModelPinMap\_A MUST appear after the ModelName. ModelPibMap\_B must appear after ModelPinMap\_A. The names must correspond exactly to the names following [Begin\_Cn\_Pin\_Map] defined in this file. These two fields are used to name the two ports of each connector terminal. Under most conditions, these will be the same name, however two variables are required to address crossover pin mapping.

The field ModelType is required and must be either SLM or MLM  
SLM indicates this model is a "single-line model" i.e. non-coupled.  
MLM indicates this model is a "multi-line model" i.e. coupled.

**SPECIAL NOTICE:**  
If ModelType is SLM then ALL sections MUST be specified using a matrix that describes only the diagonal terms.

The "SGR" Signal-Ground-Ratio value is optional. The SGR value is only allowed for use with type SLM. For example: 3:1 would indicate there is one (power or ground pin) for every 3 signal pins. No spaces are allowed between the numbers and ":". Valid range of signal number is 1 to 100. The number after the colon must always be "1". The number before the colon may include a decimal if desired. (e.g. 2.5:1)

The SGR value is the signal-to-ground ratio that was assumed when the model was created. The simulator may use this value to provide a warning if the model is being used with a higher or lower SGR. If the simulator provides such a warning then a mechanism should be provided to allow a user defined amount of tolerance. For example some areas may have 4:1 and others 2:1 with the nominal value being 3:1. It is recommended that the simulator make an average SGR display available to the user if the Model type is SLM.

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.

The SGR value MUST NOT be present if the connector is an MLM model.

The model is composed of sections of RLC matrices either in series or as "Tee" sections called stubs. The following sub-parameters are used for this purpose:

- Cn\_Section - defines a "straight through" section
- Cn\_Stub - defines a "Tee" section

Simulators SHALL automatically replace all pins in an SLM connector used for power or ground with the following values:

- R = 0.0 ohms,
- L = 0.0 nH
- C = 0.0 pF

The connector model creator SHALL create an SLM models with the knowledge that the simulators shall follow the above rules.

For example a 2 row by 10 column pin field connector would have a matrix with 20 rows to define it. Every diagonal (i.e. (pin) could have a corresponding R,L,C value that was created assuming an SGR of say 1:1. When used by the simulator those that are grounded would be considered as ideal grounds and R,L,C values of 0.0 used. In this way an SLM model could be created that would allow either the top or bottom row to be grounded or every other pin of each row to be grounded and the same SLM model used for all cases.

#### Usage Context:

It is required that [Begin Cn Model] appear after the keyword [Begin Cn Model List], but must appear before the keyword [End Cn Model Family].

This keyword pair may appear more than once in the file.

Only the following list of keywords and sub-parameters are allowed within the context of the [Begin Cn Model] and [End Cn Model] keywords:

- [Begin Cn Model Description]
- [End Cn Model Description]
- [Cn Number of Conductors]
- [Cn Columns of Pins]
- [Cn Rows of Pins]
- [Begin Cn Swath]
- [End Cn Swath]

```

=====
Sub-parameters:  Cn_Section, Cn_Stub
    Required:    Yes
    Argument:    Text Block
Description:     Used to define either a straight or tee section of a connector
                  model.  A matrix sections are interconnected, scaled and may
                  be re-used to form a connector model using these two keywords.

Usage Rules:     Sub-parameter multiplier-name pairs must follow the Cn_Section
                  or Cn_Stub sub-parameters. The first parameter of the
                  multiplier-name pair is a scale factor.  The second parameter
                  of the pair is the name of the section.

                  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.

                  The named section must reference the name specified in a later
                  usage of the keyword [Begin Cn Section].

                  Multiple sub-parameter pairs are allowed after either the
                  Cn_Section or Cn_Stub keywords.

                  Any number of Cn_Section or Cn_Stub keywords 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.

                  Each Cn_Section is connected in series with the previous
                  Cn_Section.

                  The first Cn_Section or Cn_Stub sub-parameter after [Begin Cn
                  Model] is connected to the side A connector pin.

                  The last Cn_Section or Cn_Stub sub-parameter after [Begin Cn
                  Model] is connected to the side B connector pin.

                  The number of sub-parameter pairs on a line
                  is limited by the 120 character length requirement.
                  The sub-parameter pairs may be continued by using a "/"
                  character at the end of the line.  There is no limit to the
                  number of multiplier-name pairs that may be used.

                  The last multiplier-name pair used with the Cn_Stub sub-
                  parameter is open circuit at the far end.

Usage Context:
It is required that sub-parameters Cn_Section and Cn_Stub must
appear after the keyword [Begin Cn Model] and before the
keyword [End Cn Model].

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

```

the given section.

