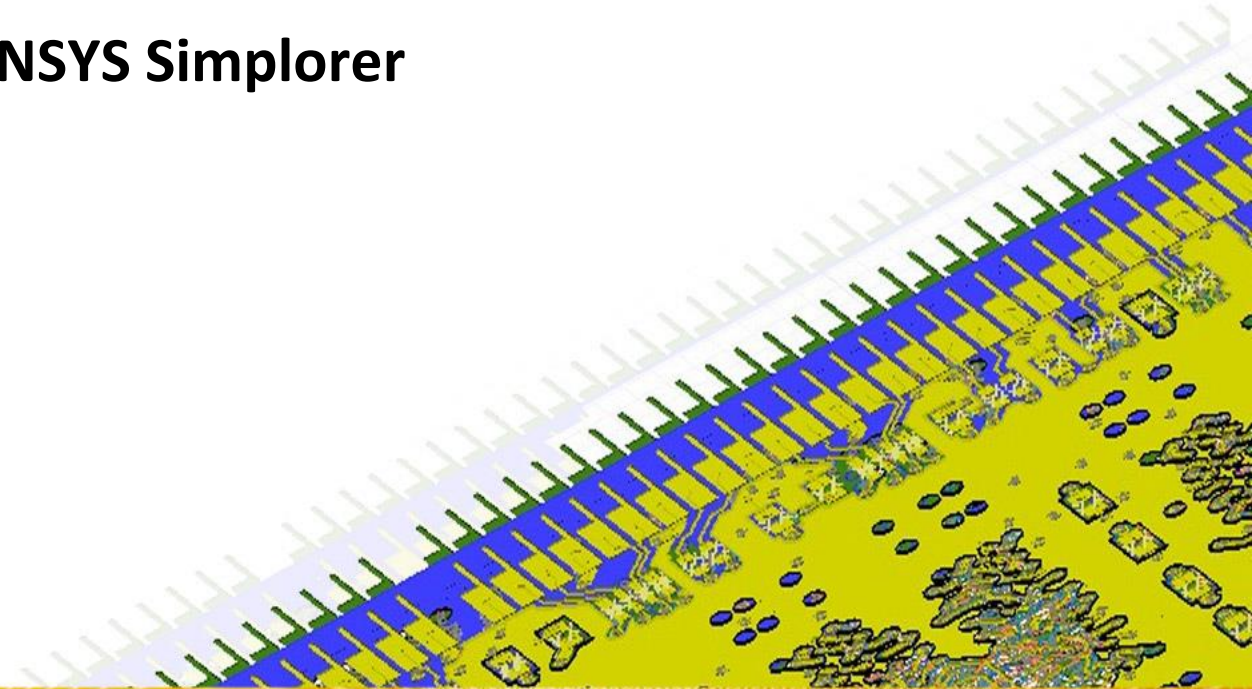




# Workshop 4.1: VHDL components and export to library



## Introduction to ANSYS Simplorer

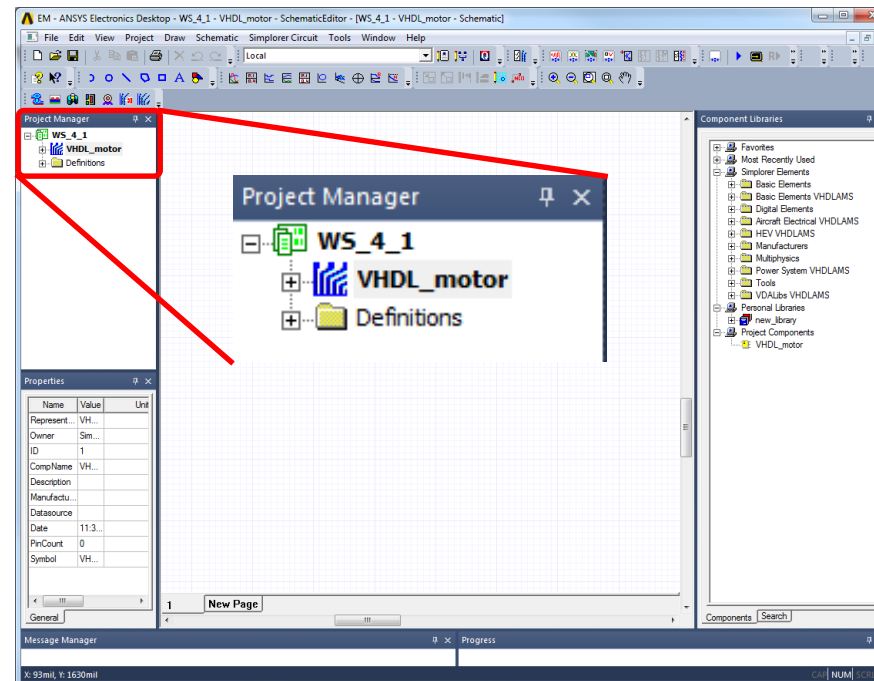
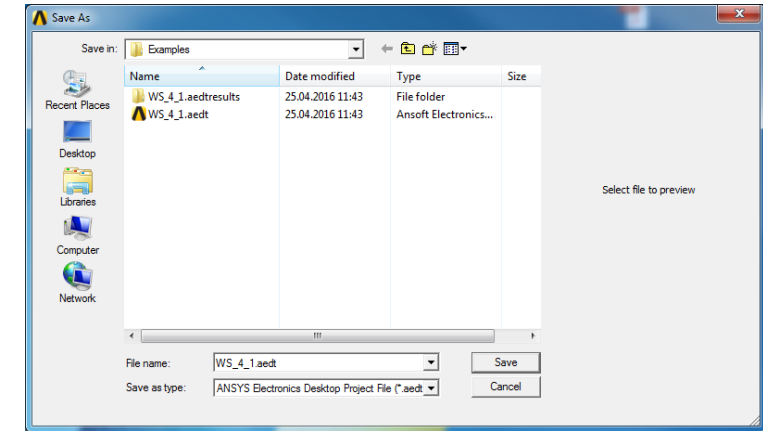


# Overview

- **VHDL-AMS Models**
  - In this example we will learn how to modify an existing VHDL-AMS model, how to manage libraries and how to save the modified model in the Simplorer libraries for future usage
  - In particular we will learn
    - How to edit an existing VHDL\_AMS Model
    - How to modify the model Properties
    - How to create a new Symbol for the model
    - How to insert the new model into the Schematic and to change its characteristics
    - How to export the new model to the Personal library

