

AN INTRODUCTION TO AUTODESK® INVENTOR® ILOGIC

INTRODUCTION

This tutorial will provide you with a hands-on introduction to Autodesk® Inventor® iLogic. iLogic extends the computational capabilities within Inventor to include rules. These rules work along with the parameter update mechanism of Inventor, and allow you to include much more sophisticated design intent into your models.

Traditional parametric modeling involves driving geometry with dimensional parameters. These parameter values can be input directly by the user, or can result from fixed equations involving other parameters or even linked spreadsheet values. Using rules in a parametric model allows for conditionally-defined equations. These “conditional equations” are not limited only to the parameters, but can involve all aspects of the design. Equations or relationships can be defined between the parameters, properties, attributes, features, components, or any other aspect of the design. Defining the relationships between all objects in a design makes it possible to update the model completely, correctly (according to the rules), and automatically when input parameter values are changed. A rules-enriched model is therefore far superior to a simple parametric model.

This tutorial will introduce you to the most important aspects of working with iLogic rules, and show you how to create simple (but powerful) rules that control the modeling of a simple part.

Subsequent tutorials expand on this information, and show you how to create even more intelligent models, still with only very simple rules.

This tutorial assumes that you are familiar with Inventor 2009, and its basic part modeling functionality and concepts.

ILOGIC PARAMETERS

In addition to the numeric parameters that you're using to using with Inventor, iLogic lets you create additional type of parameters, including String and Boolean values, which you can then use to control your model.

This portion of the tutorial will guide you through the steps of creating additional parameters in your model, which you will later use in iLogic rules.

All of this will be done in the context of a sample part model. We'll get that model set up first.

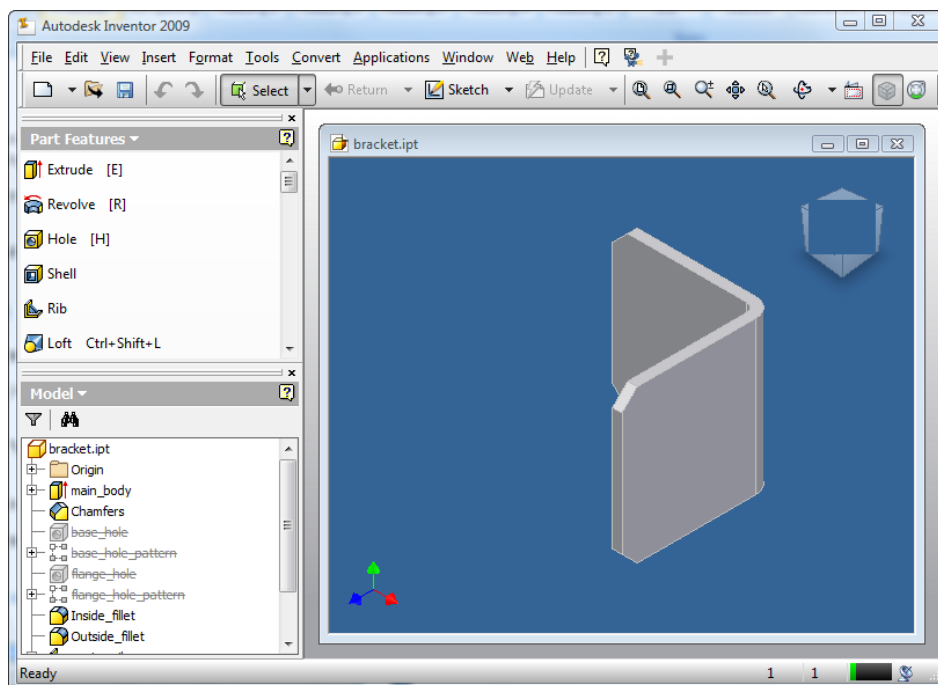
OPEN A PART FILE TO WORK WITH

Launch Inventor 2009, and make sure that the "iLogic 2009 Tutorials" project is active.

Open the file called **bracket_no_rules.ipt** from the project workspace.

Use File -> Save As... to save this document as a new file, called "bracket.ipt". This is the file that we'll make changes to in this tutorial.

At this point, you should have this newly-saved **bracket.ipt** open in Inventor.

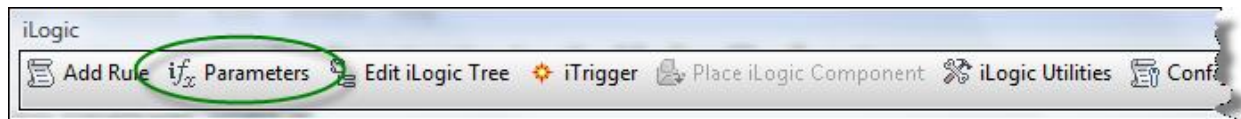


OPEN THE ILOGIC PARAMETER EDITOR

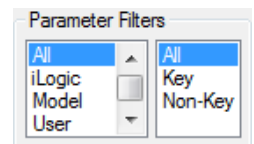
A panel bar is docked on your screen. Click on the Part Features Tab. In the drop down menu select **iLogic**.

At this point you may want to show the iLogic toolbar. It's available under the Toolbars tab of the Inventor Customize dialog:

Select **Parameters** to bring up the iLogic Parameter Editor

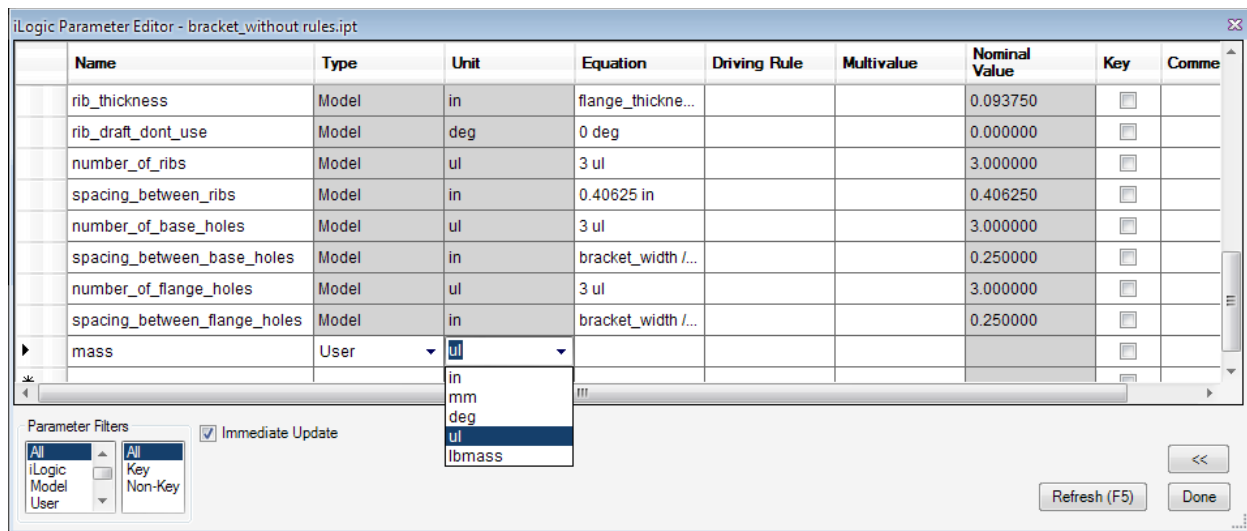


In the Parameter Filters box at the bottom of the Parameter Editor window, select the **All** option in both lists. This will display all of the parameters associated with the bracket model.



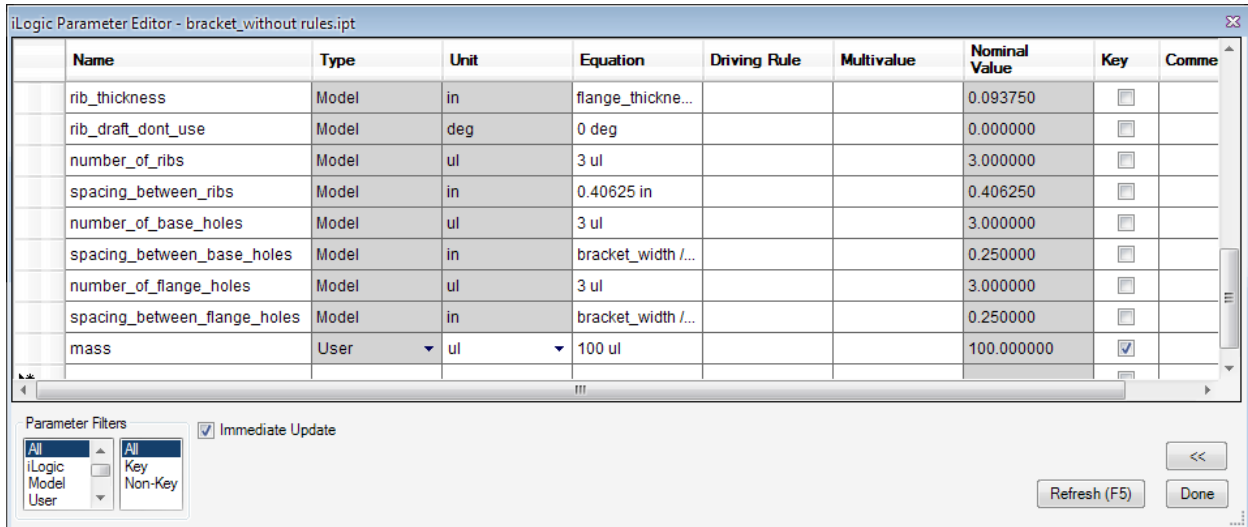
CREATE A "MASS" PARAMETER

In the blank cell at the bottom of the Name column of the list of parameters, enter the name **mass**. A drop down menu appears in the Type window. The available options are User, String and Boolean. Select the **User** option.



Parameter names in iLogic are case sensitive. Please be sure to follow the case being used in the parameter editor, and while creating rules.

In the Unit field, choose **ul** from the drop down menu. In the Equation field enter **100**. Click in a blank field and observe 100.000000 in the Nominal Value Field. Make this a Key parameter by clicking in the check box in the Key column.



The screenshot shows the iLogic Parameter Editor window for the file 'bracket_without rules.ipt'. It contains a table with 10 parameters. The 'mass' parameter is highlighted in blue, indicating it is the selected parameter. The 'Unit' for 'mass' is 'ul' and the 'Equation' is '100 ul'. The 'Nominal Value' is '100.000000'. The 'Key' checkbox is checked for 'mass'.

Name	Type	Unit	Equation	Driving Rule	Multivalue	Nominal Value	Key	Comments
rib_thickness	Model	in	flange_thickne...			0.093750	<input type="checkbox"/>	
rib_draft_dont_use	Model	deg	0 deg			0.000000	<input type="checkbox"/>	
number_of_ribs	Model	ul	3 ul			3.000000	<input type="checkbox"/>	
spacing_between_ribs	Model	in	0.40625 in			0.406250	<input type="checkbox"/>	
number_of_base_holes	Model	ul	3 ul			3.000000	<input type="checkbox"/>	
spacing_between_base_holes	Model	in	bracket_width /...			0.250000	<input type="checkbox"/>	
number_of_flange_holes	Model	ul	3 ul			3.000000	<input type="checkbox"/>	
spacing_between_flange_holes	Model	in	bracket_width /...			0.250000	<input type="checkbox"/>	
mass	User	ul	100 ul			100.000000	<input checked="" type="checkbox"/>	

