

Translator's Addendum

Release 13

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Chapter 1

Introduction

This document contains additions and corrections found after the Translator's manual went to press. The contents of this document supersedes that found in the Translator's manual and contains an update of the .matl file format that appears in the Sonnet Translator's manual Appendix I. The .matl file format is detailed in Chapter 2.

The third chapter explains how to load Assura and Helic process files in Sonnet's Cadence Virtuoso interface. This functionality was included in Release 13 but not in time to provide documentation in the Translator's manual.

Chapter 2

Material File Format: Release 13

This document details the format of the .matl file used for both Sonnet's Cadence Virtuoso and Agilent ADS Interfaces. This version of the format is compatible with Sonnet Cadence Virtuoso Interface 13.51 and above and compatible with Sonnet Agilent ADS Interface 13.51 and above

Comments

You may add comments to a .matl file. All comments should use a semi-colon as the first character.

File Syntax

There are five types of entries in the file each of which is started with a unique keyword: DIEL, METAL, MATERIAL, VIA and VMATERIAL. The keyword identifies the type of material the entry defines and is followed by the material's properties. You may define any number of each type of material. The detailed syntax for all material entries is shown following this section.

There are two ways to organize a .matl file: sorted or physical. A sorted syntax is one in which the entries for each material type are grouped together. Physical is a .matl file in which the order of entries reflects their physical order in the stackup. In either case, two rules must be adhered to:

- 1 The first non-comment line in the file must start with a DIEL entry.
- 2 For either type of organization, the dielectrics (DIEL entries) will appear in the same order in the Sonnet box as the order in which they appear in the material file.

The order of dielectrics is implicitly indicated by their order of appearance in the .matl file. Metal levels in Sonnet are based on the order of the dielectrics, with each metal level being associated with the dielectric level above it. So the first DIEL entry in the file defines the topmost dielectric layer just underneath the box top. The second DIEL entry is inserted beneath the first dielectric, regardless of any intervening entries. Metal Level 0 is always underneath the topmost dielectric, and metal level 1 under the second dielectric and continuing down until the last dielectric which sits on top of the ground plane (box bottom). Note that more than one metal type (METAL) may appear on the same metal level.

All other entry types besides DIEL may appear in any order since part of their definition indicates the metal level(s) on which they occur. Note that when a .matl level is created by an interface it is written out in the physical order.



TIP

If you wish to group types of materials together and want the properties to line up in columns you may use tabs in your entry lines. Tabs are treated the same as spaces when parsing the file.

An example file is shown below first in the sorted order, followed by the physical order, with an illustration of the resulting Sonnet stackup. Note that the resulting Sonnet stackup is identical for both orders since the DIEL statements appear in the same order within the file. Please note that due to the length of some entries some lines in the file wrap on to the next line when displayed in this document.

Sorted Format:

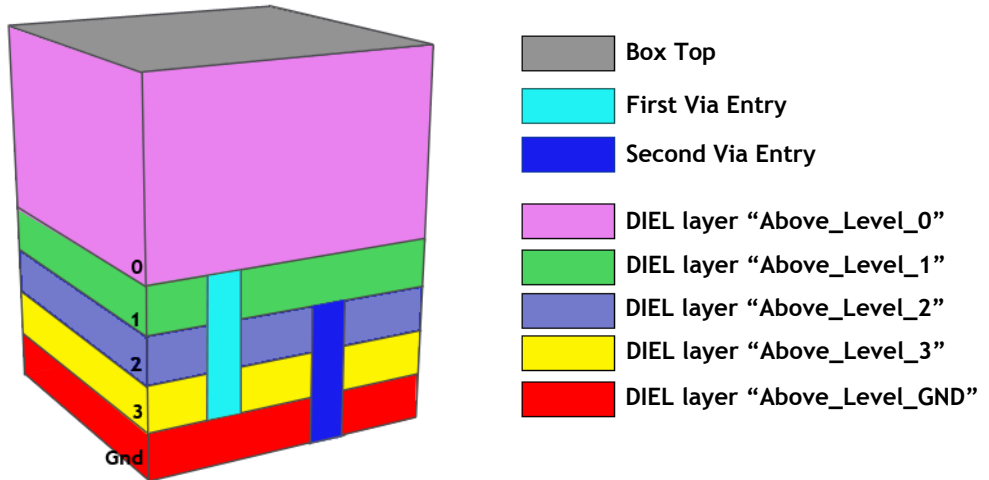
```
DIEL 100 1 1 0 0 0 "Above_Level_0"
DIEL 25 10 1 0 0 0 "Above_Level_1"
DIEL 25 1 1 0 0 0 "Above_Level_2"
DIEL 25 1 1 0 0 0 "Above_Level_3"
DIEL 25 1 1 0 0 0 "Above_Ground"
METAL cond 0 0 0 0 0 1 "Gold" 0 "Normal" 96000000 0.1 0 2 "Default" 1 100 1 100
"EdgeMeshOn" "Thin" 0 0
METAL cond2 0 0 0 0 0 0 "Lossless" 1 "Normal" INF 0 0 2 "Default" 1 100 1 100
"EdgeMeshOn" "Thin" 0 0
METAL cond3 0 0 0 0 0 2 "Copper" 3 "RoughMetal" 58000000 2 0 2 "Default" 1 100 1
100 "EdgeMeshOn" "Thick" 0.1 0.1
METAL cond4 0 0 0 0 0 3 "Silver" 3 "Normal" 61700000 1 0 2 "Default" 1 100 1 100
"EdgeMeshOn" "Thin" 0 0
VIA hole 0 0 0 0 0 0 "Lossless" 0 3 "Volume" INF 0 0 2 "Default" "PadsOff" 100
"Solid"
VIA hole2 0 0 0 0 0 1 "hole2" 1 GND "Volume" 96000000 0.1 0 2 "Default"
"PadsOff" 100 "Wall"
MATERIAL "Aluminum" 0 0 0 0 2 "RoughMetal" 58000000 2 0 2 "Thick" 0.1 0.1
```

Physical Format:

```
DIEL 100 1 1 0 0 0 "Above_Level_0"  
METAL cond 0 0 0 0 0 1 "Gold" 0 "Normal" 96000000 0.1 0 2 "Default" 1 100 1  
100 "EdgeMeshOn" "Thin" 0 0  
VIA hole 0 0 0 0 0 0 "Lossless" 0 3 "Volume" INF 0 0 2 "Default" "PadsOff" 100  
"Solid"  
DIEL 25 10 1 0 0 0 "Above_Level_1"  
METAL cond2 0 0 0 0 0 0 "Lossless" 1 "Normal" INF 0 0 2 "Default" 1 100 1 100  
"EdgeMeshOn" "Thin" 0 0  
VIA hole2 0 0 0 0 0 1 "hole2" 1 GND "Volume" 96000000 0.1 0 2 "Default"  
"PadsOff" 100 "Wall"  
DIEL 25 1 1 0 0 0 "Above_Level_2"  
DIEL 25 1 1 0 0 0 "Above_Level_3"  
METAL cond3 0 0 0 0 0 2 "Copper" 3 "RoughMetal" 5800000 2 0 2 "Default" 1 100  
1 100 "EdgeMeshOn" "Thick" 0.1 0.1  
METAL cond4 0 0 0 0 0 3 "Silver" 3 "Normal" 6170000 1 0 2 "Default" 1 100 1  
100 "EdgeMeshOn" "Thin" 0 0  
DIEL 25 1 1 0 0 0 "Above_Ground"  
MATERIAL "Aluminum" 0 0 0 0 2 "RoughMetal" 5800000 2 0 2 "Thick" 0.1 0.1
```

The resulting Sonnet stackup is shown below. The dielectric layers are shown as colored bands, with numbers identifying the metal levels sandwiched in between dielectric layers. Note that a metal level is attached to the dielectric layer above it.

If you delete that dielectric layer in the .mat1 file, the metal level below is also deleted. The via entries are represented by a not to scale color block which extends between the appropriate metal levels.