# Insert a Simplorer Design

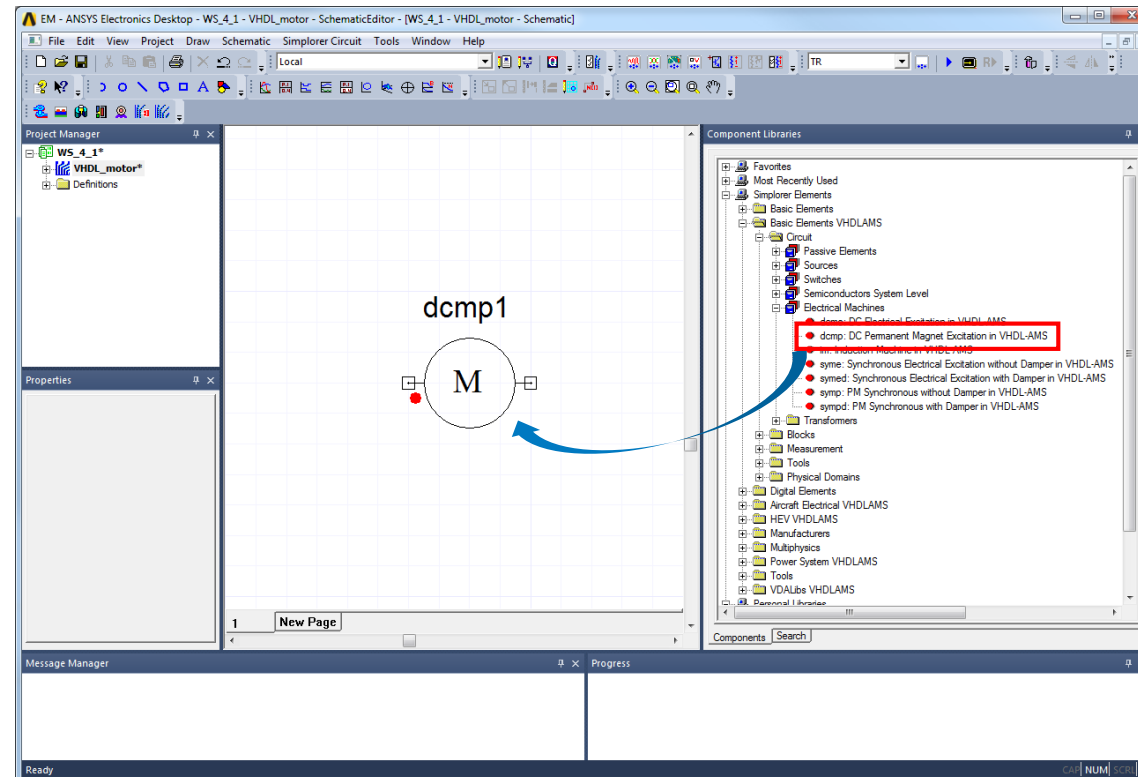
- Launch the Electronics Desktop 2016
  - Save the Project as **WS\_4\_1.aedt**
  - Insert a Simplorer Design using the icon 
  - Rename the Design as **VHDL\_motor**
  - Save again the project using the icon 



# Insert VHDL Component

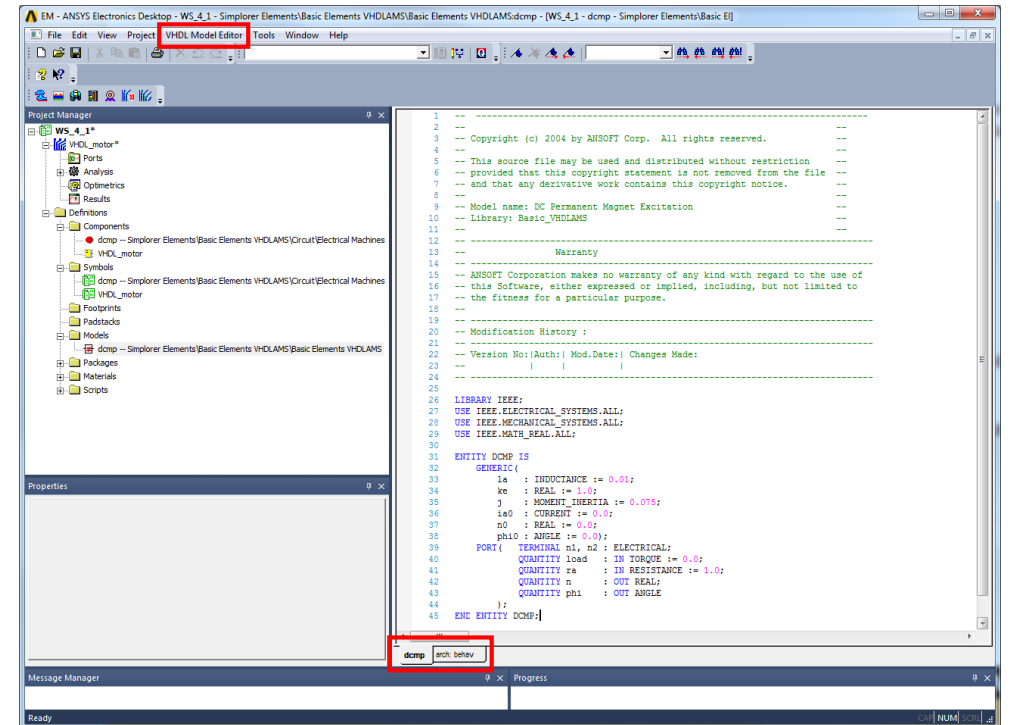
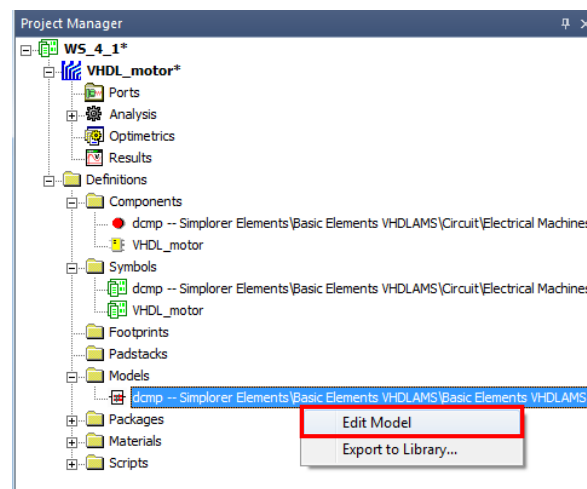
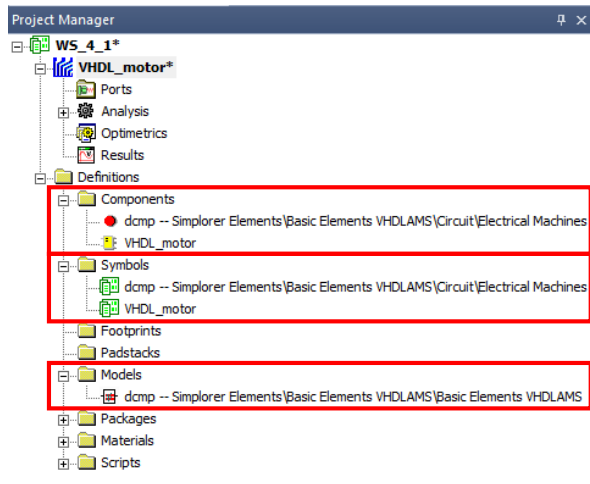
- **DCMP (Permanent Magnet DC motor)**

- In Component Libraries window *Simplorer Elements* → *Basic Elements VHDLAMS* → *Circuit* → *Electrical Machines*
- Select the **dcmp: DC Permanent Magnet Excitation in VHDL-AMS** component, drag and drop it into the Schematic. Press **Esc** key to exit the insert mode