Parameter Filters: All iLogic Model User | All Key Non-Key

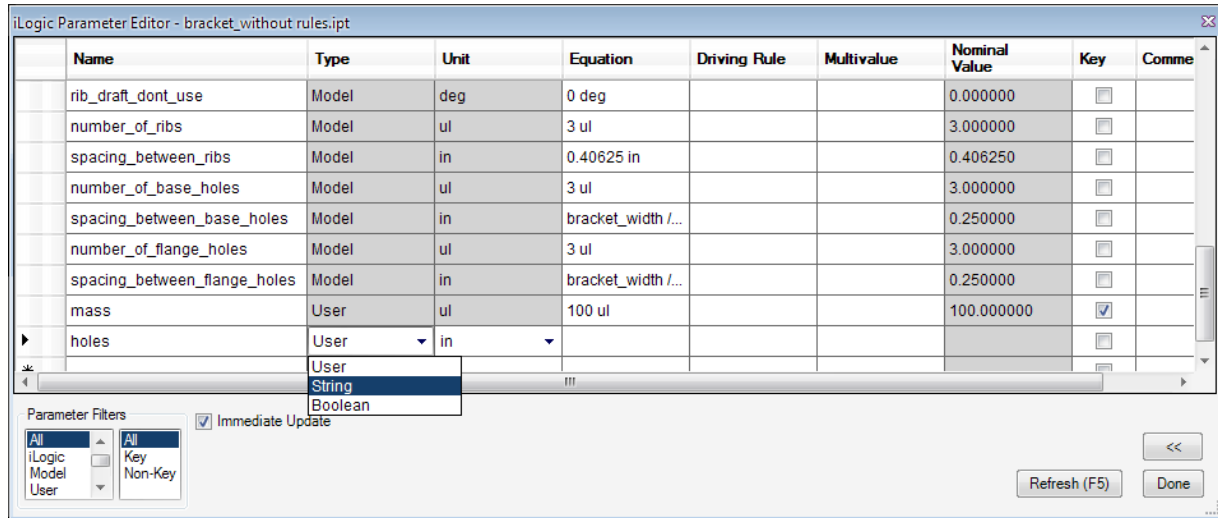
☒ Immediate Update

Refresh (F5) Done

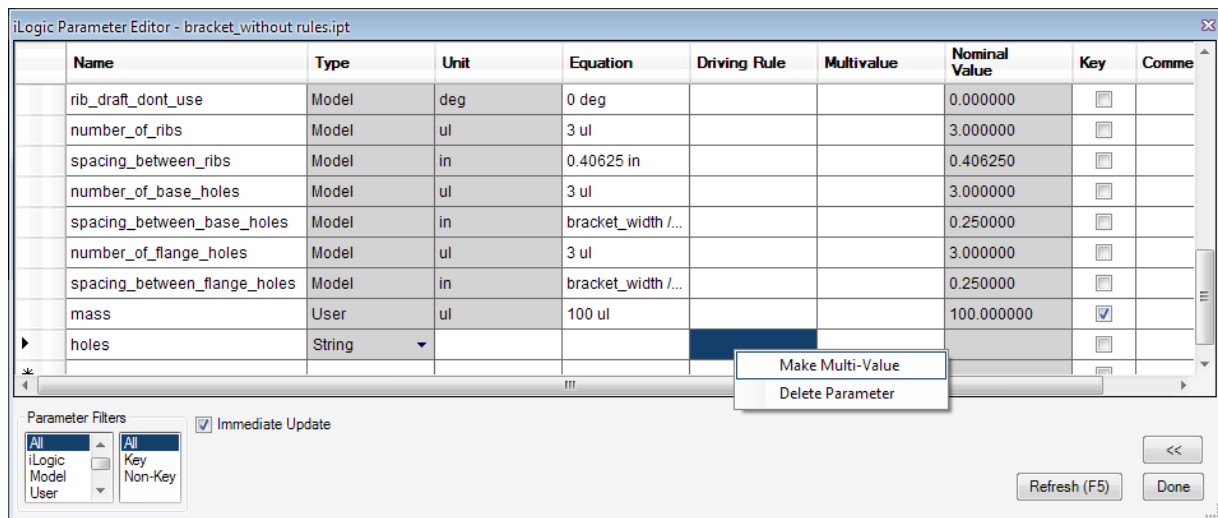
CREATE A “HOLES” PARAMETER (STRING)

Click in the empty cell at the bottom of the Name column. Type the name **holes**.

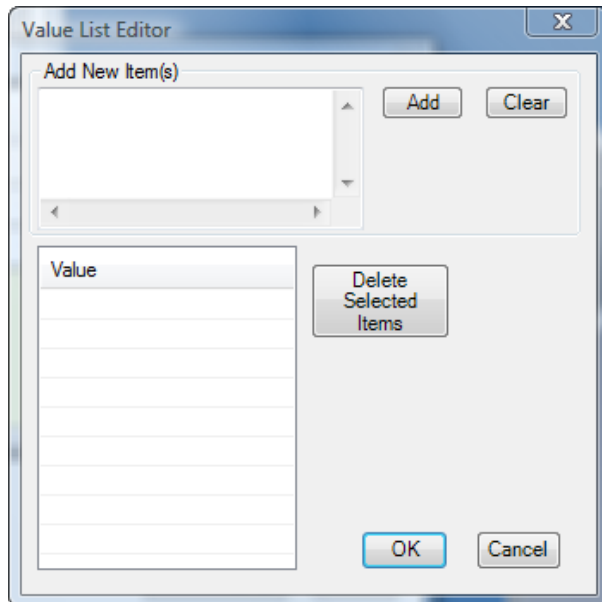
In the Type cell, select **String**.



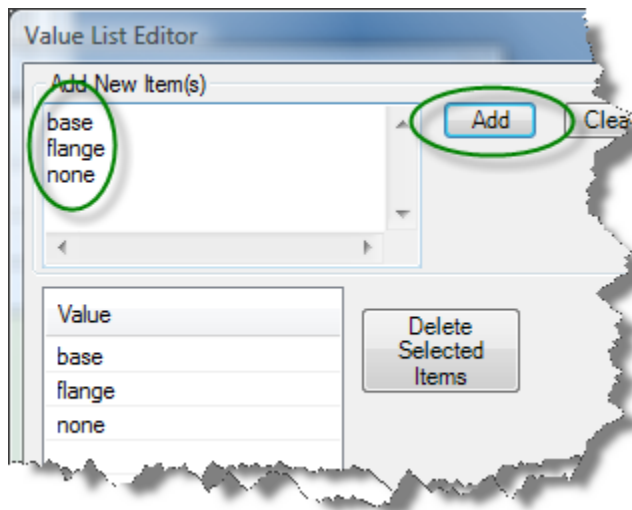
Left click in one of the empty fields. Observe that the Unit entry is blank. Right click in one of the empty fields to reveal the contextual menu containing the options **Make Multi-Value** and **Delete Parameter**.



Select the **Make Multi-Value** option to open the Value List Editor dialog box.

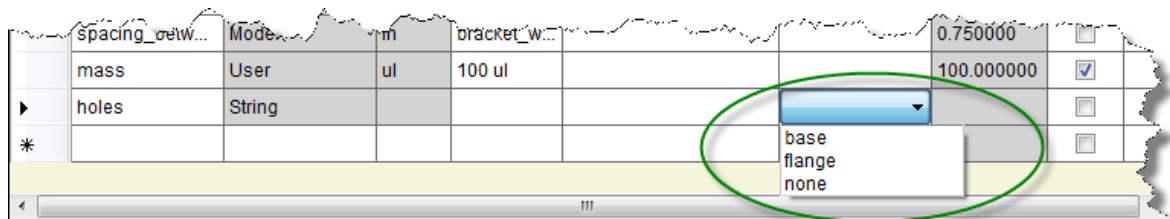


In the Add New Items field at the top of the dialog box, enter **base**, **flange** and **none**. Press the Add button to transfer the New Items to the Value field at the bottom of the dialog box.

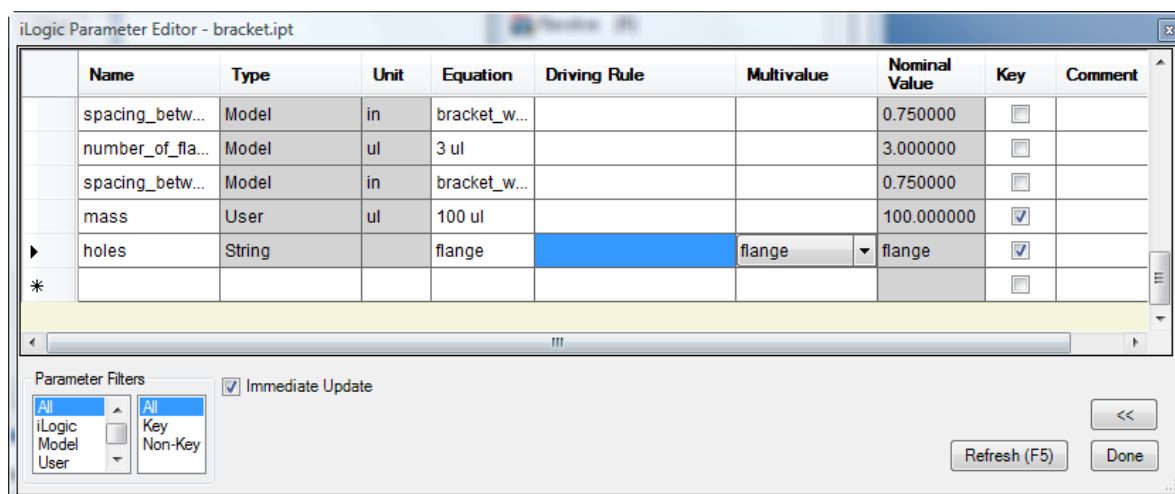


Click OK to accept these values and close the Value List Editor dialog box.

In the Multivalue column of the “holes” row in iLogic Parameters Editor, notice the arrow indicating a drop down menu. Click this arrow to see the three string values you have just added.



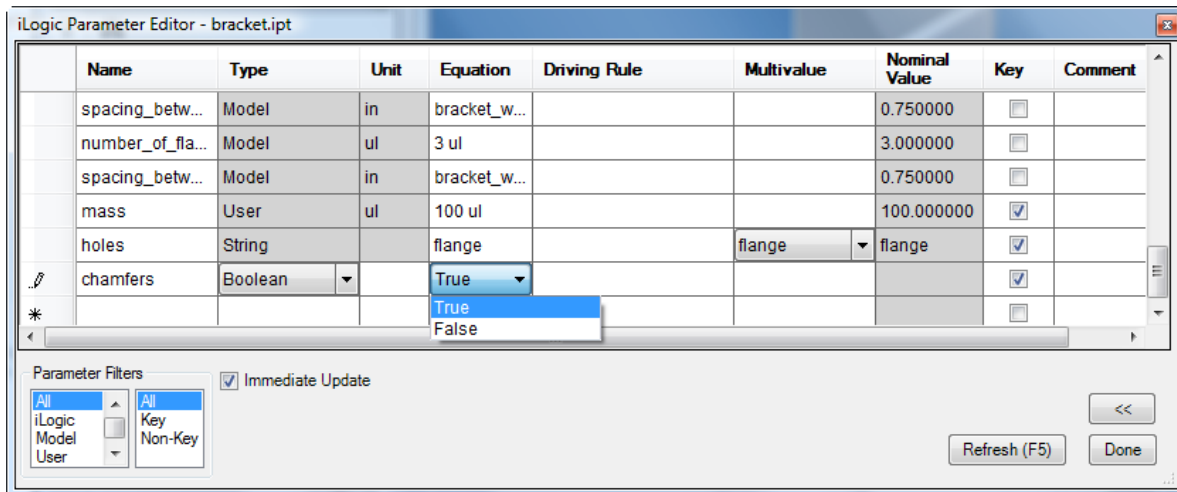
Select the “flange” choice, and then click in an empty field to set the new value. Observe the current value of the **hole** parameter – flange – appearing in the Equation and the Nominal Value fields. Make this parameter a Key Parameter by clicking on the check box in the Key column cell.



CREATE A “CHAMFERS” PARAMETER (BOOLEAN)

Now we’ll create another parameter, which will control whether to use the chamfer feature on the bracket part.

Click in the empty cell at the bottom of the Name column, type **chamfers**. In the Type cell open the drop down menu and select **Boolean**. Click in another cell and notice a drop down menu in the Equation box with **True** and **False** as the available options. Make this a key parameter by clicking the check box in the Key column cell.



Click **Done** to close the iLogic Parameter Editor and complete the parameter creation process.

USING PARAMETER FILTERS

The iLogic Parameter Editor provides a mechanism to control which parameters are displayed. By using these filters, you can focus in on only the parameters you're interested at a particular time. The Parameter Filters allow you to control which set of parameters are shown (Model, User, iLogic), and whether to display all, or only the "key" parameters.

To see how this works, first expand the iLogic Parameter Editor window to show the many parameters associated with the bracket. In the bottom left hand corner of the dialog, in the Parameter Filters group box, there are two fields. The field on the left categorizes the parameters into All, iLogic Parameters, Model Parameters, User Parameters etc. The field on the right categorizes the parameters into All, Key and Non-Key Parameters. For the sake of illustration, set the following Model Parameters as Key Parameters:

base_hole_length_loc	base_hole_width_loc
base_hole_dia	flange_hole_dia
flange_hole_length_loc	flange_hole_width_loc

To do this, click the check box in the Key column cell of each of these parameters. Then, click the different options in the 2 filter fields. Notice how the list of displayed parameters changes. The following table describes the results for the various selections in the Parameters Filter fields.

Left Field Selection	Right Field Selection	Result
All	All	All parameters shown
All	Key	All Key Parameters shown
All	Non-Key	All Non-Key Parameters shown
Model	All	Shows all Model Parameters
Model	Key	Shows all Key Model Parameters

This simple bracket model has 27 parameters associated with it. It is not unreasonable to expect that a complex part or assembly of parts may have hundreds of parameters. By strategically designating Key parameters, it is possible to find relevant parameters much more easily by filtering the list.