The keyword entries and their formats are defined below.

Dielectrics

DIEL This entry defines a dielectric layer and dielectric material.

Syntax

DIEL Thickness Erel Mrel TanE TanM DielCond DielName

There is a DIEL entry for each dielectric layer in your project. The numbering of the dielectric layers is implicitly defined by the position of the DIEL statement in the .matl file. The first DIEL layer represents the highest dielectric layer in your project. The next DIEL statement represents the dielectric layer below that one and so on. The fields are defined in the table below.

Field	Definition
Thickness	A non-zero positive floating point number which defines the thickness of the dielectric in microns.
Erel	A positive floating point number which defines the relative permittivity of the dielectric.
Mrel	A positive floating point number which defines the relative permeability of the dielectric.
TanE	A positive floating point number which defines the dielectric loss tangent of the dielectric.
TanM	A positive floating point number which defines the magnetic loss tangent of the dielectric.
DielCond	A positive floating point number which defines the conductivity of the dielectric in S/m.
DielName	A character string used to identify the dielectric. This entry should appear in quotes and may not use any spaces. Used as the name for the dielectric layer in the translated Sonnet project.

Metals

METAL

This entry defines a metal type or metal layer used in your project and its location.

Syntax

```
METAL LayerName Growth Rdc Rrf Xdc Ls Color MetalName SonLevel
SonMetalType MetalCond MetalThick CurrentRatio NumSheets
FillType XMin XMax YMin YMax UseEdgeMesh CrossSection
TopRoughness BottomRoughness
```

There is a METAL entry for each type of metal defined in your project. The SonLevel field determines its location in the Sonnet box. Note that in Sonnet, the metal level is attached to the dielectric layer ABOVE it, with the highest metal level underneath the top dielectric layer being metal level 0 and increasing in number as you move down through the box.

When specifying a METAL entry, you should fill in all values for all fields even if you are not using a particular field for this metal. For example, if you set the SonMetalType to Normal, you would set MetalCond, MetalThick and CurrentRatio to the values desired and set the other values to a any valid value. Any values not used in the definition are ignored, but must be set to a valid value in order to not create an error condition when reading the .matl file.

The fields are defined in the table below.

Field	Definition
Layername	A character string which is the name of the layer in the Virtuoso or ADS layout containing the objects which are being mapped to this Sonnet level. Only the layer name is required, the Virtuoso or ADS purpose name is not presently used. The character string should appear in quotes and must not contain any spaces.
Growth	This field is not currently implemented but is reserved for future use. A floating point number which represents the oversize factor per edge. If this value is not necessary, the default value of 0.0 should be used.
Rdc	A floating point number which provides the sheet resistance of the metal in ohms/square. This field is only used when the SonMetalType is either General, Resistor, or Rdc/Rrf.

Field	Definition
Rrf	A floating point number which provides the skin effect coefficient of the metal. This field is only used when the SonMetalType is either General, or Rdc/Rrf.
Xdc	A floating point number which provides the surface reactance of the metal. This field is only used when the SonMetalType is either General, or Sense.
Ls	A floating point number which provides the surface inductance in pH/square of the metal. This field is only used when the SonMetalType is General.
Color	An integer value which represents the Color/Pattern for this metal type used in the Sonnet project editor. The value range is 0-54 with zero always representing the default lossless metal type.
MetalName	A character string which is the name of the Sonnet metal type. The character string should be placed in quotes.
SonLevel	A positive integer value which is the Sonnet level where the metal is located. The character string GND is used for the bottom of the Sonnet box (ground).
SonMetalType	A character string which identifies the Sonnet metal model used for this metal. Possible values are General, Normal, ThickMetalModel, SenseMetal, RoughMetal, Resistor, or Rdc/Rrf. The character string should be placed in quotes.
MetalCond	A positive floating point number which provides the conductivity of the metal in S/m. This value may also be set to the character string INF for infinite. This field is only used when the SonMetalType is Normal, ThickMetalModel, or RoughMetal.