# DCMP Component Properties

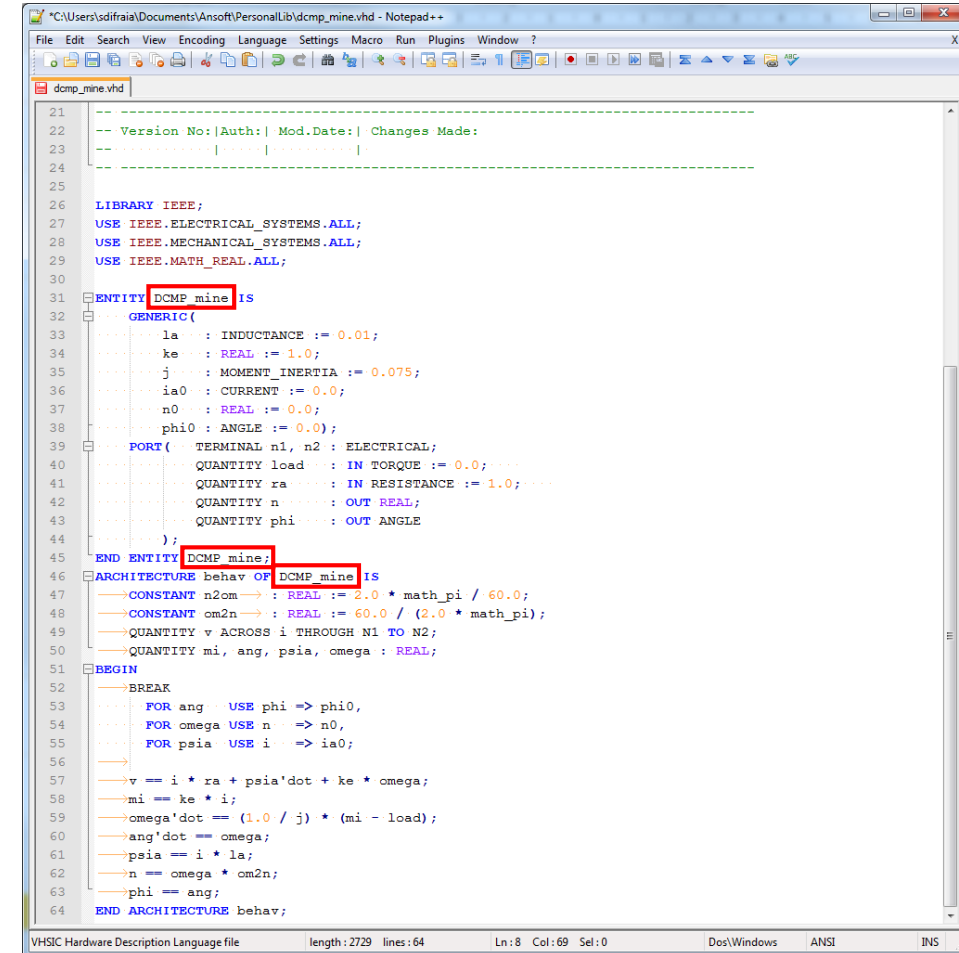
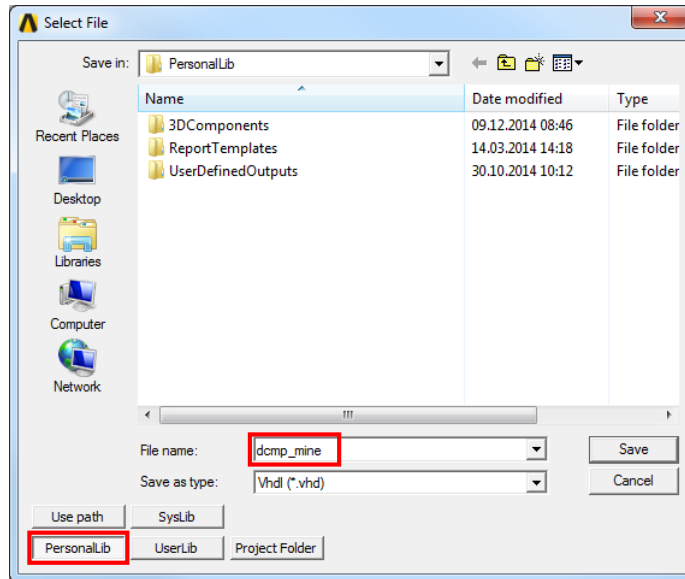
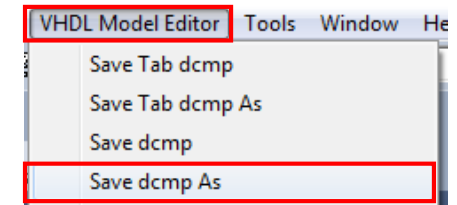
- In the Project Manager window, expand **Definitions** and verify that inserting the DCMP VHDL-AMS model into the Schematic has added its Component, Symbol and Model Definitions
- Select the model and **RMB** → **Edit Model** to have access to the VHDL-AMS **Entity** and **Architecture** through the **VHDL Model Editor**





# Export Model

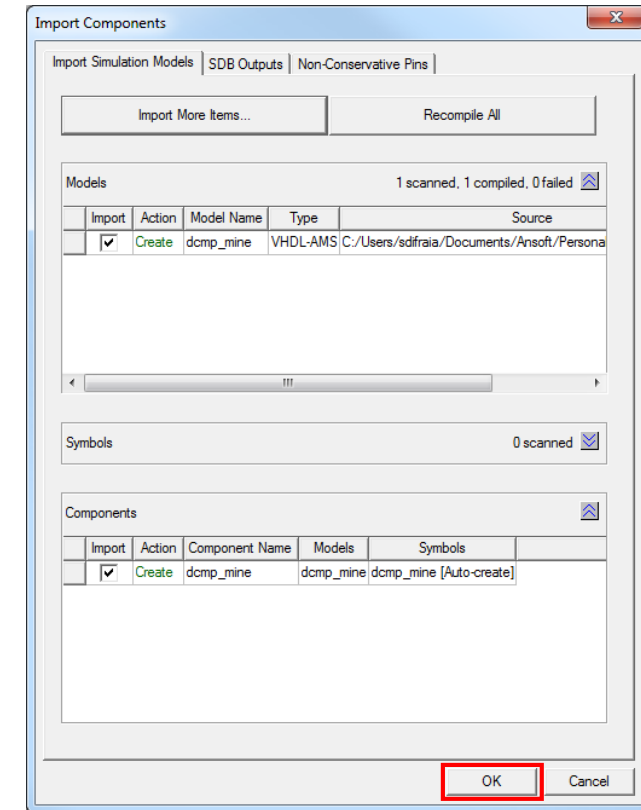
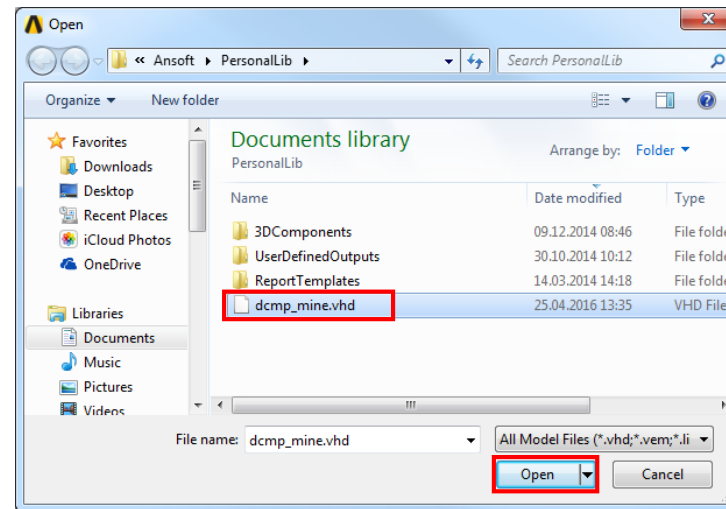
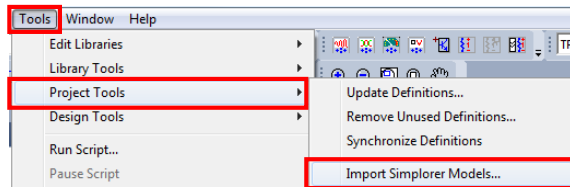
- To Export the model, use menu item **VHDL Model Editor** → **Save dcmp As**
- Name the file “**dcmp\_mine**” and press Save. Double click on **VHDL\_motor Design** to exit VHDL Model Editor