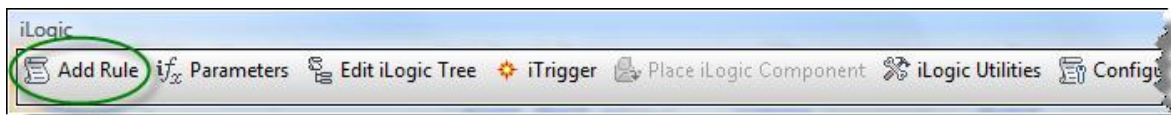
It is possible to multi-select (using shift-click) the values in these filter fields. If you select multiple values, you can see the parameters in the combined set.

CREATING RULES

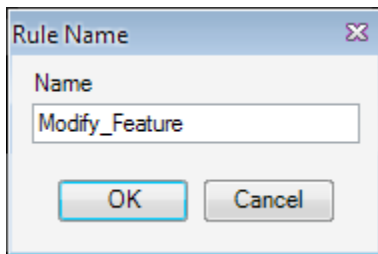
With the necessary parameters in place, we can now add logic to the model, in the form of rules. Rules can be used for various actions, including setting the values of parameters, activating or suppressing features, and many more. This tutorial will focus on just a few of the most common actions to demonstrate the power of iLogic rules.

RULE #1 – FEATURE SUPPRESSION

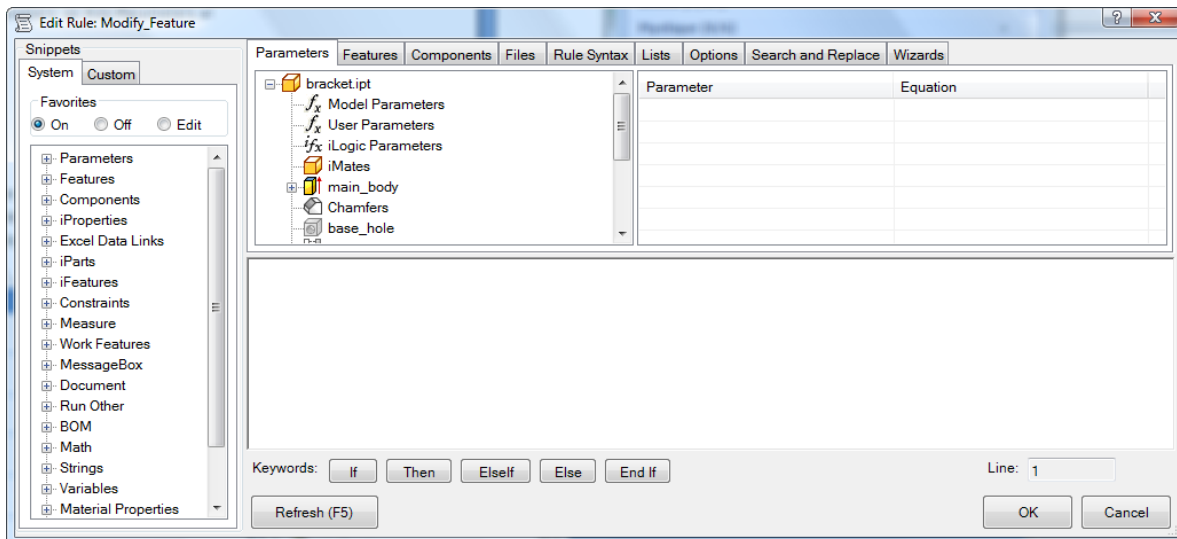
To create a rule, click on the Add Rule icon on the iLogic toolbar or panel.



This will open up the Rule Name dialog. Name the rule: **Modify_Feature**.



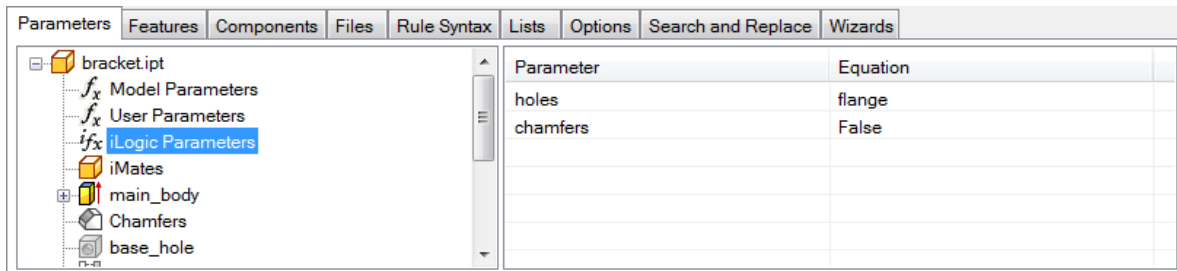
Clicking OK opens the iLogic Rule editor window:



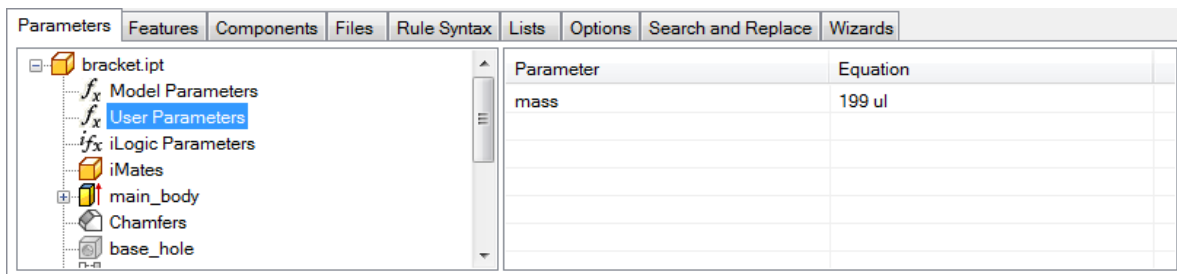
There are several tabs at the top of this dialog box. Select the **Parameters** tab. In the top left panel of this window is a view of the model tree. Click on the **Model**

Parameters node in the model tree. Notice that the top right panel now lists only the Model parameters.

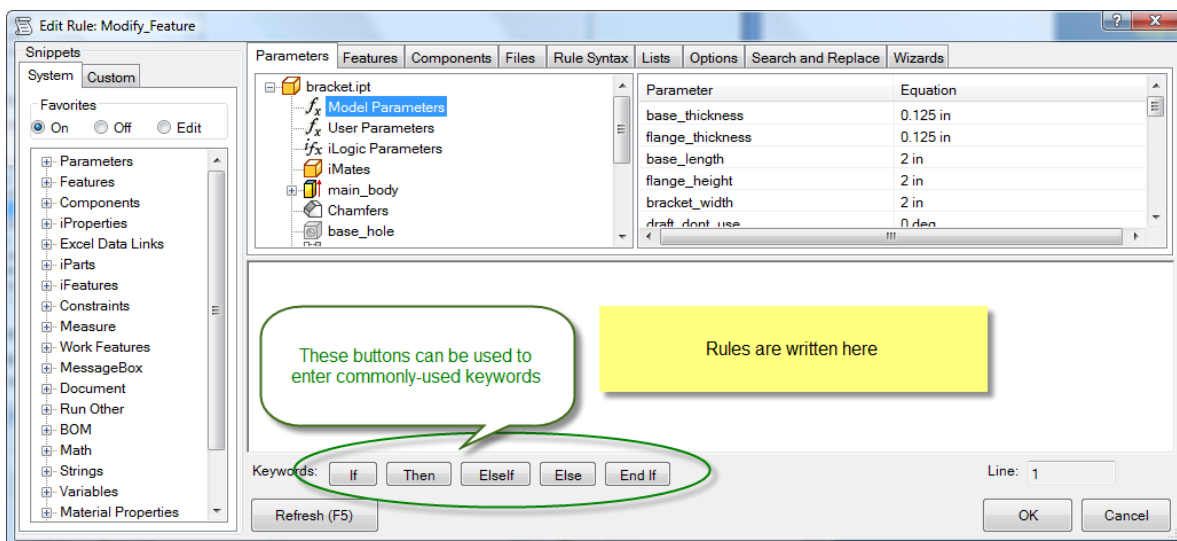
Clicking on the **iLogic Parameters** node in the model tree results in only the iLogic parameters (String and Boolean types) being listed in the top right panel.



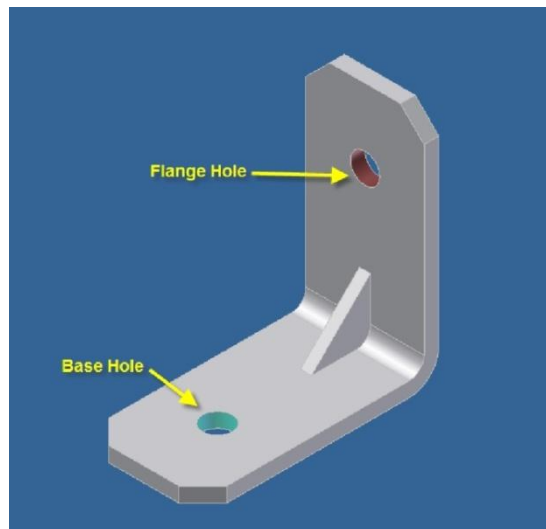
To display the User parameters in the top right panel, click on the **User Parameters** node of the model tree.



Rules are written in the bottom panel of the iLogic Rule Editor window. Rule keywords can be entered by typing them directly, or clicking the buttons representing common keywords at the bottom of the dialog box.



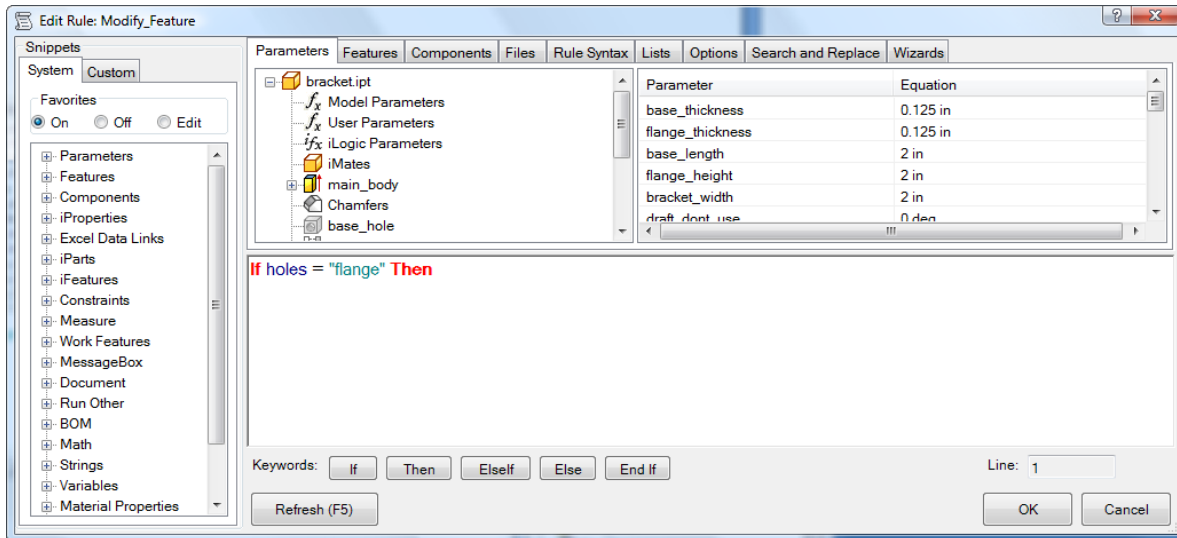
There are two holes on the bracket model: a hole in the base, and a hole on the flange. We will write a rule that will turn on (or off) the base hole, the flange hole or both. Earlier we created a multi-value parameter called **holes**. The three values we assigned to this parameter were **base**, **flange** and **none**. The rule we will write will turn on the flange hole when the **flange** value is chosen. Choosing **base** will turn on the base hole and choosing **none** will turn off both holes.



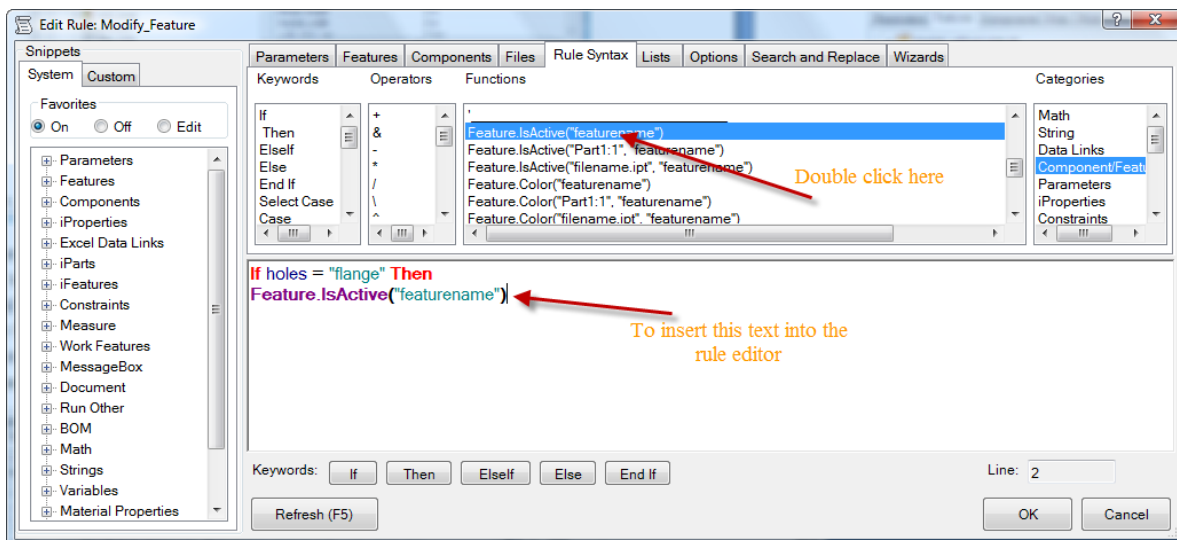
Now let's start creating the rule. We'll first handle the "flange" setting of the **holes** parameter.