Field	Definition
MetalThick	A positive non-zero floating point number which provides the metal thickness in microns. This field is only used when the SonMetalType is Normal, ThickMetalModel, or RoughMetal.
CurrentRatio	A positive floating point number which provides the current ratio for the metal. This field is only used if SonMetalType is set to Normal.
NumSheets	An integer value greater than or equal to 2 which defines the number of sheets used to model the metal. This field is only used if SonMetalType is set to ThickMetalModel.
FillType	A character string which identifies the Sonnet fill type used for this metal. Possible values are Default, Staircase, Diagonal, or Conformal. The character string should be placed in quotes.
XMin	An integer value greater than or equal to 1 which defines the minimum number of cells in a subsection in the X direction. The default value is 1. Must be less than or equal to XMax.
XMax	An integer value greater than or equal to XMin which defines the maximum number of cells in a subsection in the X direction. The default value is 100.
Ymin	An integer value greater than or equal to 1 which defines the minimum number of cells in a subsection in the Y direction. The default value is 1. Must be less than or equal to YMax.
YMax	An integer value greater than or equal to YMin which defines the maximum number of cells in a subsection in the Y direction. The default value is 100.

Field	Definition
UseEdgeMesh	A character string which identifies whether the edge mesh option is on. Possible values are EdgeMeshOn or EdgeMeshOff. Default value is EdgeMeshOn.
CrossSection	A character string which identifies how a Rough Metal type is being modeled. Possible values are Thin or Thick. This field is only used if SonMetalType is set to RoughMetal.
TopRoughness	A positive floating string number which provides the the top surface roughness in RMS microns. This field is only used if SonMetalType is set to RoughMetal.
BottomRoughness	A positive floating string number which provides the the bottom surface roughness in RMS microns. This field is only used if SonMetalType is set to RoughMetal.

Vias

VIA This entry defines a via.

Syntax
VIA LayerName Growth Rdc Rrf Xdc Ls Color MetalName SonLevel
SonToLevel SonMetalType MetalCond MetalThick CurrentRatio
NumSheets FillType Pads FillFactor VolType

This entry defines both the placement of a via and its via metal type. There is a VIA entry for each via layer in your project.

When specifying a VIA entry, you should fill in all values for all fields even if you are not using a particular field for this entry. For example, if you set the SonMetalType to Volume, you would set MetalCond, MetalThick and VolType to the values desired and set the other values to a any valid value. Any values not used in the definition are ignored, but must be set to a valid value in order to not create an error condition when reading the .matl file.

The location of the via is determined by the SonLevel and SonToLevel fields; the via starts at the metal level specified in SonLevel and ends at the metal level specified in SonToLevel. Note that in Sonnet, the metal level is attached to the dielectric layer ABOVE it, with the highest metal level underneath the top dielectric layer being metal level 0 and increasing in number as you move down through the box.

The fields are defined in the table below.

Field	Definition
Layername	A character string which is the name of the layer in the Virtuoso or ADS layout containing the objects which are being mapped to this Sonnet layer. Only the layer name is required, the Virtuoso purpose name is not presently used. The character string should appear in quotes.
Growth	This field is not currently implemented but is reserved for future use. A floating point number which represents the oversize factor per edge. If this value is not necessary, the default value of 0.0 should be used.
Rdc	A floating point number which provides the sheet resistance of the via metal in ohms/square. Used only when SonMetalType is Surface.
Rrf	A floating point number which provides the skin effect coefficient of the via metal in ohms/square. Used only when SonMetalType is Surface.
Xdc	A floating point number which provides the surface reactance of the via metal. Used only when SonMetalType is Surface.
Ls	A floating point number which provides the surface inductance of the via metal. Use of this value is not recommended but may be used for backwards compatibility.

