

Can't We All Get Along? Importing AutoCAD® Electrical Data to Autodesk® Inventor® Cable and Harness

Mark Allen Flayler : ASCENT – Center for Technical Knowledge®

ML215-2 Bring the electrical and mechanical engineers together with AutoCAD Electrical and Autodesk Inventor Professional. Learn how to import the controls design data from AutoCAD Electrical into the Inventor Professional Cable and Harness environment. Learn how to configure the Inventor wire library and publish connectors in Inventor to support the AutoCAD Electrical data. Publish DWF files from AutoCAD Electrical and Inventor, and then top it off by combining the DWF files in Design Review to share outside the engineering department. This class is targeted at Inventor users interested in the interoperability potential of Inventor Professional.

About the Speaker:

Mark is an Application Engineer with the ASCENT and IMAGINiT Division of RAND Worldwide, specializing in the Autodesk manufacturing products. He has implemented the Autodesk Manufacturing products with many industries including the blow and injection molding, automotive, and custom machinery markets. Inventor has been a profound augmentation in his abilities allowing him to bring 3D digital prototyping to the forefront of the industries with which he has interacted. He has extensive experience and a comprehensive understanding of the technical, practical, business, and human dimensions of implementation. He is an effective and skillful communicator, consulting with his clients to help achieve their business objectives. Mark is an ATC certified instructor and has been instrumental in the training of hundreds of users. Mark is certified in AutoCAD, AutoCAD Mechanical, AutoCAD Electrical, Autodesk Data Management, and Autodesk Inventor.

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Introduction

The increasing need to digitally prototype designs for lean manufacturing has become a popular trend for first class manufacturers. In recent releases, Autodesk has added the ability to share information back and forth between its control design and 3D parametric software packages. This added functionality for users to document their designs for installation, repair, and purchasing, as well as a host of other needs, is a major advantage to the digital prototyping toolbox.

AutoCAD Electrical 2009 Overview



AutoCAD Electrical software is purpose-built to create and modify electrical controls systems. AutoCAD Electrical delivers the tools needed to design electrical controls faster and more accurately than ever before.

Autodesk Inventor 2009 Overview



Autodesk Inventor software provides a comprehensive and integrated set of tools for generating 3D mechanical design, including dynamic simulation, stress analysis, and design visualization. Cable and Harness exists in both Professional and Routed Systems versions.

Autodesk Design Review 2009 Overview



Autodesk Design Review software is the free, all-digital way to share, review, mark up, and track changes to digital prototypes, all without access to the original creation software.

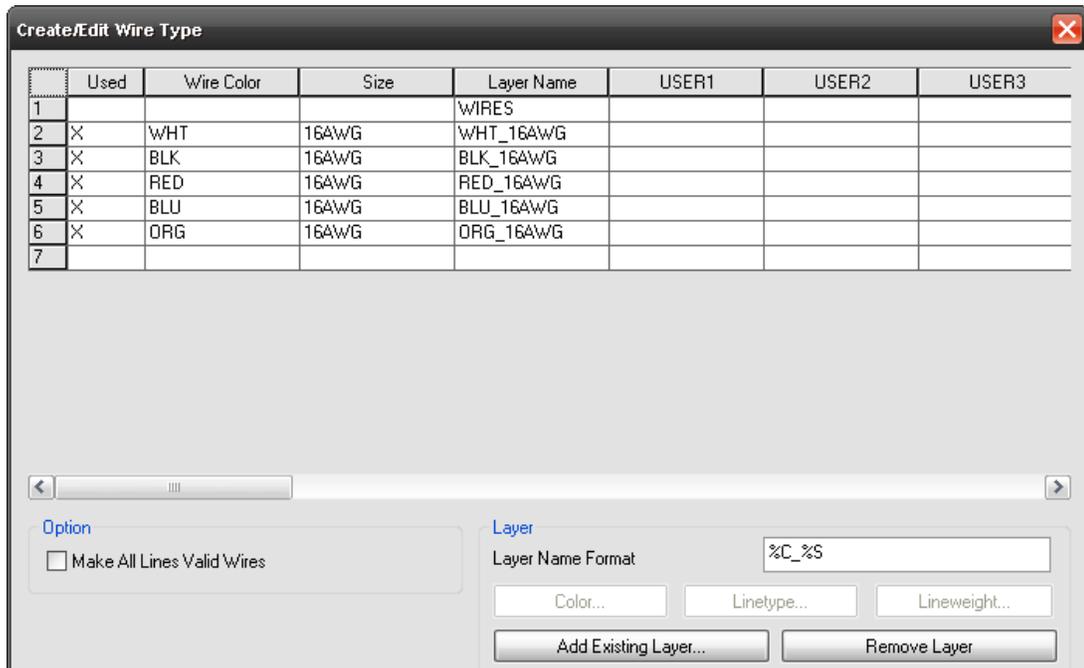
AutoCAD Electrical & Autodesk Inventor Interoperability