- Locate the file **dcmp\_mine.vhd** in the **Personal Lib**
- Edit it using a text Editor like Notepad++
- Change the name of the **ENTITY** in 3 places to **DCMP\_mine** and save the file

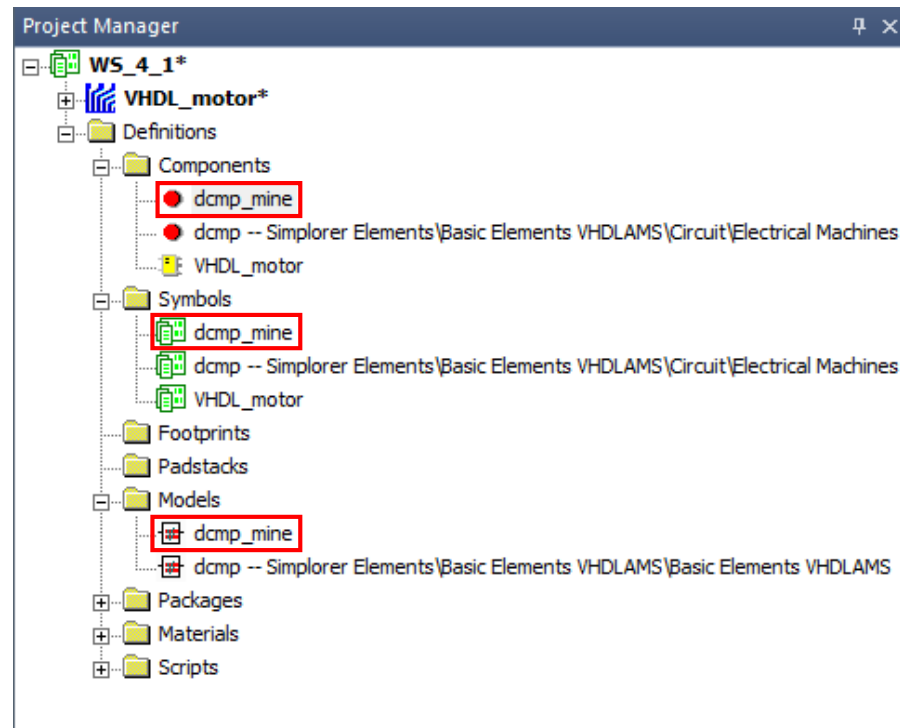
# Import the New VHDL-AMS Model

- Import the new `dcmp_mine.vhd` VHDL-AMS model into Simplorer using the menu item **Tools** → **Project Tools** → **Import Simplorer models**
- Locate the `dcmp_mine.vhd` file and open it
- This will pop up the **Import Components** Window
- Press **OK**



# Import the New VHDL-AMS Model

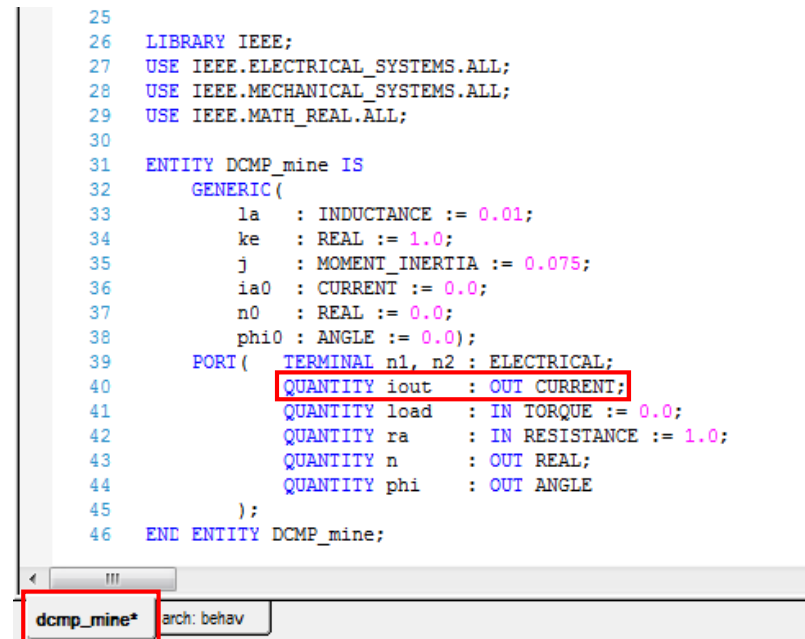
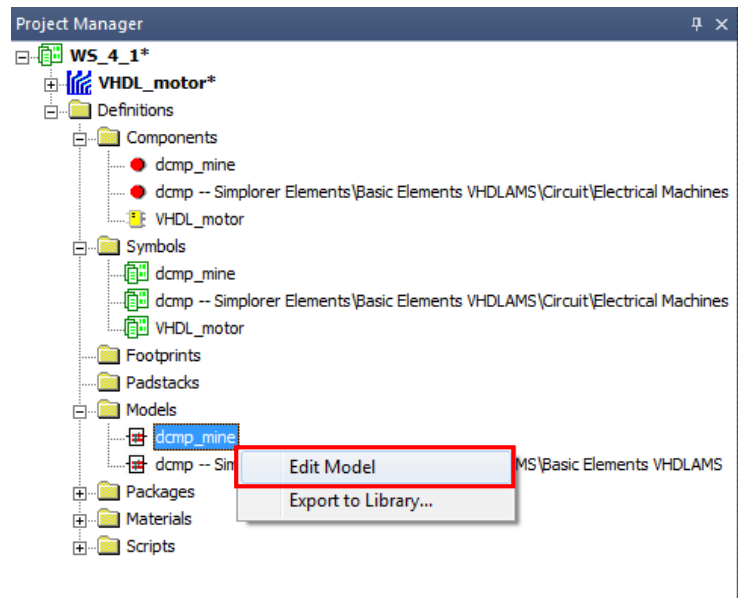
- This will create all the Definitions (Components, Symbols and Models) for the new imported model in the **Project Manager** window