Field	Definition
Color	An integer value which represents the Color/Pattern for this metal type. The value range is 0-54 with zero always representing the default lossless metal type.
MetalName	A character string which is the name of the Sonnet metal type. The character string should be placed in quotes.
SonLevel	A positive integer value, or the string GND for the Sonnet box bottom, which is the Sonnet level where the via starts.
SonToLevel	A positive integer value, or the string GND for ground or TOP for box top, which is the Sonnet Level where the via ends.
SonMetalType	<p>A character string which identifies the Sonnet metal model used for this via metal. Possible values are Volume, Surface, and Array. The character string should be placed in quotes.</p> <p>NOTE: The values General, Normal, Thick-MetalModel, SenseMetal, RoughMetal, Resistor or Rdc/Rrf are not recommended but may be used for backwards compatibility.</p>
MetalCond	A positive floating point number which provides the conductivity of the metal in S/m. This value may also be set to the character string INF for infinite.Used only when the SonMetalType is set to Volume or Array.
MetalThick	A positive non-zero floating point number which provides the wall metal thickness in microns.This value is used in modeling loss and is not a physical thickness. This field is only used when SonMetalType is Volume and VolType is Wall.

Field	Definition
CurrentRatio	A positive floating point number which provides the current ratio for the via metal. This field is only used if < SonMetalType> is set to Normal. Use of this value for vias is not recommended but may be used for backwards compatibility.
NumSheets	An integer value greater than or equal to 2 which defines the number of sheets used to model the via metal. Use of this value for vias is not recommended but may be used for backwards compatibility.
FillType	A character string which identifies the Sonnet meshing fill type used for this metal. Possible values are Default, Ring, Vertices, Center or Full. The character string should be placed in quotes.
Pads	A character string which determines whether via pads are added to the top and bottom of the via. If set to "PadsOn" pads are added. If set to "PadsOff" then no pads are added. Default value is "PadsOff."
FillFactor	A positive floating point number which defines the fill factor for the Array model. Default value is 100. This field is only used when the SonMetalType is Array.
VolType	A character string which identifies the type of Volume loss model used for this via metal. Possible values are Wall, Solid, or N/A. The character string should be placed in quotes. Default value is Wall. This value is only used when SonMetalType is set to Volume. "N/A" should be used if SonMetalType is Surface or Array.

Planar Metals - Unused or Box Definition

- MATERIAL** This entry defines a Sonnet planar metal type that cannot be specified with the METAL entry. There are two reasons you may wish to do this:
- 1 You wish to define metal for the box top cover or bottom cover. The .matl file does not support mapping of metals to the top and bottom covers, so you cannot use a METAL entry. Instead, you would create a MATERIAL entry, and then assign the top/bottom cover using the interface (The Analysis Box dialog box).
 - 2 You wish to define a planar metal type that is not presently being used, but you wish to have available for use in the future.

For both cases, a new metal type will be created in the Sonnet project file with the specified parameters.

Syntax MATERIAL MetalName Rdc Rrf Xdc Ls Color SonMetalType MetalCond MetalThick CurrentRatio NumSheets CrossSection TopRoughness BottomRoughness

There is a MATERIAL entry for each additional metal type you wish to define for your project. Please see "METAL" on page 12 for an explanation of the fields.

Unused Via Metals

VMATERIAL This entry defines a Sonnet via metal type which is unused in the circuit.

Syntax VMATERIAL MetalName Rdc Rrf Xdc Color SonMetalType MetalCond MetalThick FillFactor VolType

There is a VMATERIAL entry for each additional unused via metal type you wish to define for your project. Vmaterials are via metal types you wish to have defined in your translated project, although the via metal type is not presently being used for any vias in your circuit. This via metal type is available for subsequent design changes.

Please see "VIA" on page 16 for an explanation of the fields.