In the rule text window, type **If** (or click the "If" keyword button below the rule text area), and then enter a space. Notice that the text of the "If" keyword turns bold and red. The red color indicates a recognized language element (in this case a keyword). In the model tree, click the **iLogic Parameters** node to reveal the list of iLogic parameters. Double click on **holes** and the holes parameter name will be inserted into the editor. Type " = " and then in quotation marks type **flange**. Finish this statement by typing **then** (or click the "Then" button). Notice the different colors applied automatically to the different language elements of the expression defined so far. This color coding makes rules much easier to read, and will help you quickly comprehend their meaning, and identify any mis-entered information.

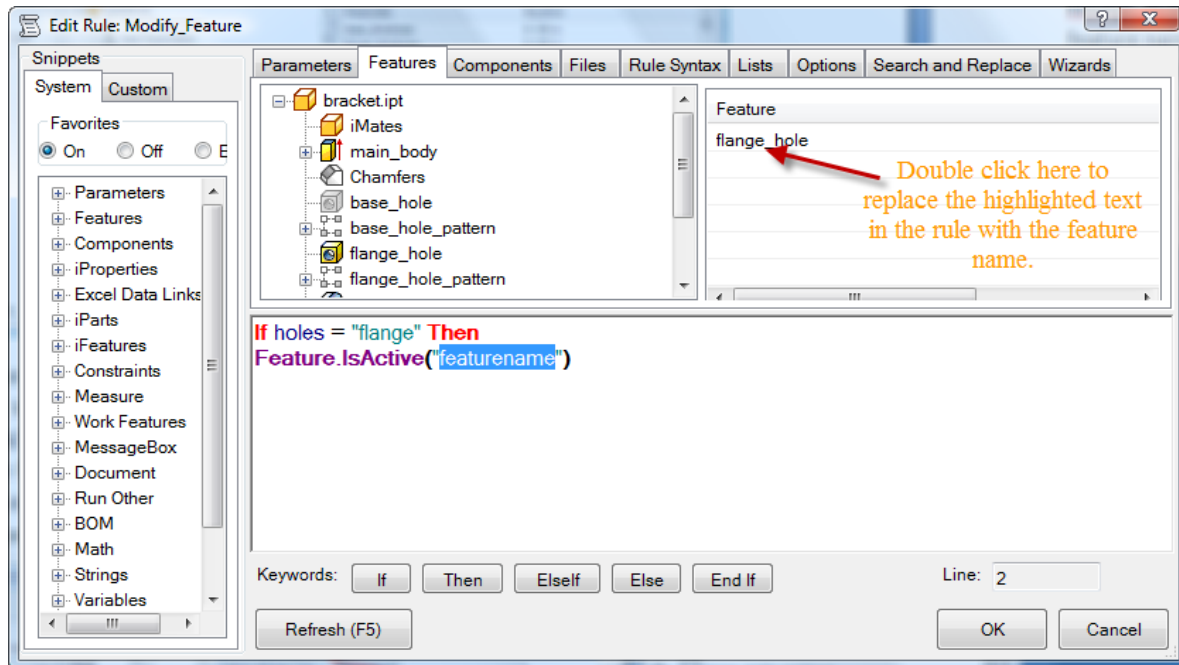
Press **Enter** to move to the next line.



We can make the flange hole active by using an iLogic function. At the top of the Rule Editor, select the **Rule Syntax** tab. In the **Categories** field choose the **Component/Features** option. iLogic functions that control Components and Features are found here. Locate the **Feature.IsActive(featurename)** function in the Functions window. Highlight and then double-click the function, and its text will be entered into the rule editor.



Click on the Features tab at the top of the iLogic Rule Editor. Locate the **flange_hole** on the model tree and click its node. **flange_hole** will appear in the feature name list in the top right corner. Replace “featurename” in the command with “flange_hole” by highlighting **featurename** in the rule text, and then double-clicking on **flange_hole** from the feature name list.



The **Feature.IsActive** function sets the activity state (suppression state) of a feature whose name is specified in quotation marks inside the parentheses. Assigning a value of **True** indicates that the flange hole is active (unsuppressed).

```
If holes = "flange" Then
Feature.IsActive("flange_hole") = True
```

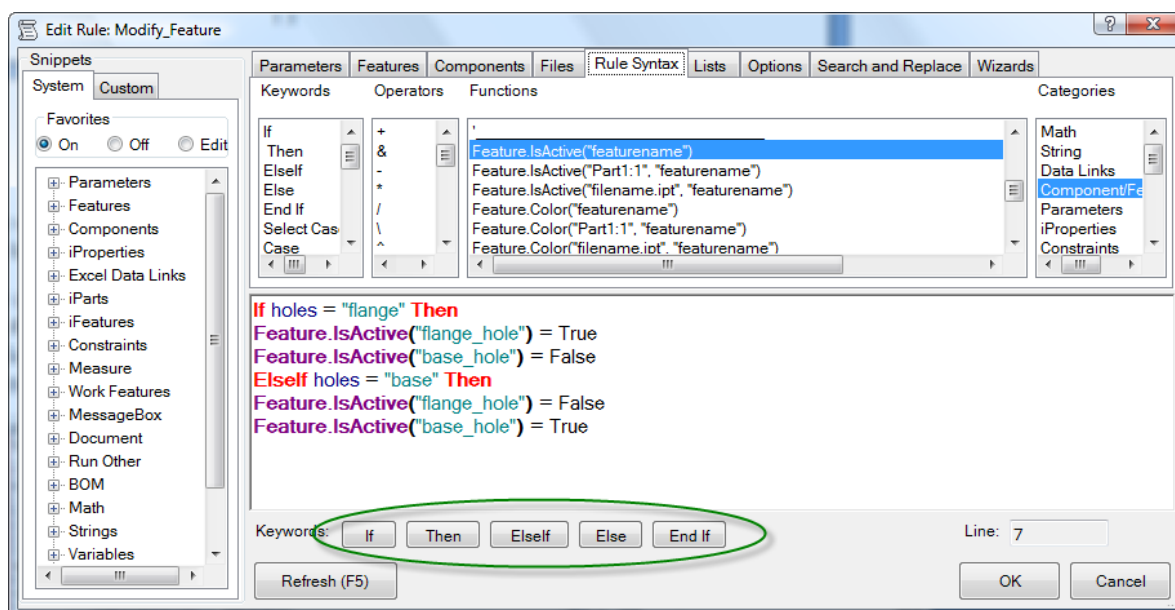
When the flange option is chosen for the **holes** parameter, we only want the flange hole active. We must include a command that deactivates the base hole. We can do this by using the same method we just used to activate the flange hole

Go to the Rules Syntax tab and insert the **Feature.IsActive(featurename)** command in the next line of the rule. Now click the Features tab and this time select the **base_hole** feature from the model tree. Replace the “featurename” text with “base_hole”. Assign a value of **false**. These two lines turn on the flange hole and turn off the base hole. Your rule should look like this so far:

```
If holes = "flange" Then
Feature.IsActive("flange_hole") = True
Feature.IsActive("base_hole") = False
```

For the case where the base hole is to be activated, a similar strategy is employed; activate the base hole and deactivate the flange hole.

To start this portion of the rule, start with an **Elseif** keyword. This can be entered by typing it directly, inserting it by clicking the **Elseif** button at the bottom of the iLogic Rule Editor window, or double-clicking **Elseif** from the list in the Keywords window on the Rule Syntax tab.



To cover the third case, where no holes are required, we will use the same method. To reuse blocks of text, you can perform a copy and paste operation, and then change the pasted text as required.

Highlight the “re-usable” text as shown here. Press **Ctrl-C** to copy the text to the clipboard. Then, position the cursor at the end of the rule text, and press **Ctrl-V** to paste it.

```
If holes = "flange" Then
Feature.IsActive("flange_hole") = True
Feature.IsActive("base_hole") = False
Elseif holes = "base" Then
Feature.IsActive("flange_hole") = False
Feature.IsActive("base_hole") = True
```

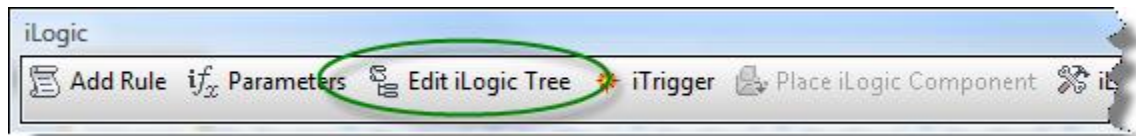
Finally, modify the newly pasted text to deactivate (suppress) both hole features when the **holes** parameter is set to “none”. Finish the statement by typing “End If” (or clicking the corresponding keyword button).

Your completed rule should look like this:

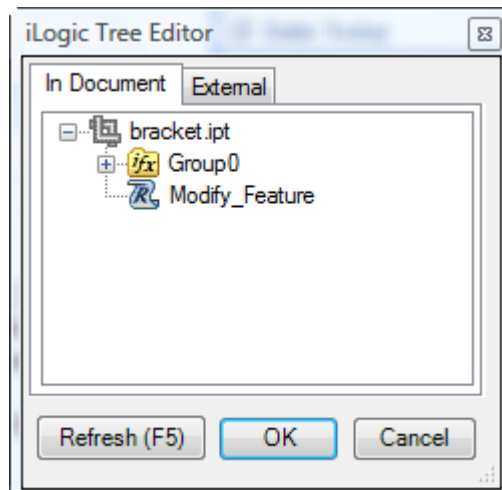
```
If holes = "flange" Then
Feature.IsActive("flange_hole") = True
Feature.IsActive("base_hole") = False
Elseif holes = "base" Then
Feature.IsActive("flange_hole") = False
Feature.IsActive("base_hole") = True
Elseif holes = "none" Then
Feature.IsActive("flange_hole") = False
Feature.IsActive("base_hole") = False
End If
```

In the iLogic Rules Editor text window, right clicking will bring up a contextual menu with Cut, Copy and Paste, and other editing commands.

Click OK in the bottom right of the Rule Editor dialog. If there are no mistakes, the Rule Editor will close without an error message. An icon representing the new rule will appear in the iLogic Tree Editor. Verify this by opening the Tree Editor. You access this by clicking the iLogic Tree Icon:

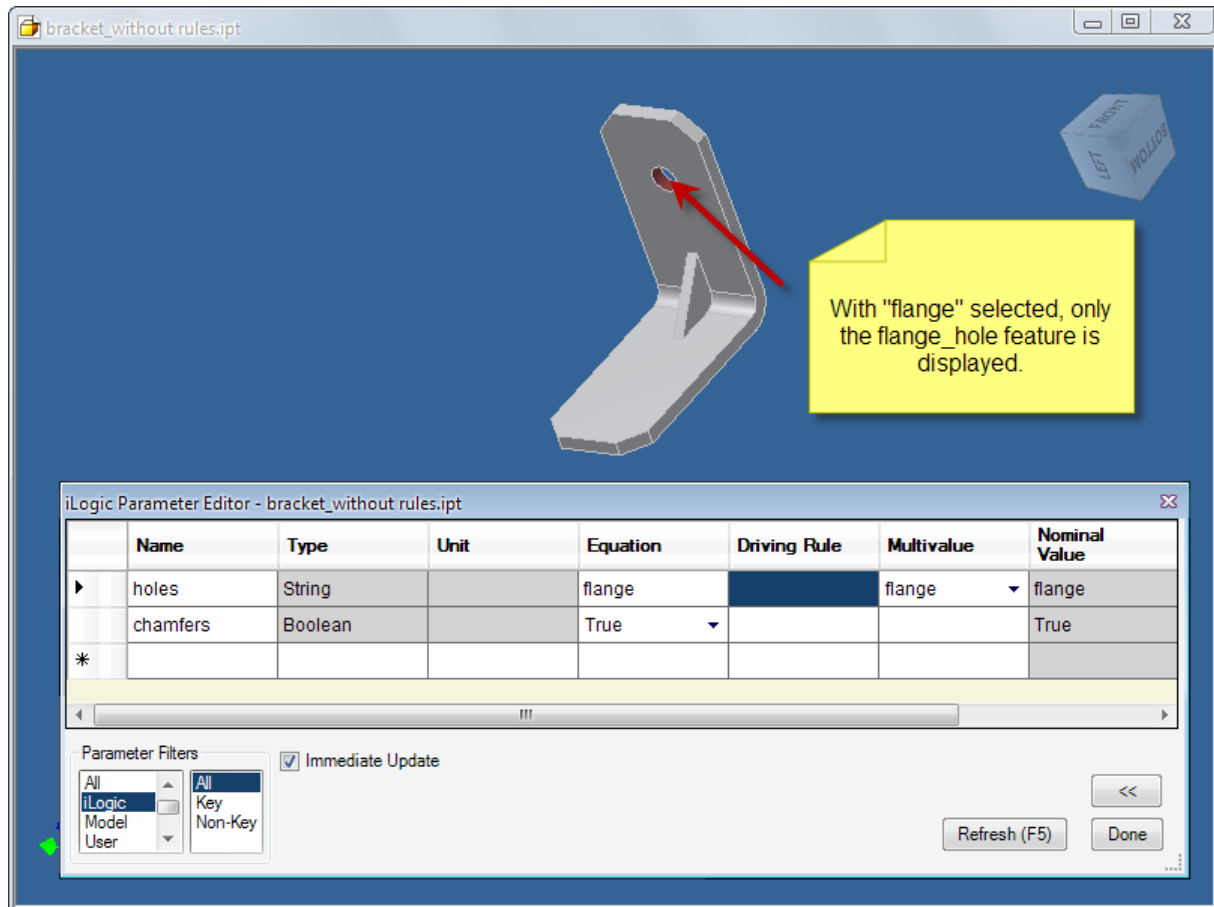


The iLogic Tree Editor provides a way for you to see the rules in the current model. We'll work more with the Tree Editor later in this tutorial.

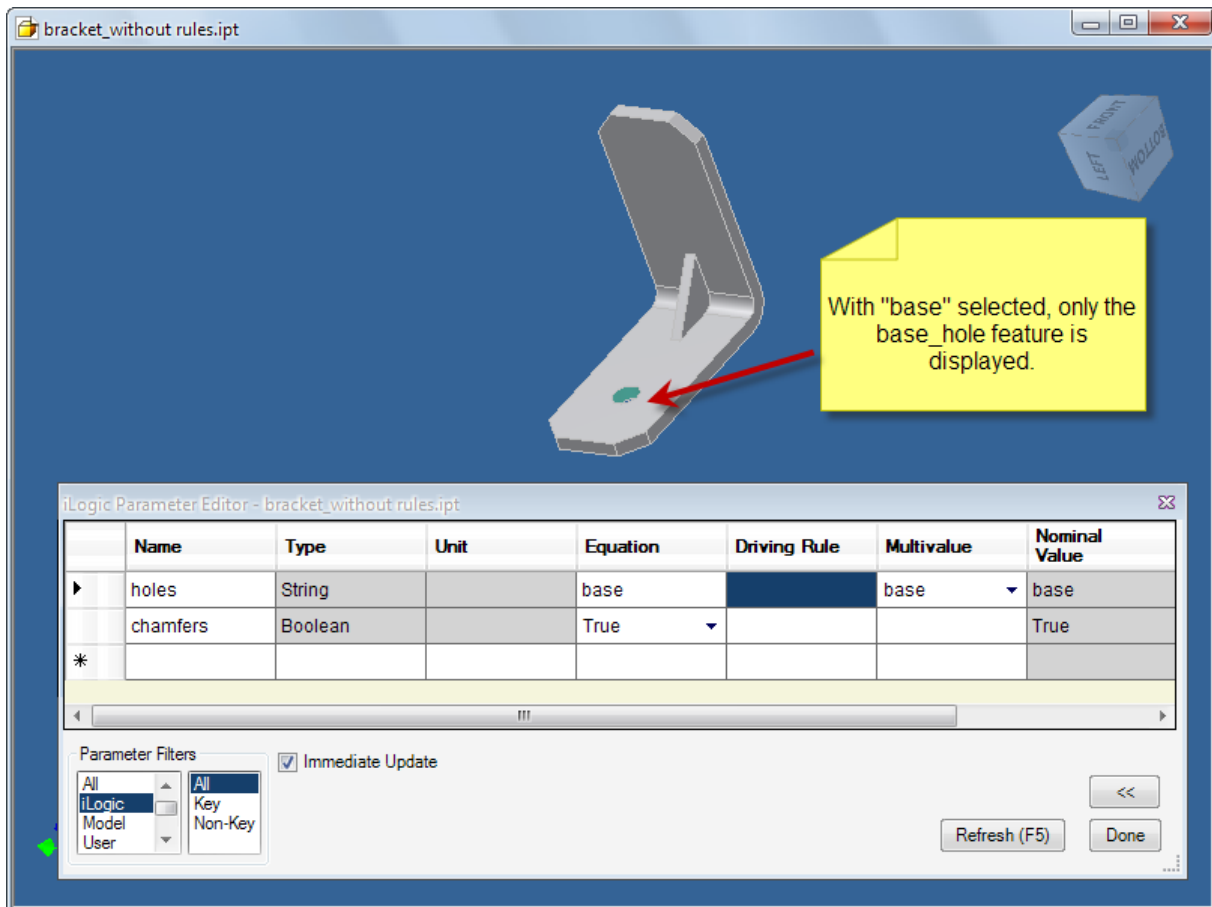


TEST THE RULE

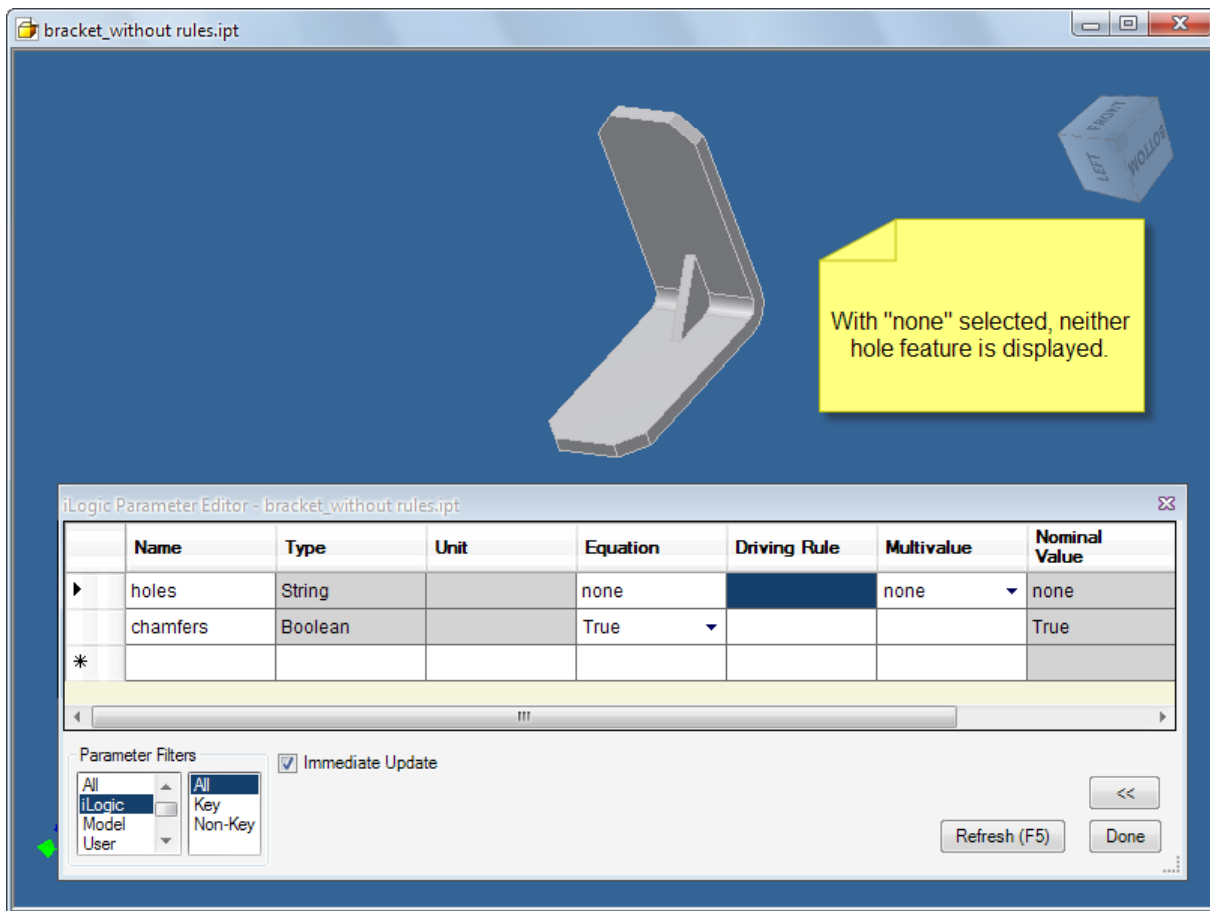
Open the iLogic Parameter Editor and, using the Parameter Filters, filter to see all iLogic Parameters. (See illustration below). In the Multivalue field of the **holes** parameter, choose **flange** from the dropdown menu. Hit Tab to accept the selected value, and observe the bracket. The only hole activated is the **flange_hole**.



Now select the **base** option in the Multivalue list, and hit Tab to accept the new value. Now only the base hole is active.



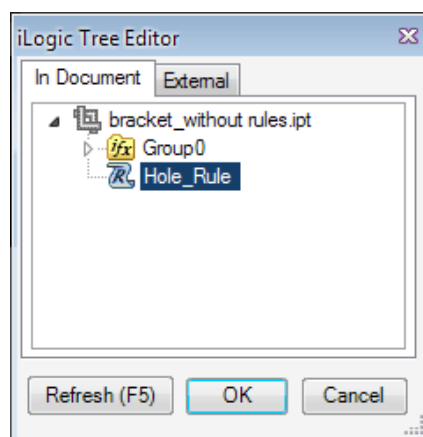
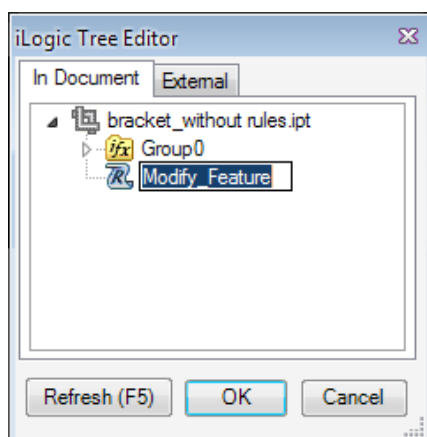
Finally, select **none** from the Multivalue list. This results in no holes being active.



Close the iLogic Parameter Editor by clicking **Done**.


RENAME THE RULE

The rule we just created requires a more descriptive name. To change name of the rule, open the iLogic Tree Editor. Click **Modify_Feature** once to highlight the rule, then click it again to make its name modifiable. Rename the rule to “Hole_Rule”, and click **OK** to close the iLogic Tree Editor.



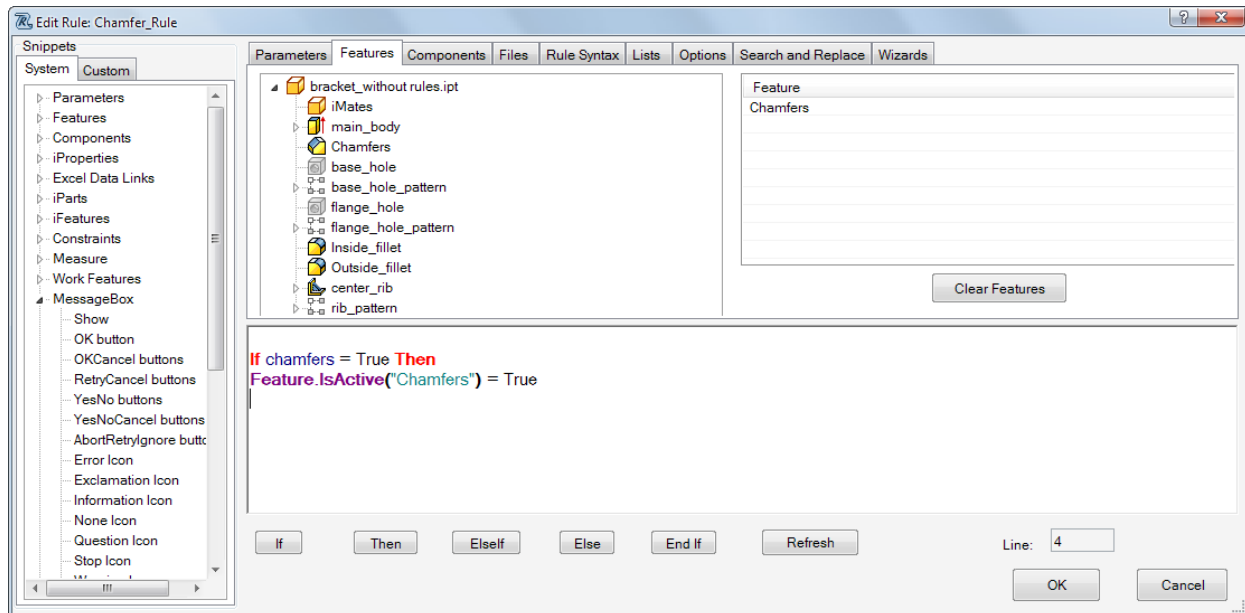
RULE #2 – CHAMFER ACTIVATION

Now we'll create a second rule. This new rule will control the activation of the chamfers on the bracket. Earlier we created a Boolean-type parameter called "chamfers". The two possible values for a Boolean parameter are True and False; we will exploit this for turning chamfers on and off.