# Edit the VHDL-AMS Model

- Select the new “**dcmp\_mine**” vhdl model that was just imported, **RMB** → **Edit Model** to bring this new model back into the VHDL Model Editor
- Select the Entity tab named “**dcmp\_mine**” at the bottom of the editor page and insert the following line “**QUANTITY** iout : **OUT** current;” as shown



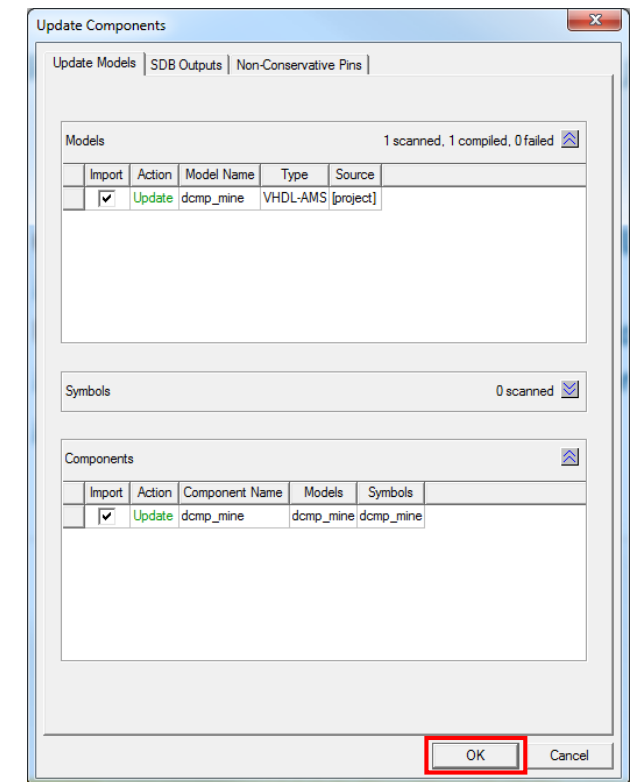
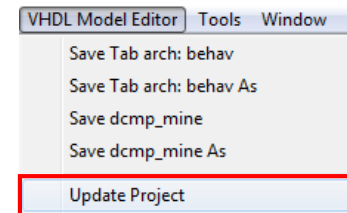
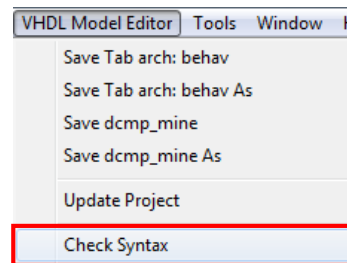
# Edit the VHDL-AMS Model

- Select the Architecture tab “**arch:behav**” at the bottom of the Editor page and insert the following code “**iout == i;**” as shown below
- *Note: this additional code line will allow the motor current to be available for the control design*

```
1  ARCHITECTURE behav OF Dcmp_mine IS
2  CONSTANT n2om : REAL := 2.0 * math_pi / 60.0;
3  CONSTANT om2n : REAL := 60.0 / (2.0 * math_pi);
4  QUANTITY v ACROSS i THROUGH N1 TO N2;
5  QUANTITY mi, ang, psia, omega : REAL;
6  BEGIN
7  BREAK
8  FOR ang USE phi => phi0,
9  FOR omega USE n => n0,
10 FOR psia USE i => ia0;
11
12 v == i * ra + psia'dot + ke * omega;
13 mi == ke * i;
14 omega'dot == (1.0 / j) * (mi - load);
15 ang'dot == omega;
16 psia == i * la;
17 n == omega * om2n;
18 phi == ang;
19 iout == i;
20 END ARCHITECTURE behav;
```

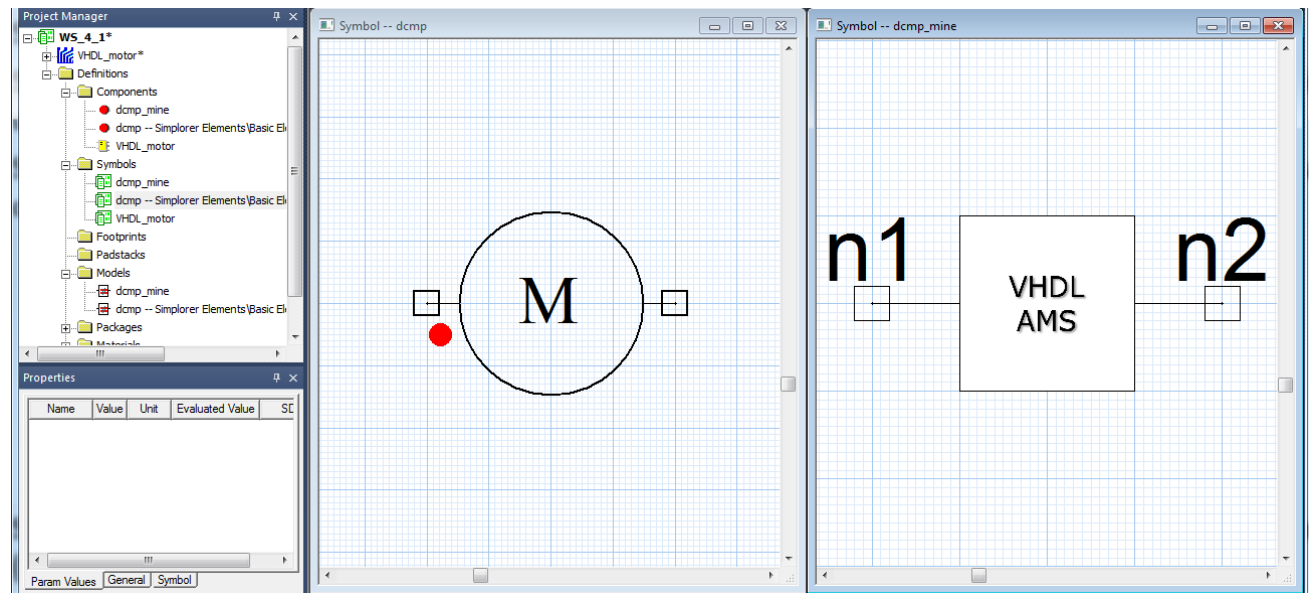
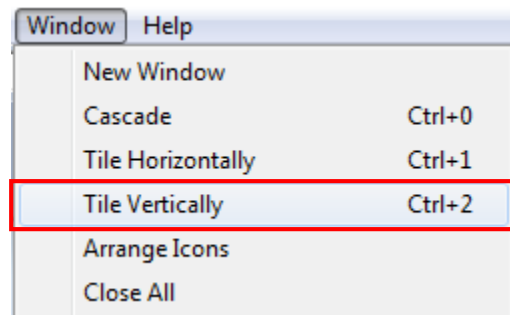
dcmp\_mine\* **arch: behav\***

- Check the model syntax via menu **VHDL Model Editor → Check Syntax**
- Update the model via menu **VHDL Model Editor → Update Project**
- In the **Update Components** window press OK
- Close the VHDL Model Editor