Example 1:

A named section represents a 0.01 inch section of a connector and the model developer feels there is one section that is 0.015 long and another that is 0.020 long the same matrix could be used with a multiplier of 1.5 and 2.0.

Example 2:

A named section represents a 1 meter section of a connector and the model developer feels there is one section that is 0.015m long and another that is 0.009m long the same matrix could be used with a multiplier of 0.015 and a multiplier of 0.9e-3.

Example 3:

A named section represents an electrical section of a connector with no length known and the model developer decides there is one section that has two times the electrical characteristics of another section. The same matrix could be used in this case with multipliers of 1.0 and 2.0.

=====

"Cn Model" Examples

=====

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

```
[Begin Cn Model] MyModel MyModelPinMap_A MyModelPinMap_B SLM 3:1
Cn_Section 1.0 Diagonal_matrix1
[End Cn Model] MyModel
```

Example 2: (5 sections straight through)

```
          SectionA      SectionB      SectionC      SectionD      SectionE
Pin >-----< >-----< >-----< >-----< >-----< Pin

[Begin Cn Model] TestName1 TestName1Pin_A TestName1Pin_B SLM 3:1
Cn_Section 1.0 SectionA
Cn_Section 1.0 SectionB
Cn_Section 1.0 SectionC
Cn_Section 1.0 SectionD
Cn_Section 1.0 SectionE
[End Cn Model] TestName1
```

Example 3: (5 sections straight through with line continue)

```
          SectionA      SectionB      SectionC      SectionD      SectionE
Pin >-----< >-----< >-----< >-----< >-----< Pin

[Begin Cn Model] TestName1 TestName1Pin_An TestName1Pin_B SLM 3:1
Cn_Section 1.0 SectionA 1.0 SectionB 1.0 SectionC 1.0 SectionD \
Cn_Section 1.0 SectionE
[End_Cn_Model] TestName1
```

Example 4: (2 series sections with one stub)

```
          SectionA      SectionB
```

```

Pin >-----< >-----< Pin
      StubSection1

[Begin Cn Model] MyModel MyModelPinMap_A MyModelPinMap_B MLM
Cn_Section 1.0 SectionA
Cn_Stub 1.0 StubSection1
Cn_Section 1.0 SectionB
[End_Cn_Model] MyModel

Example 5: (2 stub sections, one stub matrix is re-used)
      A          B          C
Pin >-----< >-----< >-----< Pin
      |stub1      |stub1
      |stub2
      |stub3

[Begin Cn Model] MyModel MyModelPinMap_in MyModelPinMap_out MLM
Cn_Section 1.0 A
Cn_Stub 1.0 stub1 1.0 stub2 1.0 stub3
Cn_Section 1.0 B
Cn_Stub 1.0 stub1
Cn_Section 1.0 C
[End_Cn_Model] MyModel

```

Example 6: (3 stubs)

```

      A          B          C          D
Pin >-----< >-----< >-----< >-----< Pin
      |Stub1      |Stub2      |Stub1
      |Stub3      |Stub3
      |Stub3

[Begin Cn Model] MyModel MyModelPinMap_A MyModelPinMap_B MLM
Cn_Section 1.0 A
Cn_Stub 1.0 Stub1
Cn_Section 1.0 B
Cn_Stub 1.0 Stub2 1.0 Stub3 1.0 Stub4
Cn_Section 1.0 C
Cn_Stub 1.0 Stub1
Cn_Section 1.0 D
[End Cn Model] MyModel

```

Example 7: (NOT ALLOWED, parallel stubs)

**\*\* BAD EXAMPLE, DO NOT USE PARALLEL STUBS \*\***

```

      A          Stub1 Bee          C
Pin >-----< >-----< >-----< Pin
      |Stub2
      |Stub3

[Begin Cn Model] MyModel MyModelPinMap_A MyModelPinMap_B MLM
Cn_Section 1.0 A
Cn_Stub 1.0 Stub1
Cn_Stub 1.0 Stub2 1.0 Stub3
Cn_Section 1.0 Bee
Cn_Section 1.0 C
[End Cn Model]