Chapter 3

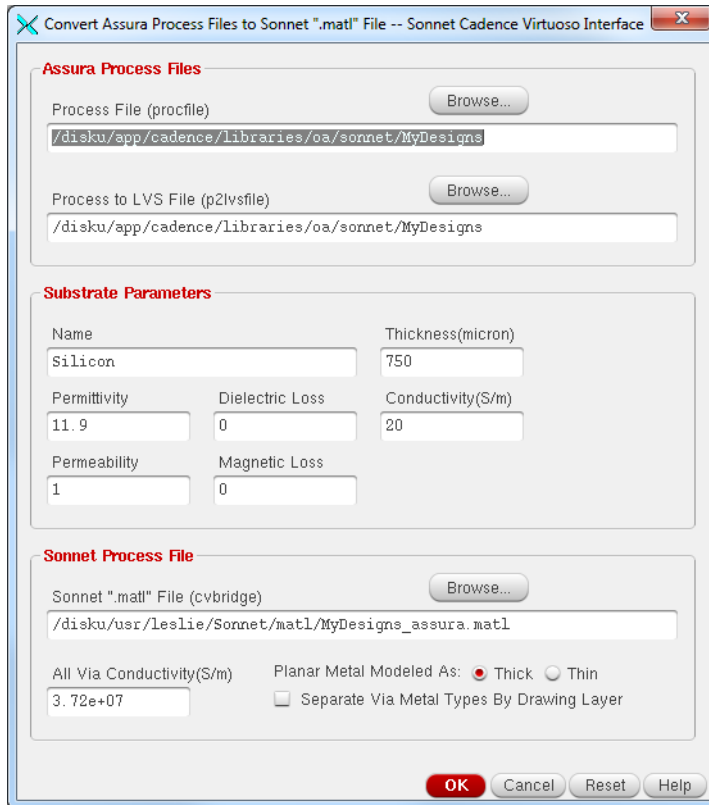
Loading Process Files

Release 13.52 included the additional functionality of loading in Assura and Helic process files and translating these process files in a .matl file format that could be used in Sonnet's Cadence Virtuoso Interface. There was not time to include documentation of these functions in the Translator's manual published for the release. The dialog boxes for importing both types of process files are detailed below.

Note that loading both type of processing files is done in the Substrate Setup dialog box which is opened by clicking on the Substrate button in the Cadence Virtuoso Interface or by selecting *Setup* ⇒ *Substrate* from the menu in the interface.

Load Assura

When you click on the Load Assura button in the Substrate File Setup dialog box in Sonnet's Cadence Virtuoso Interface, the Convert Assura Process Files to Sonnet ".matl" File dialog box appears on your display, as shown below. This dialog box allows you to input Assura process files and translate them into a Sonnet .matl file which can be used in the Cadence Virtuoso Interface.



Assura Process Files

You enter the Assura process files you wish to load into the Cadence Virtuoso Interface. The process file (procfile) should be entered in the first text entry box in this section of the dialog box and the p2lvsfile in the second text entry box. There is a browse button available to the right of both entry fields which will open a browse window and allow you to select the desired file or you may directly enter the pathname of the file by editing the text entry box.

Substrate Parameters

This section of the dialog box allows you to enter the desired parameters for the Sonnet substrate to be used with the imported process files. This defines the dielectric layer in the Sonnet box which appears just above the Sonnet box bottom (ground level). The entries are explained below.

Name: Enter the desired name for the dielectric material to be used in the layer here.

Thickness: Enter the desired thickness of the dielectric layer here.

Permittivity: Enter the relative dielectric constant (ϵ_{rel}) here.

Dielectric Loss: Enter the dielectric loss tangent here.

Conductivity (S/M): Enter the dielectric conductivity here.

Permeability: Enter the relative magnetic permeability (m_{rel}) here.

Magnetic Loss: Enter the magnetic loss tangent here.

Sonnet Process File

This section of the dialog box defines the .matl file which is created when you translate the Assura process files.

Sonnet .matl File: Specify the name of the .matl file to which you wish to save the translated Assura process files. There is a browse button available above the entry field which will open a browse window and allow you to select the desired file or you may directly enter the pathname of the file by editing the text entry box.