Click the **Add Rule** icon in the iLogic toolbar. 

Name the new rule **Chamfer_Rule**. Click OK to open the iLogic Rule Editor.

Start the rule with an If statement. If the value for the Boolean parameter **chamfers** is true, then the chamfers will be activated.



When the value of the **chamfers** parameter is false, the chamfers will be deactivated. The completed rule should look like this:

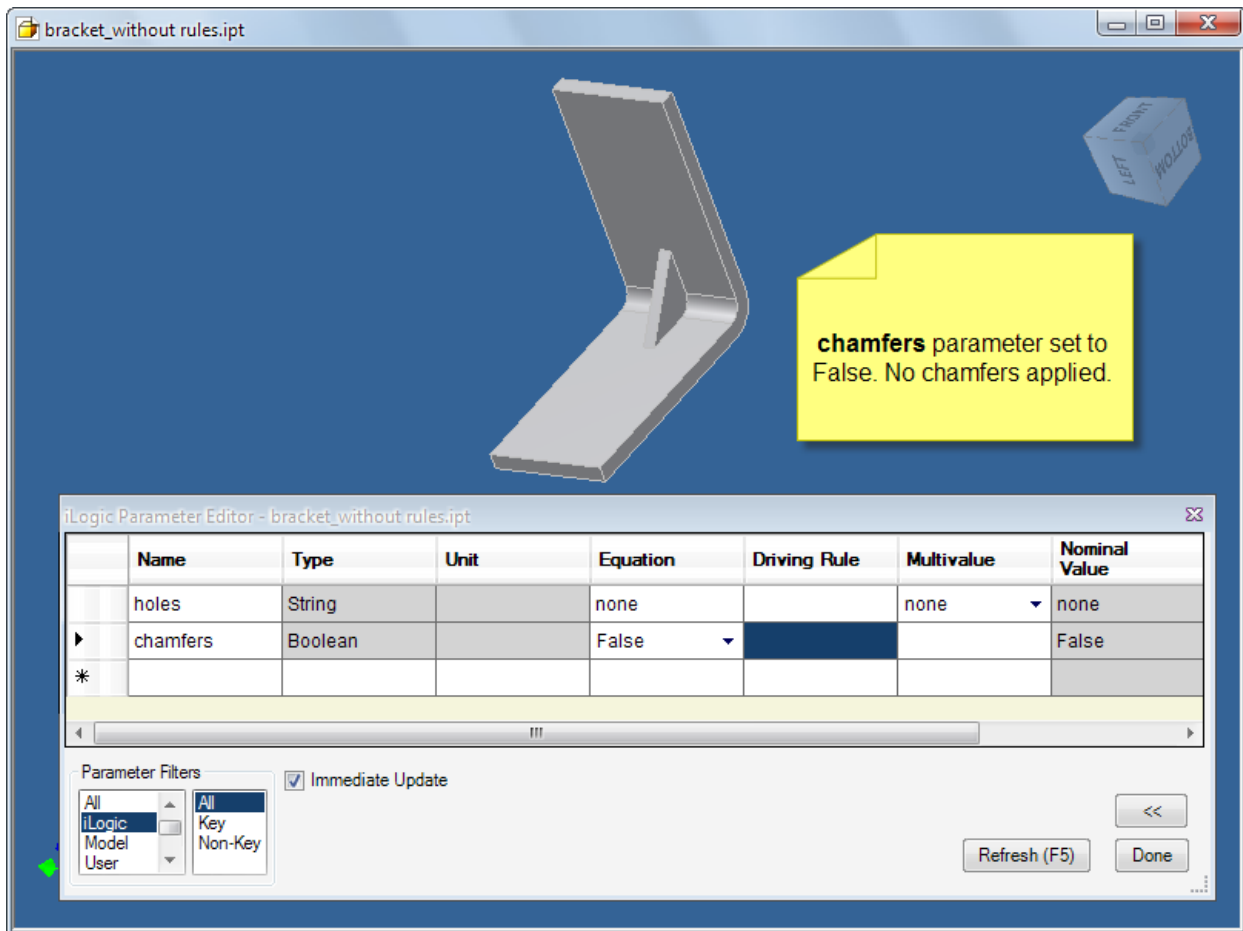
```
If chamfers = True Then
Feature.IsActive("Chamfers") = True
Else
Feature.IsActive("Chamfers") = False
End If
```

Click OK to accept the rule, and in the absence of any error messages, the rule is ready to be tested.

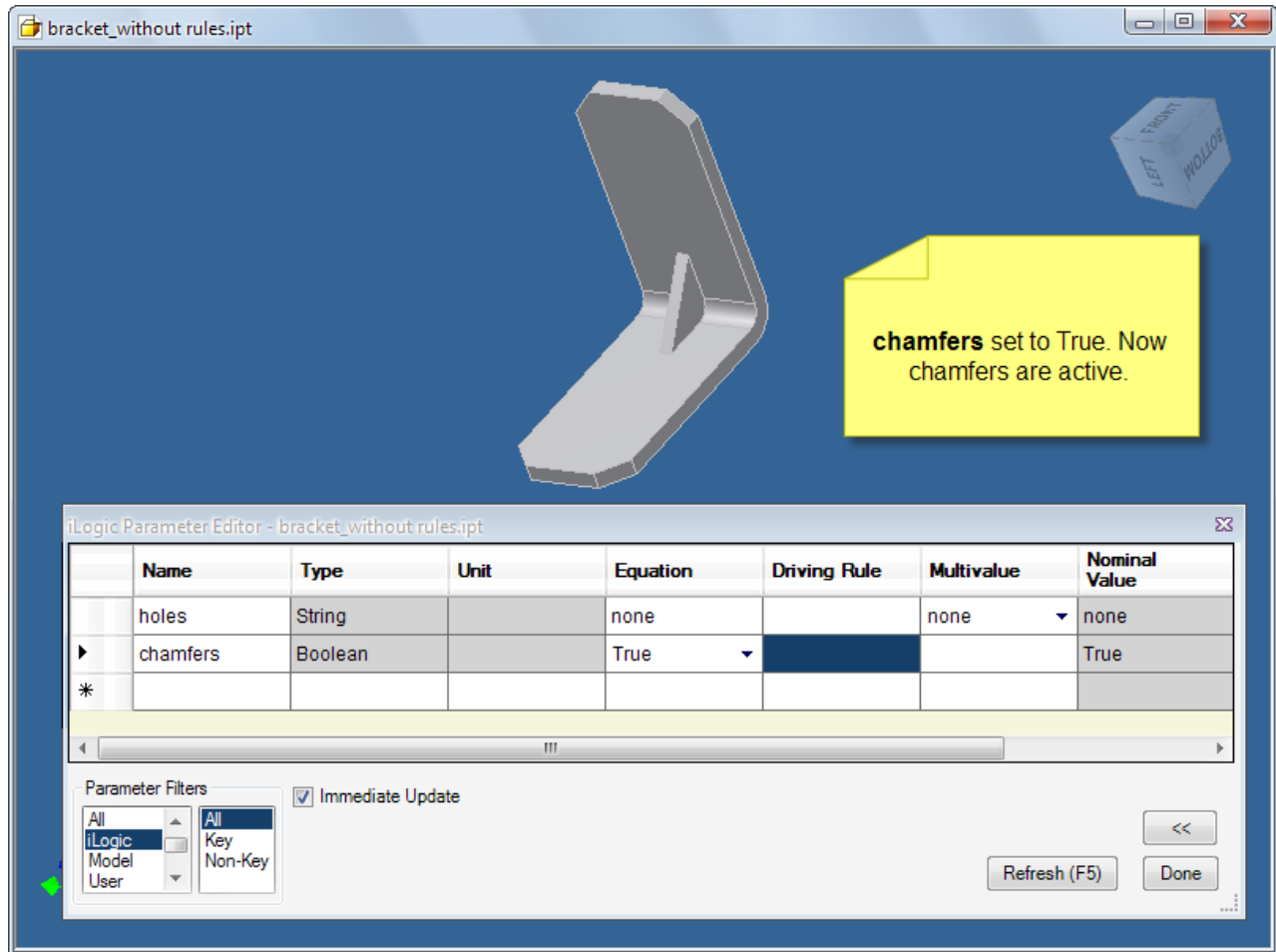
TEST THE CHAMFER_RULE

Open the iLogic Parameter Editor. 

In the **chamfers** row, access the dropdown menu in the Equation cell. Select **False** and press Tab to accept the selection. Notice that all chamfers are deactivated as a result.



Now choose **True** from the dropdown menu from the Equation cell. Press Tab to accept the change. The chamfers are now activated.



RULE #3 – BRACKET DIMENSIONS

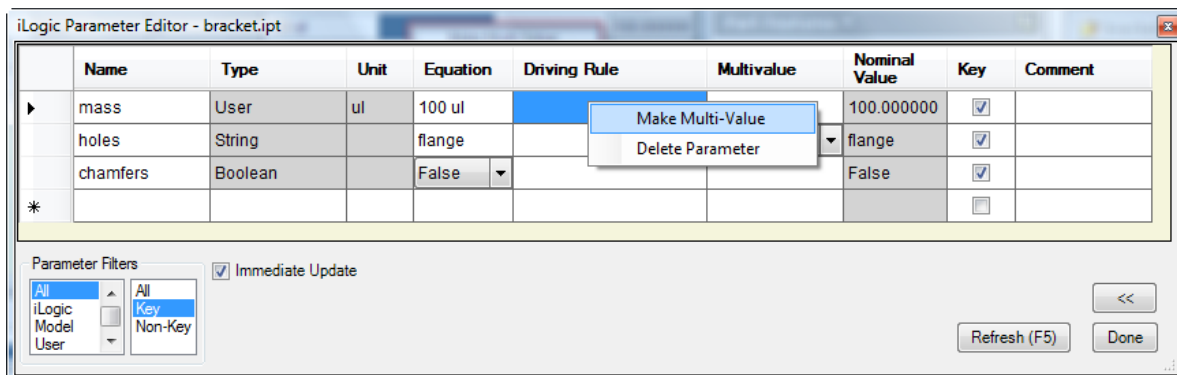
The third rule we will create will drive the dimensions of the bracket. Earlier we created a User parameter called **mass**. Our new rule will modify the width of the bracket based on the value of this parameter. In the first scenario, the width of the bracket will change according to the values shown in the following chart.

Mass	Bracket Width
100	1 in
200	2 in
300	3 in
400	4 in

ADD THE SET OF POSSIBLE VALUES

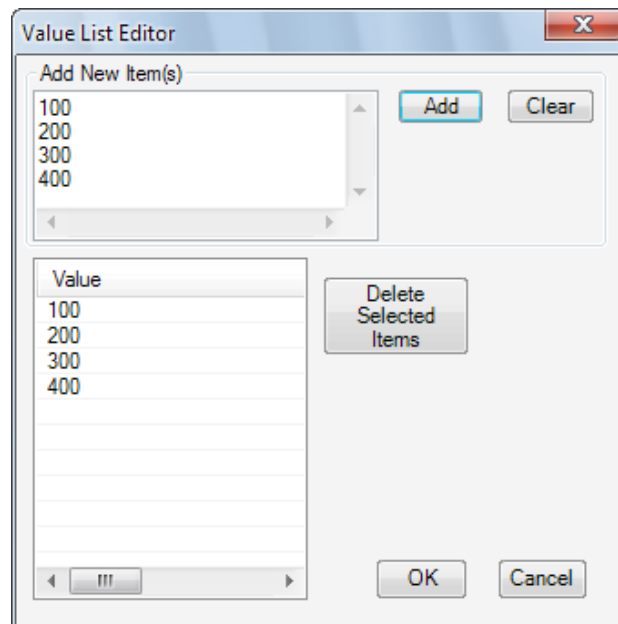
First, we will add the set of possible values for the **mass** parameter.

Right click in any empty cell in the **mass** row and choose the **Make Multi-Value** option from the context menu. The Value List Editor will open.