```



Example 8: (line continuation)

```

                                C
Pin >-----< >-----< >-----< Pin
      A           B           |Stub1
                              |Stub2
                              |Stub3
                              |Stub4
                              |Stub5
                              |Stub6
                              |Stub7
                              |Stub8
                              |Stub9
                              |Stub10
                              |Stub11
** BAD EXAMPLE **
[Begin Cn Model] MyModel MyModelPinMap_A MyModelPinMap_B MLM
Cn_Section 1.0 A /
1.0 B
Cn_Stub 1.0 Stub1 1.0 Stub2 1.0 Stub3 1.0 Stub4 1.0 Stub5 /
1.0 Stub6 1.0 Stub7 1.0 Stub8 1.0 Stub9 1.0 Stub10 1.0 Stub11
Cn_Section 1.0 C
[End Cn Model] MyModel
```

```
=====
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 connector designed
for use on EIA RS99999Example bus.
```

```
=====
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.<br>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.<br>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 [Define 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:** 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:

```

*--*--*--*--*
| \ | \ | \ | \ |
| / | / | / | / |
*--*--*--*   [Cn Column Swath] 3 5 1 1 0 0
| \ | \ | \ | \ |
| / | / | / | / |
*--*--*--*

```

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

```

1  2  3  4  5
*--*--*--*--*
| \ | \ | \ | \ |
| / | / | / | / |
*--*--*--*   Swath:
| \ | \ | \ | \ |   [Cn Column Swath] 3 5 1 1 0 0
| / | / | / | / |
*--*--*--*

```

```

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

```

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

```

1  2  3  4  5
*--*--*--*--*
|\|/\|/\|/\|
|/\|/\|/\|/\|   Swath:
*--*--*--*--*   [Cn Column Swath] 3 5 1 1 0 0
|\|/\|/\|/\|
|/\|/\|/\|/\|
*--*--*--*--*

*--*--*--*--*--*--*--*
|\|/\|/\|/\|/\|/\|/\|/\|/\|
|/\|/\|/\|/\|/\|/\|/\|/\|/\|
*--*--*--*--*--*--*--*   Full Connector
|\|/\|/\|/\|/\|/\|/\|/\|/\|

```

```

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

```

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.

#### Usage Context:

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:  
Rows in the swath matrix  
Columns in the swath matrix  
LEFT EDGE: Columns in the swath matrix  
used to represent left edge  
RIGHT EDGE: Columns in the swath matrix  
used to represent right edge  
TOP EDGE: Rows in the swath matrix used  
to represent top edge  
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.

```
-----
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 sprintf(<template string>, <list of variables>) the conditional statements if (<expression>) { <statement> } else { <statement> }

The forming 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 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.  
**Usage Rules:** The keyword [Begin Cn Pin Map] must be followed by two  
required parameters which are ModelPinMapName\_A and  
ModelPinMapName\_B.  
e.g. [Begin Cn Pin Map] ModelPinMapName\_A ModelPinMapName\_B  
  
The ModelPinMapName fields are required and must be less than  
20 characters. The ModelPinMapName fields MUST appear after  
the [Begin Cn Pin Map] and may optionally appear as  
parameters following the [End Cn Pin Map] keyword. This name  
is used by the [Begin Cn Model] keyword to reference a 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

The lines between [Begin Cn Pin Map] and [Begin Cn Pin Map]  
shall contain one line for each pin in this connector  
model. The pin map line shall contain the following  
parameters.

Pin (required)  
If a pin name specified by the manufacture  
This allows EDA tools to align pin names in the model  
with pin names in the net list.

Signal (Optional, based on application but recommended if  
applicable)  
Is the signal name used; required if this is an industry-  
standard connector like RS232, PCI, EISA etc.

NOTE: NA should be used to indicate this field is not  
available.

This can be used by EDA tools or by users interactively  
to easily identify the pins of the connector.  
This is an alternate method for EDA tools to align  
signal names in the model with net names from the  
design's net list if the pin names cannot be aligned.  
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 [Begin Cn Pin Map] and [End Cn Pin  
Map] may appears as a pair more than once in a file.

Simulators should consider pin names with case sensitive  
compares. To make human comparison easy it is recommended  
that all uses of the pin name in the file utilize the same  
case.