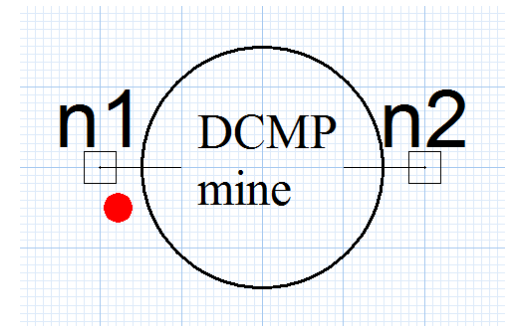
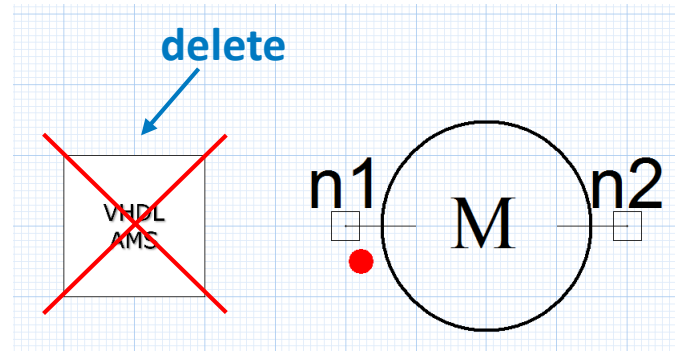
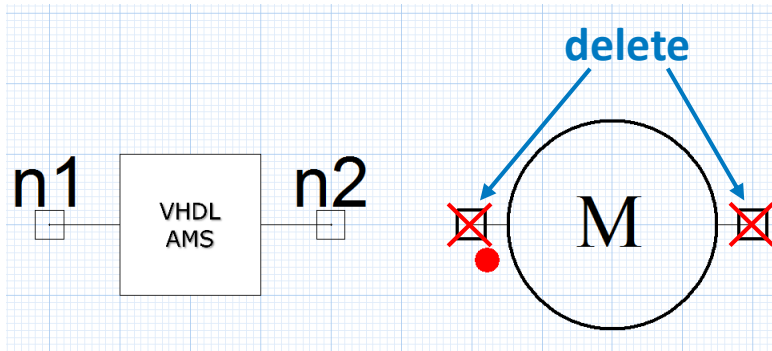
# Create a New Symbol for the VHDL-AMS Model

- Select the **dcmp\_mine** symbol in the Definitions/Symbols folder, **RMB** → **Edit Symbol**
- Select the original “**dcmp**” symbol in the Definitions/Symbols folder, **RMB** → **Edit Symbol** to also bring up the symbol for the original “dcmp” model
- Select the menu **Window** → **Tile Vertically** to view both symbols side by side. Note: close out any other windows that appear and re-tile



# Create a New Symbol for the VHDL-AMS Model

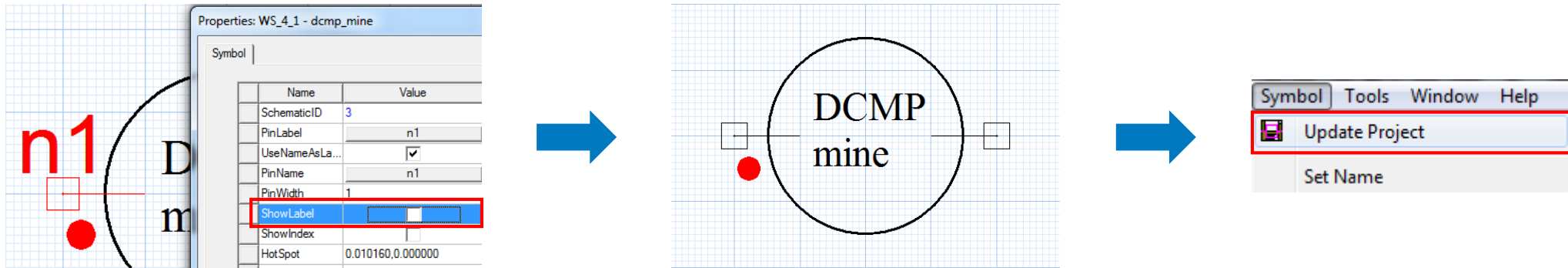
- Select with the mouse the entire symbol from the original “**dcmp**” symbol edit window, copy it (Ctrl + C) and paste it (Ctrl + V) into the new “**dcmp\_mine**” symbol editor window
- Close out the original “**dcmp**” symbol edit window which now leaves just the Symbol Edit window for the new “**dcmp\_mine**” component symbol
- Remove the pins from the original “**dcmp**” symbol that was copied over, and move the pins from the new “**dcmp\_mine**” default symbol in their place
- Delete the default symbol box and add unique text so that the new symbol will be different than the original symbol



- To change the text size inside the Symbol Editor, select the text of interest and modify the TextSize item in the Properties window

# Symbol Creation

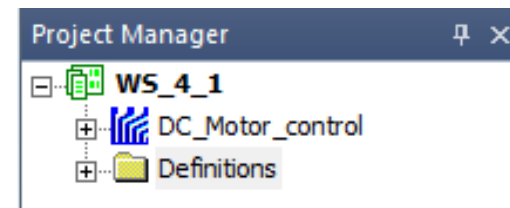
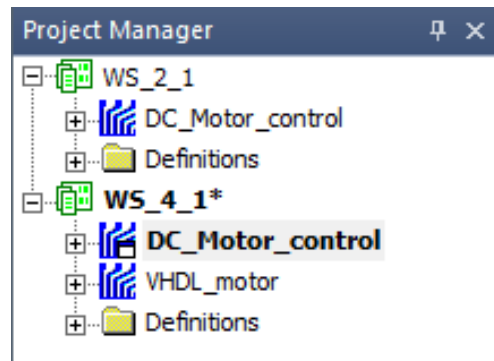
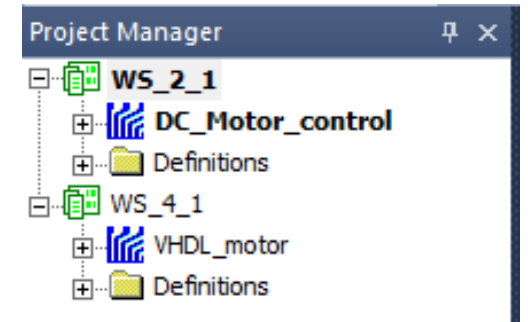
- Select the pins and **RMB** → **Properties** uncheck “Show Label” to hide the pins names
- The new symbol for the imported “dcmp\_mine” VHDL-AMS model should now appear as shown below  
Save the symbol using menu item **Symbol** → **Update Project**



- Close the Symbol Editor window. Save the File
- The user could at this point further edit the model equations for the new VHDL-AMS “dcmp\_mine” model as desired

# Test the Model

- The test circuit will be created using the previous DC motor Workshop 2.1
- Open the previous “**WS\_2\_1.aedt**” example using *File → Open*
- There should now be two Projects in the Project Manager Window
- Select the Design named “**DC\_Motor\_control**” from **WS\_2\_1** Project, copy it with Ctrl+C
- Select the **WS\_4\_1** Project and Paste the previous Design using Ctrl+V
- Close the **WS\_2\_1** Project and delete **VHDL\_motor** Design from **WS\_4\_1** Project. Save the File