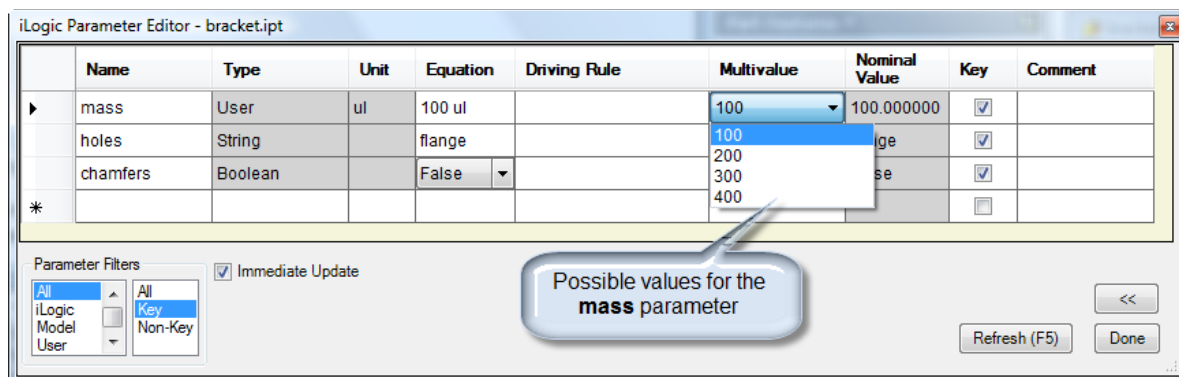


If you haven't already done so, you should use the Parameter Filter to display only the Key parameters in the list. This will make it easier to focus in on the mass parameter.

In the **Add New Item(s)** field, add the values 100, 200, 300 and 400. Click the Add button to populate the Value list, and then click the OK button to accept the list and return to the iLogic Parameter Editor.



Clicking the dropdown menu in the Multivalue field in the **mass** row in the Parameter Editor reveals the list of values for the **mass** parameter.



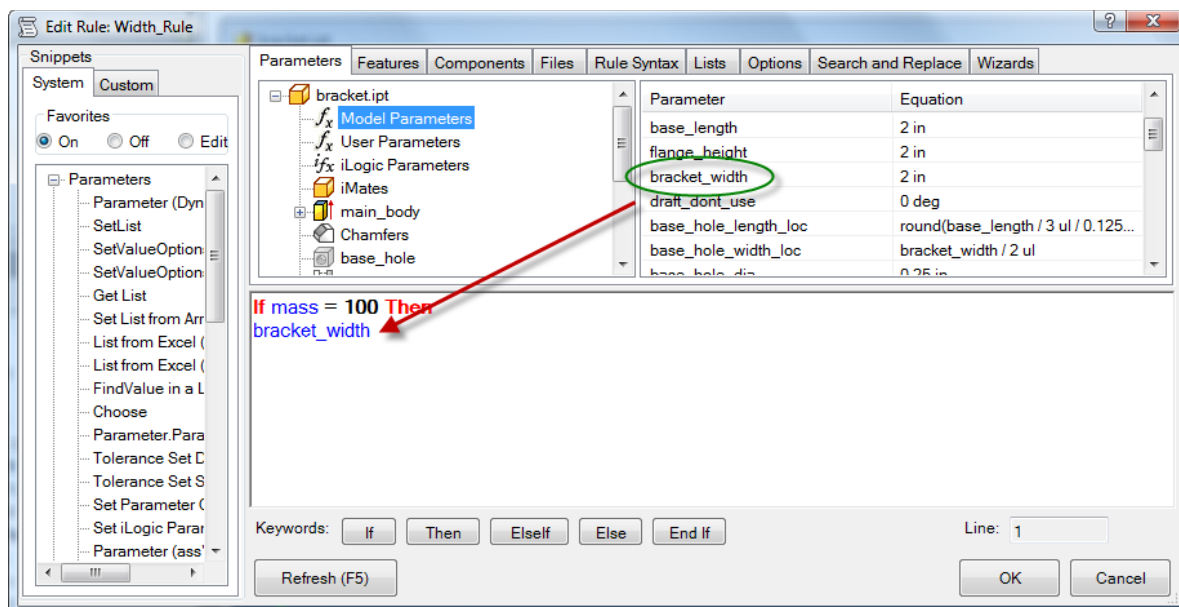
Click **Done** to complete the modification of the mass parameter.

Now we're ready to create a rule that will drive the bracket width.

ADD THE RULE

Click the Add Rule icon on the iLogic Toolbar. Name the rule “Width_Rule”. In the text window of the Rule Editor, start with an If statement. If the mass is 100, we want the bracket to be 1 inch wide. Locate the parameter called bracket_width by clicking on the **Model Parameters** node in the model tree. The list of model parameters will be displayed in the window at the top right of the Rule Editor.

Double-click on **bracket_width** in the parameter list to insert the parameter name into the rule text. Parameter names can be directly typed into the rule, but double clicking from the list to insert them eliminates the possibility of spelling errors.



Set the bracket width to 1 inch:

If mass = 100 Then
bracket_width = 1

It is possible to specify units in iLogic numeric expressions (e.g., “1 in”). However, we don’t demonstrate that in this tutorial for the sake of simplicity. When units are omitted, the units specified in the model’s document properties are assumed.

In the case where the mass = 200, the width should be 2 inches. Use an Elself statement to set the bracket_width to 2 inches when the mass is 200. The rule should look like this:


```
If mass = 100 Then  
  bracket_width = 1  
Elself mass = 200 Then  
  bracket_width = 2
```

Now use two more Elself statements to cover the remaining value cases. End the rule with an End If statement. The complete rule, covering all possible values for mass, should look like this:

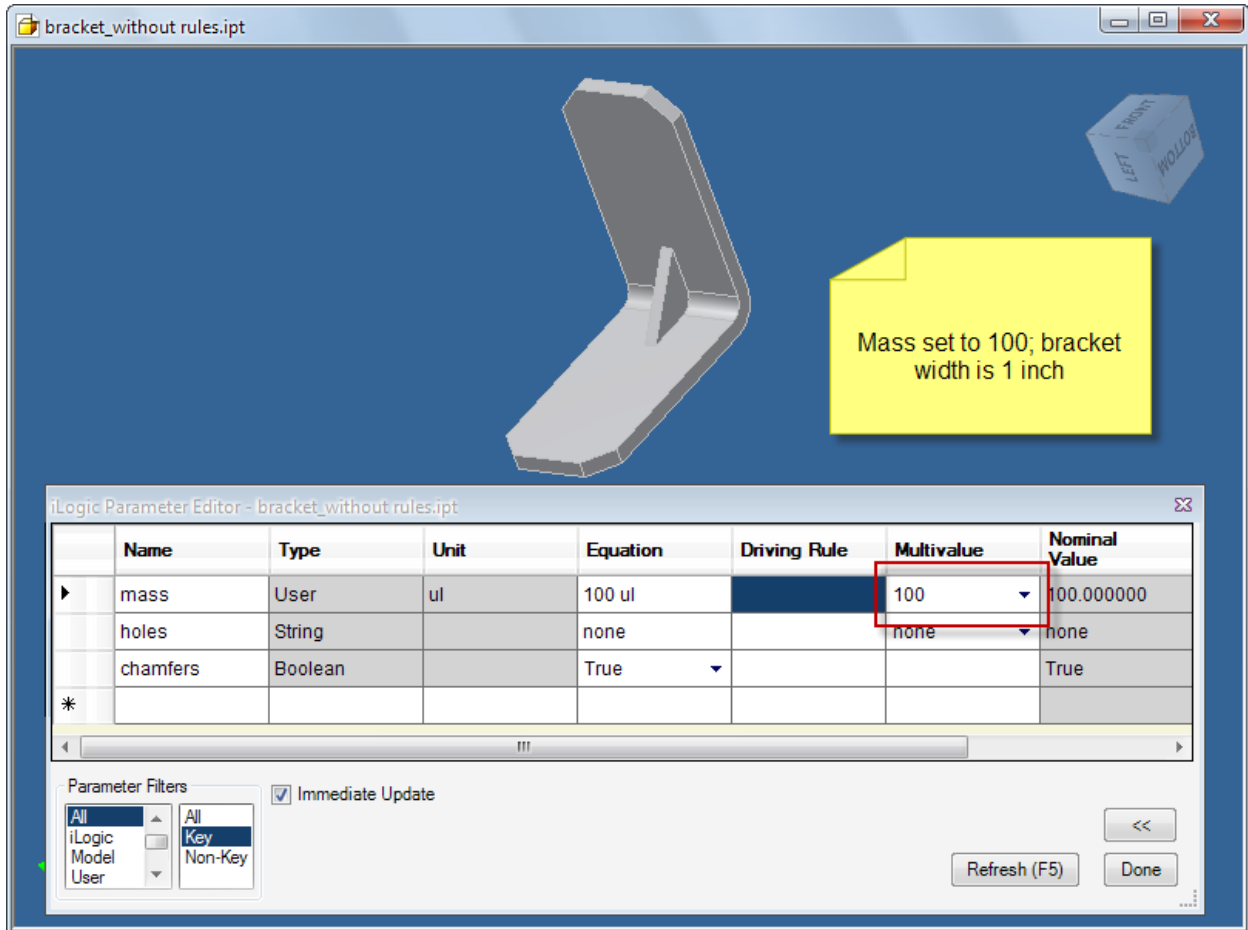
```
If mass = 100 Then  
  bracket_width = 1  
Elself mass = 200 Then  
  bracket_width = 2  
Elself mass = 300 Then  
  bracket_width = 3  
Elself mass = 400 Then  
  bracket_width = 4  
End If
```

Click OK on the Rule Editor dialog to save this new rule. Next, we'll exercise it.

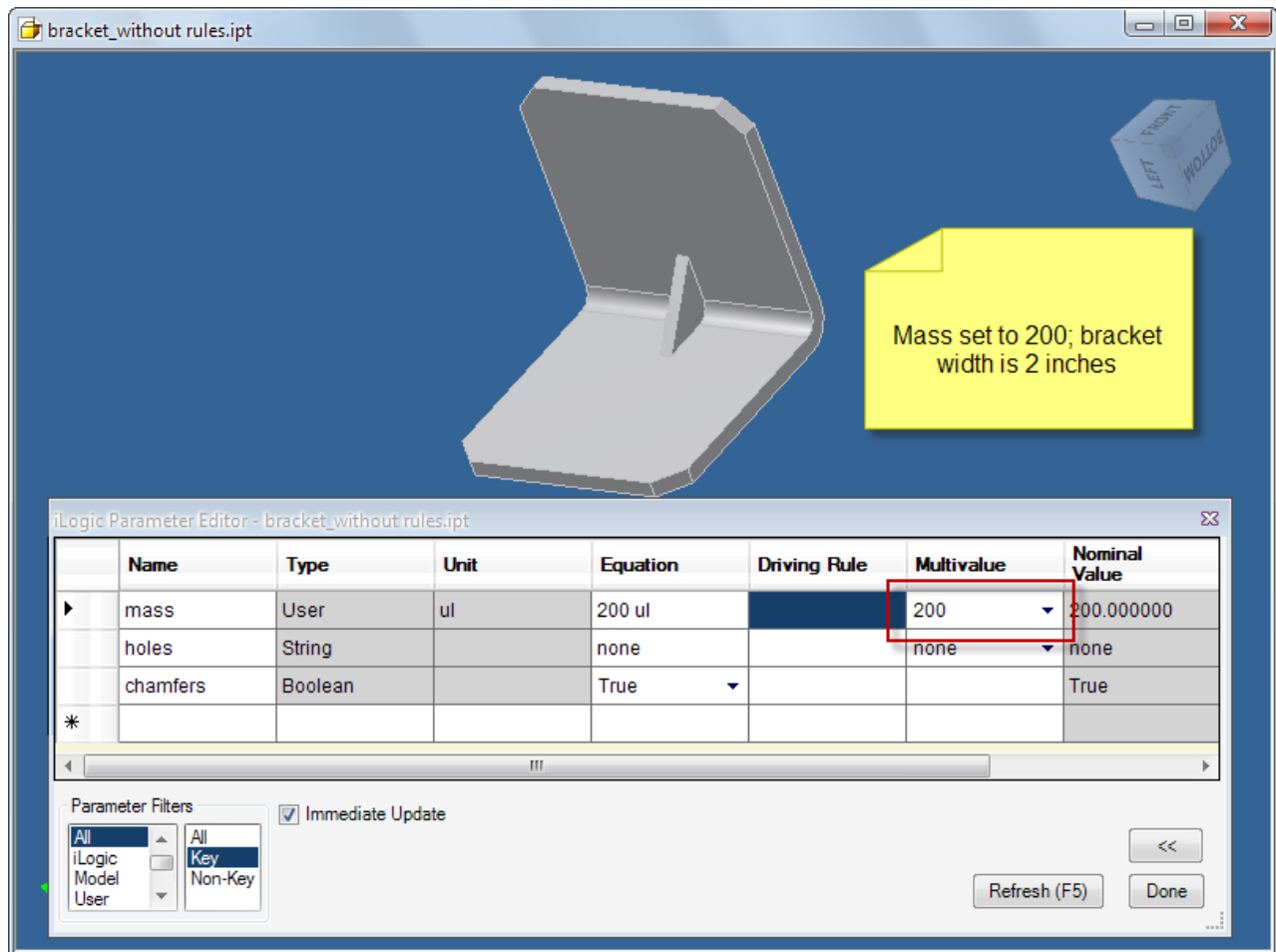
TEST THE WIDTH_RULE

To test this rule, open the iLogic Parameter Editor from the iLogic Toolbar.  Parameters

First, set the value of the **mass** parameter to **100**. The bracket width is set to 1 inch.