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

NOTICE: The special Signal names POWER, RET, GND, and PWRGND  
shall be used to indicate that this pin should be  
connected to either a Power pin like +5V, a ground  
pin, or (either a power or ground pin). This  
information may be used by the simulator or PCB  
layout tool to provided a warning that the connector  
is not following an established industry standard  
layout. The keyword RET is available to indicate it  
is a return pin and could be either power or ground.

```
-----  
[Begin Cn Pin Map] 20PinHdiPin  
Pin    Signal  
A1     GND  
A2     D0  
A3     CLK  
A4     D1
```

```

B1      STROBE1
B2      A0
B3      POWER
B4      PWRGND
[End Cn Pin Map]

```

```

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

```

```

    Required: Yes
    Argument: None
    Description: The name of the connector family in this file.
    Usage Rules: These commands wrap the entire model in this file.
                  Only a single occurrence of each [End Cn Model Family]

```

```

-----
[End Cn Model Family]

```

## 8.0 MATRIX KEYWORDS

```

=====
    Keyword:  [Begin Cn Section], [End 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

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.

Keyword: [Derivation Method]  
 Required: Yes  
 Argument: Lumped or Distributed  
 Description: Describes the type of model that should be generated 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]

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

case 1: [Resistance Matrix] only

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]

NOTE: In case 4,5 the matrices shall be any combination of

matrix types (Diagonal, Banded, Sparse, Full).

Argument: None  
Description: The sub-parameters mark the beginning of a matrix, and specify how the matrix data is formatted.  
Sub-Params: Diagonal\_matrix, Banded\_matrix, Sparse\_matrix, or Full\_matrix

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.)

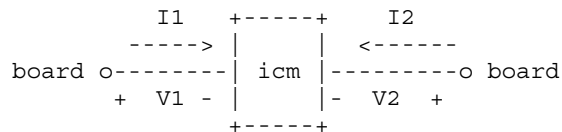
MUST BE USED between keywords [Begin Cn Section] and [End Cn Section].

Notes: Numeric Accuracy:

The numeric accuracy used in the file should not be significantly greater than the known accuracy of the model. Refer to "Section 3" for greater detail.

Currents and Sign Conventions:

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's and resistances.

For each [Resistance Matrix], [Inductance Matrix], or [Capacitance Matrix] a different format can be used for the data. The choice of formats is provided to satisfy different simulation accuracy and speed requirements. Also, there are many packages in which the resistance matrix can have no coupling terms at all. In this case, the most concise format (Banded\_matrix) can be used.

#### 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 (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

|          |              |  |                    |
|----------|--------------|--|--------------------|
| (side A) | Return ..... |  | Return             |
|          | Signal ..... |  | (side B)<br>Signal |
|          | Return ..... |  | Return             |

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.

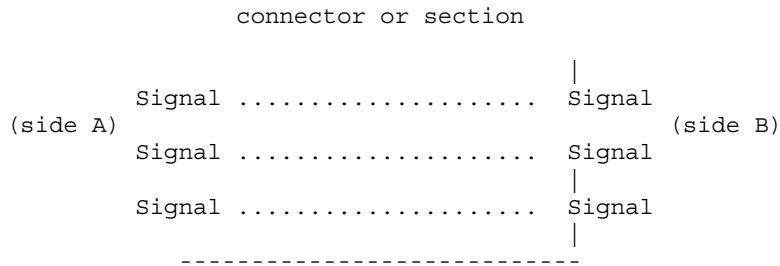
#### Partial Self Inductance Matrix (MLMs ONLY):

=====

DESCRIPTION: A partial self inductance is an approximation of the loop



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.



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, Partial-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.

Both capacitance and inductance matrix of a given section must use the same method.

#### Single-Line Capacitance Matrix Description:

-----  
To define capacitance requires conductors separated by a dielectric. The conductors are the 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.

#### 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:

=====

These are also called Single-Line-Models or SLM 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:  
2D field solver 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 without specific return path pins. A return plane is specified as a reference only and is placed far field. from the pin field. Only the diagonal matrix data is used and the off diagonal information must be appropriately reduced to a single diagonal matrix. 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:

=====

These are also called Multi-Line-Models or MLM models.

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:

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.

2D field solver without specific return path pins. A return plane is specified as a reference only and is placed far field.

2D field solver with return path pins specifically defined.

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.

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.

#### Full\_matrix

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.

-----

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: [Bandwidth]  
Required: Yes, if a Banded\_matrix matrix is being defined.  
Argument: Numeric Value  
Description: Indicates the bandwidth of the matrix. 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.

=====  
sub-parameter: 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 also has the added benefit of requiring half as many lines.  
Usage Rules: A Diagonal\_matrix is one whose entries are guaranteed to be zero