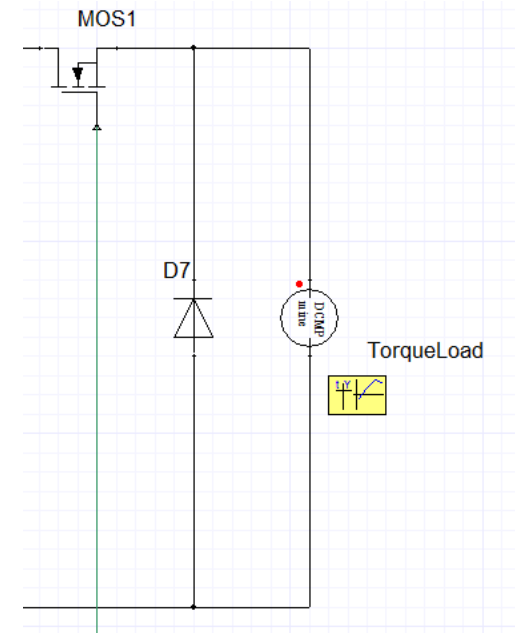
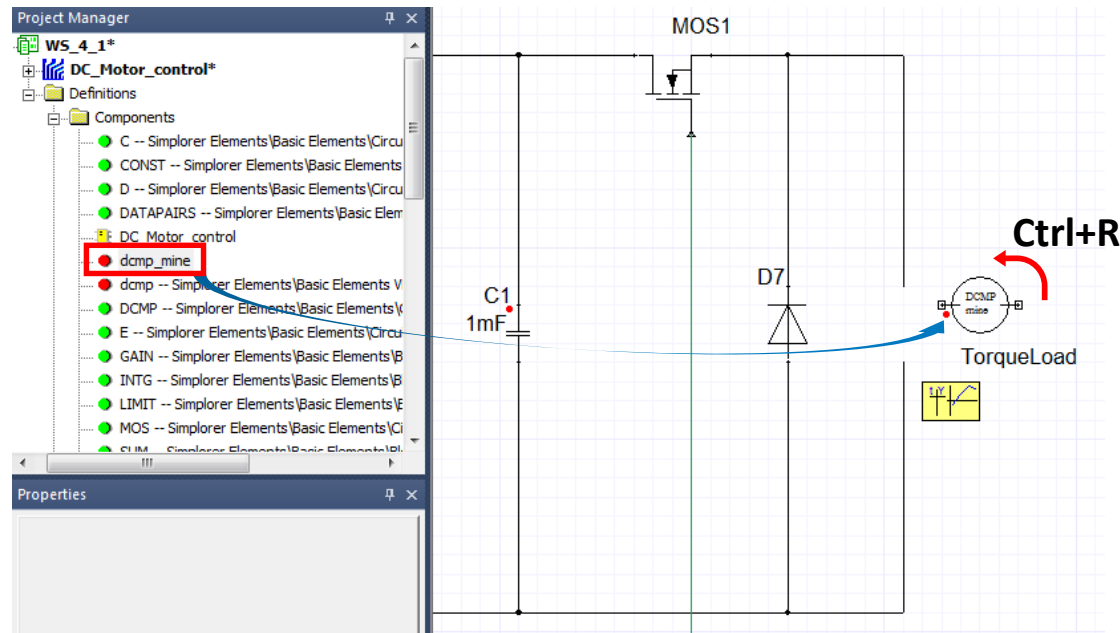


*Note: the Close operation does not delete the file from the Computer*



# Test the Model

- Double click on **DC\_motor\_control** Design to bring up the Schematic
- Delete the **DCMP1** motor model that was used in Workshop 2.1
- Expand Definition/Components folder, select **dcmp\_mine** component and drag and drop onto the Schematic
- Rotate the component 3 times using **Ctrl+R** and connect it in place of old DCMP1 motor component



# Characterize the New VHDL-AMS Model

- Double click on the new “DCMP\_mine” symbol in the schematic, select the “Parameter Values” tab, set  $I_a = 9.5$  mH,  $k_e = 0.544$ ,  $J = 0.004$  kgm<sup>2</sup>, load = TorqueLoad.VAL,  $r_a = 1.2$  ohms
- Press OK
- Double click on the “Motor\_speed” block, and change the input signal to “dcmp\_mine1.n”
- Press OK
- Double click on the “Motor\_current” block, and change the input signal to “dcmp\_mine1.iout”
- Press OK

Parameters			
	Name	Value	Units
	SimulatorModel	dcmp_mine - behav	
	Ia	9.5	mH
	ke	0.544	
	J	0.004	kgm2
	Ia0	0	A
	n0	0	
	phi0	0	rad
	load	TorqueLoad.VAL	
	ra	1.2	ohm

Parameters - Motor\_speed - Gain ✕

Parameters | Output / Display

Name  ☒ Show

Parameters

	Name	Value	Units	Description
	INPUT	dcmp_mine1.n		Input Signal
	KP	1		Proportional Gain
	TS	0	s	Sample Time

Parameters - Motor\_current - Gain ✕

Parameters | Output / Display

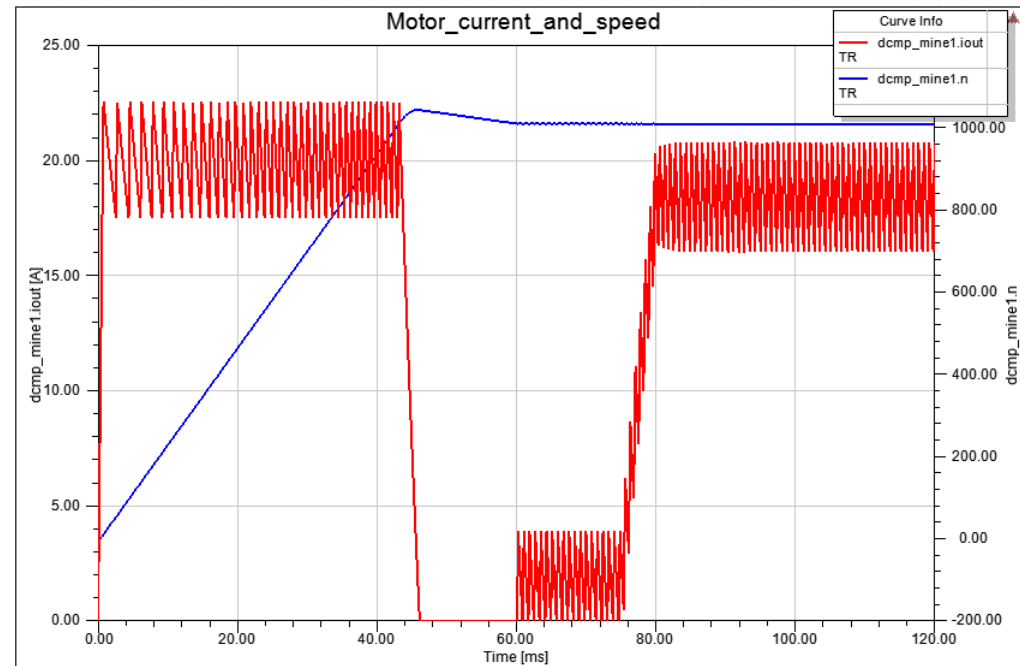
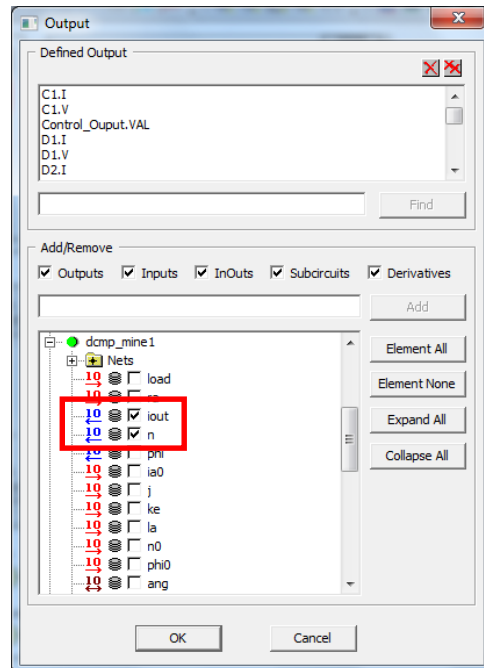
Name  ☒ Show