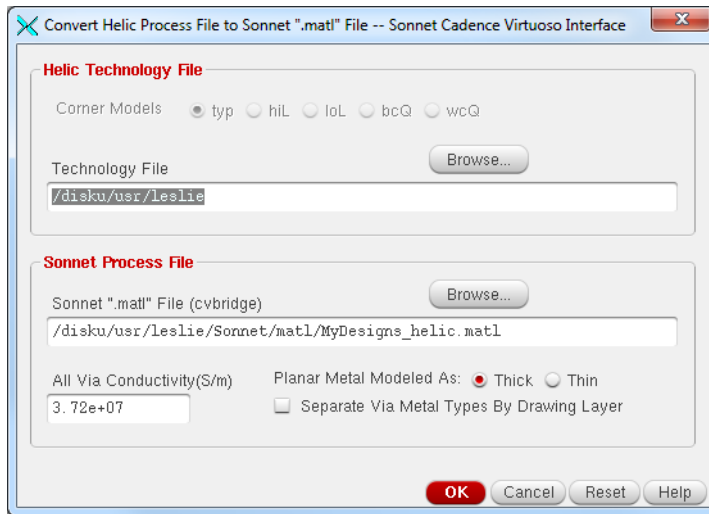
Planar Metal Modeled as: This field determines how the metal used for metal polygons is modeled in the Sonnet analysis. You may select **Thin** or **Thick**. For more information about Sonnet's metal types, please refer to "Creating Planar Metal Types" on page 52 of the **Sonnet User's Guide**.

All Via Conductivity: This sets the conductivity of all vias modeled using this .matl file. This may be changed later by editing the resulting .matl file. Enter the Conductivity in S/m in the text entry box.

Separate Via Metal Types by drawing layer: Select this checkbox if you wish to create a unique via metal type for each drawing layer in which a via appears. The via metal types will all initially use the same conductivity but have unique names.

Load Helic

When you click on the Load Helic button in the Substrate File Setup dialog box in Sonnet’s Cadence Virtuoso Interface, the Convert Helic Process File to Sonnet “.matl” File dialog box appears on your display, as shown below. This dialog box allows you to input a Helic process file and translate it into a Sonnet .matl file which can be used in the Cadence Virtuoso Interface.



Helic Technology File

This section of the dialog box allows you to specify the Helic process file you wish to translate into a .matl file. Helic process files are defined by which corner model they use. The corner model controls the values (nominal, maximum or minimum) used for metal thickness, sheet resistance, dielectric resistance, substrate resistivity, and substrate thickness when performing corner analyses. Corner analyses refer to testing all combinations of extreme and nominal values of the selected properties in order to test the “corners” of the design. For more information on the corner models, please refer to the Helic documentation.

You specify the corner model you wish to use and enter the location of the desired Helic Technology File.

Corner Models: Helic process files are defined for corner models with a different process file for each corner model. The corner model selected determines which Helic process file is translated. You may select one of five available corner models. The extension used for each process file is based on the corner model. You may enter this extension as part of the file name or use these radio buttons and the correct file will be input in the Technology File text entry box. The choices are described below:

- typ is Typical
- hiL is High Inductance
- loL is Low Inductance
- bcQ is best case Q
- wcQ is worst case Q

Technology File: Enter the desired Helic process file in this text entry box. You may click on the browse button to open a browse window which allows you to select the desired file or you may directly edit this text entry box. The extension of the Helic process file is “.vlc.tech.<corner model>” where <corner model> are the extensions defined above.

Sonnet Process File

This section of the dialog box defines the .matl file which is created when you translate the Helic process file.

Sonnet .matl File: Specify the name of the .matl file to which you wish to save the translated Helic process file. There is a browse button available above the entry field which will open a browse window and allow you to select the desired file or you may directly enter the pathname of the file by editing the text entry box.

Planar Metal Modeled as: This field determines how the metal used for metal polygons is modeled in the Sonnet analysis. You may select **Thin** or **Thick**. For more information about Sonnet’s metal types, please refer to “Creating Planar Metal Types” on page 52 of the **Sonnet User’s Guide**. The “Thin” setting uses the Normal metal model.

All Via Conductivity: This sets the conductivity of all vias modeled using this .matl file. This may be changed later by editing the resulting .matl file. Enter the Conductivity in S/m in the text entry box.

Separate Via Metal Types by drawing layer: Select this checkbox if you wish to create a unique via metal type for each drawing layer in which a via appears. Each via metal type will use the same conductivity, but have a unique name.