if they are not on the main diagonal. Let the matrix size be  $N \times N$ , An entry  $[I,J]$  of the matrix is zero if:  $|I - J| \neq 0$  where  $| \cdot |$  denotes the absolute value.

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].

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

=====

**sub-parameter: Banded\_matrix**

Required: No  
Argument: None

Description: The Banded\_matrix is used to specify the coupling effects up to B pins on either side. Two variations are supported. One allows for the coupling to circle back on itself. This is technically a simple form of a bordered block diagonal matrix. However, its data can be completely specified in terms of a Banded\_matrix for an  $N \times M$  matrix consisting of N rows and  $M = N + B$  columns. The second variation is just in terms of an  $N \times N$  matrix where no circle back coupling needs to be specified.

Usage Rules: 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." Let the matrix size be  $N \times M$ , and let the bandwidth be B. An entry  $[I,J]$  of the matrix is zero if:  $|I - J| > B$  where  $| \cdot |$  denotes the absolute value.

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, as above. As before, symmetry is exploited: do not provide entries below the main diagonal.

For case where coupling can circle back on itself, consider a matrix of N pins organized into N rows 1 ... N and M columns 1 ... N, 1 ... B. The first row only needs to specify the entries [1,1] through [1,1+B] since all other entries are guaranteed to be zero. The second row will need to specify the entries [2,2] through [2,2+B], and so on. For row K the entries [K,K] through [K,K+B] are given when  $K + B$  is less than or equal to the size of the matrix N. When  $K + B$  exceeds N, the entries in the last columns 1 ... B specify the coupling to the first rows. For row K, the entries [K,K] ... [K,N] [K,1] ... [K,R] are given where  $R = \text{mod}(K + B - 1, N) + 1$ . All rows will contain  $B + 1$  entries. To avoid redundant entries, the bandwidth is limited to  $B \leq \text{int}((N - 1) / 2)$ .

For the case where coupling does not circle back on itself, the process is modified. Only N columns need to be considered. When  $K + B$  finally exceeds the size of the matrix N, the number of entries in each row starts to decrease; the last row (row N) has only 1 entry. This construction constrains the bandwidth to  $B < N$ .

As in the Full\_matrix, if all the entries for a particular row do not fit into a single 120-character line, the entries can be broken across several lines.

It is possible to use a bandwidth of 0 to specify a diagonal matrix (a matrix with no coupling terms.) This is sometimes useful for resistance matrices.

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

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

=====

sub-parameter: 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. This feature is useful in certain situations, such as for Pin Grid Arrays (PGAs) sockets.

As usual, symmetry can be exploited to reduce the amount of data by eliminating from the matrix any entries below the main diagonal.

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

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.

Data for the entries of a row is given in a slightly different format, however. For the entry [I, J] of a row, it is necessary to explicitly list the name of pin J before the value of the entry is given. This specification serves to indicate to the parser where the entry is put into the matrix.

Note that each of the column indices listed for any row must be greater than or equal to the row index, because they always come from the upper half of the matrix. When alphanumeric pin names are used, special care must be taken to ensure that the ordering defined in the [Pin Numbers] section is observed.

With this convention, please note that the N'th row of an N x N matrix has just a single entry (the diagonal entry).

The proper location is not otherwise obvious because of the lack of restrictions on where nonzero entries can occur. Each (Index, Value) pair is listed upon a separate line. An example follows. Suppose that row 10 has nonzero entries [10,10], [10,11], [10,15], and [10,25]. The following row data would be provided:

See example "Matrix Example" lower in this document.

=====

sub-parameter: 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.

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

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.

Notes: To conserve the file size it is recommended that the Full\_matrix sub-parameter not be used if one of the other matrix sub-parameters provides sufficient accuracy. The definition of sufficiency being at the discretion of the model creator.

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

=====  
**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
[Row]    3
3.04859e-07      4.73185e-08      2.73201e-08      7.35469e-08
1.74022e-07      7.35469e-08
[Row]    4
3.04859e-07      1.33807e-08      2.73201e-08      7.35469e-08
1.74022e-07
[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
[Row]    7
4.70049e-07      1.43791e-07
[Row]    8
4.70049e-07
```

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
=====
```

```
[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
.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]

```