Parameters

	Name	Value	Units	Description
	INPUT	dcmp_mine1.iout		Input Signal
	KP	1		Proportional Gain
	TS	0	s	Sample Time

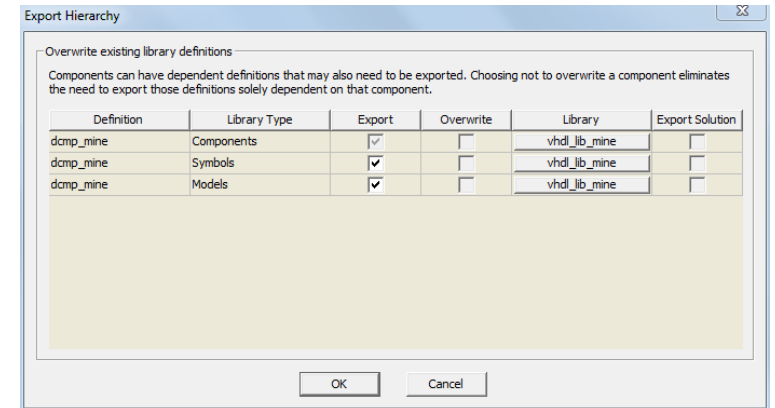
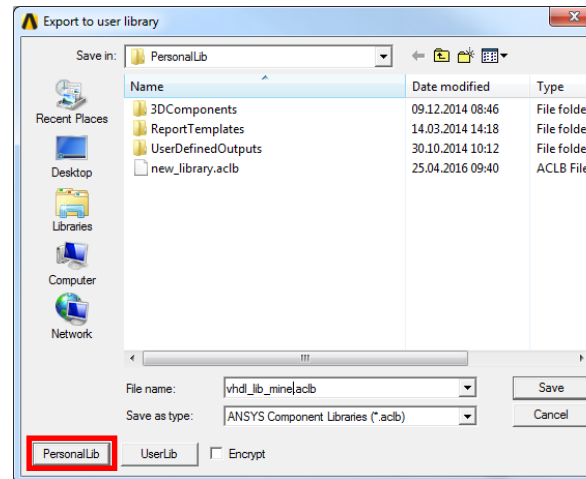
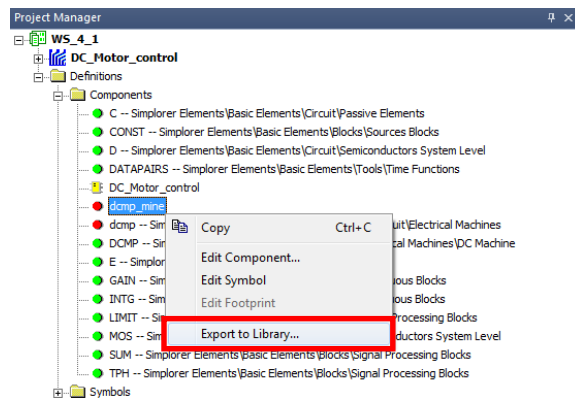
# Run the Simulation

- Select the *menu Simplorer Circuit → Output Dialog*, choose “**Collapse All**”, expand “**dcmp\_mine1**” and select the speed (**n**) and output current (**iout**), press **OK**
- Select the Plot from Results in Project Manager window and name it “**Motor\_current\_and\_speed**”
- In the Schematic, double click on the plot, select the “**dcmp\_mine1.iout**” and “**dcmp\_mine1.n**” signals, “**Add Trace**”, “**Close**”
- Run the simulation, the results should appear as shown below, confirming what expected



# Export the New VHDL-AMS Model to Personal Lib

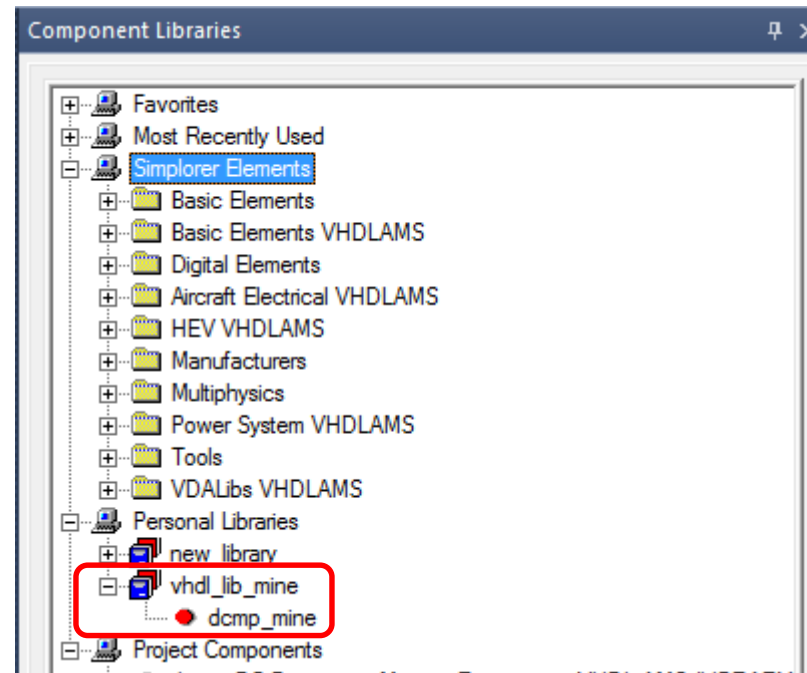
- Once the VHDL-AMS model has been imported, a new symbol created, and the component tested in a circuit, it can be exported into a personal library to be used in other designs
- Expand the “Definitions/Components” folder in the Project Manager Window, select the new VHDL-AMS Component, then **RMB** → **Export to Library**
- Select the “**PersonalLib**” and name the new library (or update existing libraries with the new component)



- Press **YES** in the first pop-up window asking “would you like to create a new library?” and Press **OK** in the **Export Hierarchy** window, showing all the parts of the Component to be exported to libraries (Component, Symbol, and Model libraries will be created)

# Note the New Model in Personal Library

- The new library with the new component model will now be available in the Personal Library section of the Component Manager Window and can be used in future projects



# Saving the Project

- This completes the workshop
- Save the file with the name **WS\_4\_1** in the working folder