Change the **mass** parameter value to 200 and notice that the bracket width changes again.



Changing the mass to 300 causes the width of the bracket to increase to 3 inches. A mass of 400 results in a 4 inch wide bracket. Try it.

TESTING FOR RANGES OF VALUES

What about cases where mass is not limited to the exact values but may occur in several ranges of values? The following example will illustrate this case.

Mass range	Width
Less than or equal to 100	1 in
Greater than 100 but less than or equal to 200	2 in
Greater than 200 but less than or equal to 300	3 in
Greater than 300 but less than or equal to 400	4 in
Greater than 400	6 in

Let's modify an existing rule. Open the iLogic Tree Editor, and double-click on **Width_Rule** to open it in the Rule Editor.

Modify the rule as follows:

```
If mass <= 100 Then
  bracket_width = 1
Elseif mass > 100 And mass <= 200 Then
  bracket_width = 2
Elseif mass > 200 And mass <= 300 Then
  bracket_width = 3
Elseif mass > 300 And mass <= 400 Then
  bracket_width = 4
Else
  bracket_width = 6
End If
```

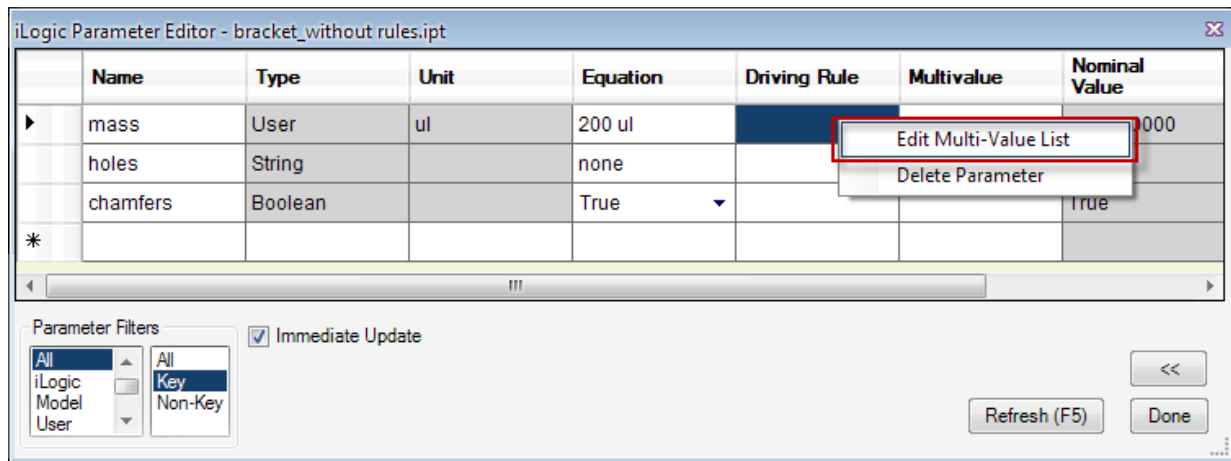
Here, we are checking for a range of values in each of the If statements.

Click OK to close the Rule Editor.

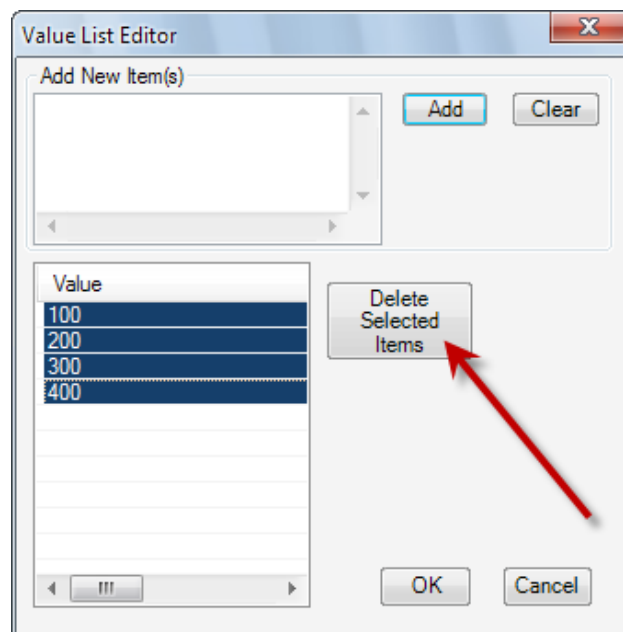
REMOVE THE MULTI-VALUE LIST FOR THE MASS PARAMETER

The last step is to modify the User parameter called **mass**. It is currently a Multi-value parameter. We can remove the Multivalue list associated with this parameter by editing the multi-value list.

Right-click an empty cell in the **mass** row and select **Edit Multi-Value List** from the context menu.



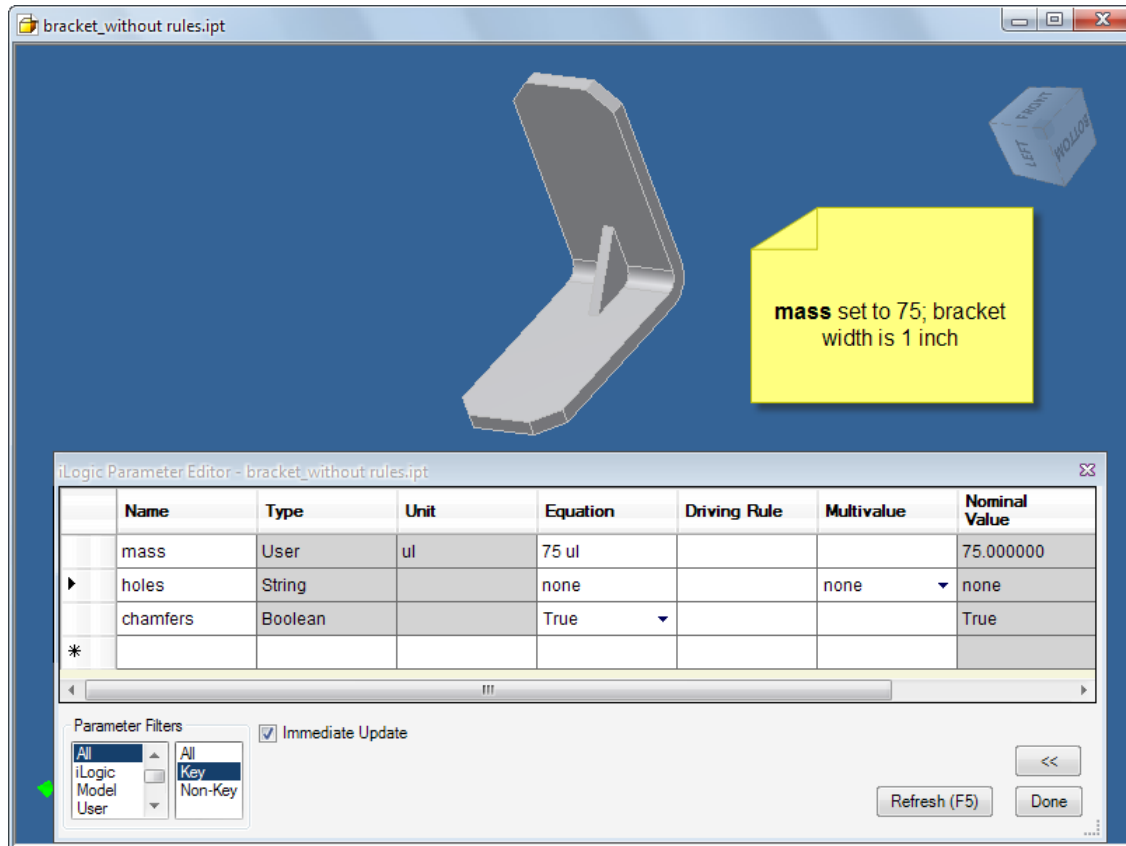
Select all of the values in the “Value” list, and then click the **Delete Selected Items** button.



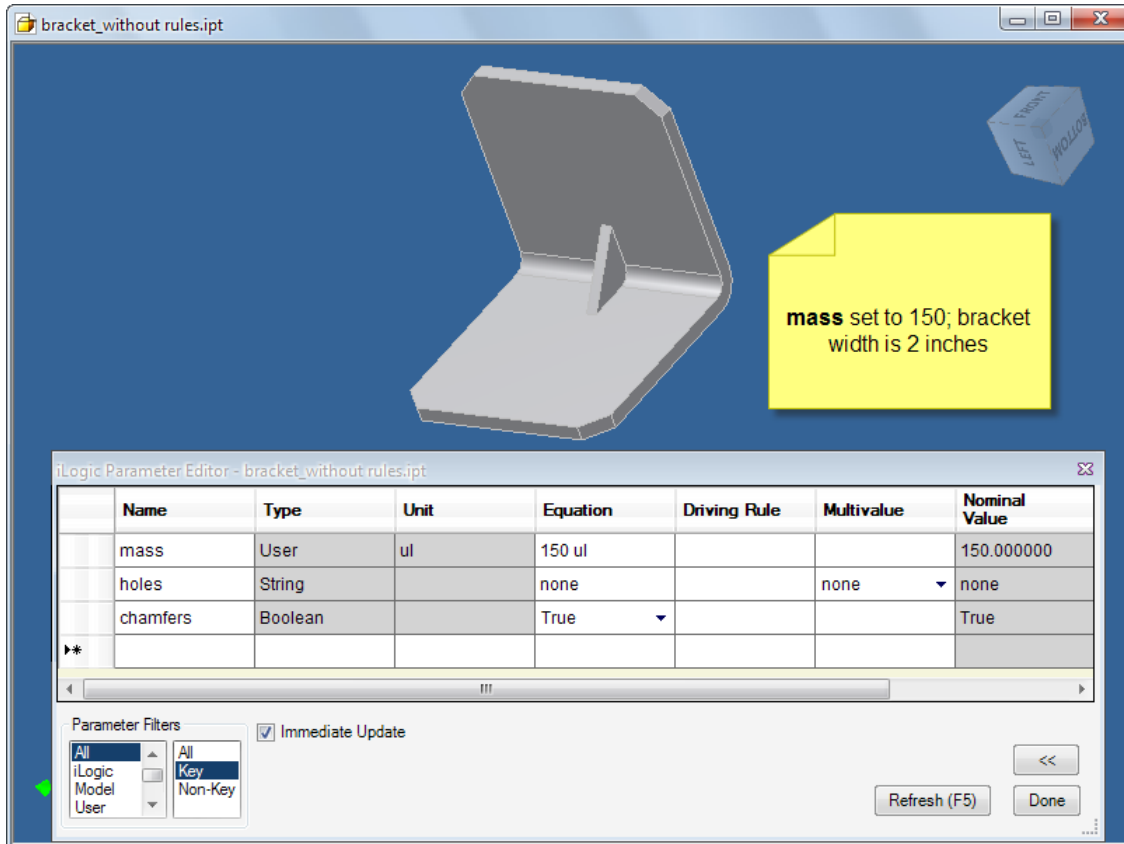
Notice that the **mass** parameter no longer has a multi value list to select from. Click OK to accept the change.

TEST THE MODIFIED RULE

Enter a **mass** value of 75. The width of the bracket is set to 1 inch.



Now set the mass to 150. The bracket width is now 2 inches.



Change the **mass** to 250. The width changes to 3 inches. When mass = 350, the width of the bracket is 4 inches. Entering a mass value greater than 400 results in bracket width of 6 inches. Verify this by setting the mass to 1500.

SUMMARY

In this introductory exercise we have covered the following topics.

THE PARAMETER EDITOR

- Creating User, Boolean and String Parameters
- Creating Multi-Value Parameters
- Key Parameters as search filters
- Modifying Parameters

THE RULE EDITOR

- Creating rules
- Conditional Statements
- Activation and deactivation of features
- Driving part dimensions with a rule
- Modifying an existing rule

These exercises have covered just a few of the many capabilities of Inventor iLogic. To learn more about iLogic, we suggest that you take time to complete the remaining tutorials provided.



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