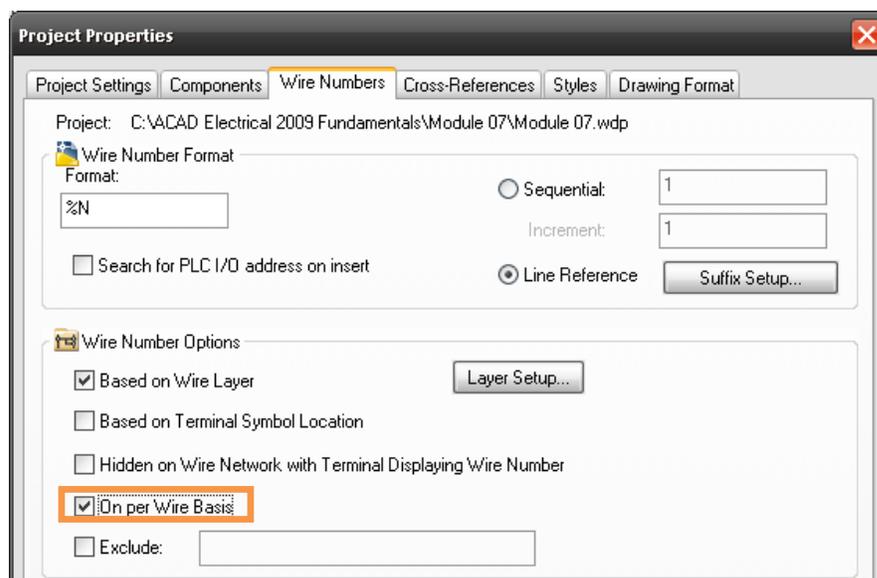
Configuring AutoCAD Electrical

AutoCAD Electrical must be set up for the export to Inventor. To do this, simply ensure that the following items are defined in the design and the conventional CAD standards:

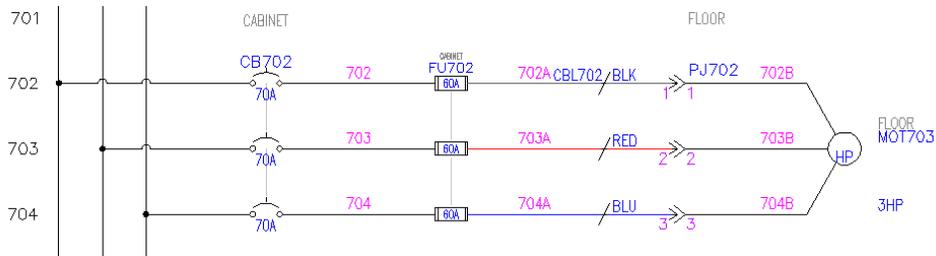
- You must define wires in AutoCAD Electrical as valid wire layers. Click  Create/Edit Wire Type to access the Create/Edit Wire Type dialog box, as shown below.



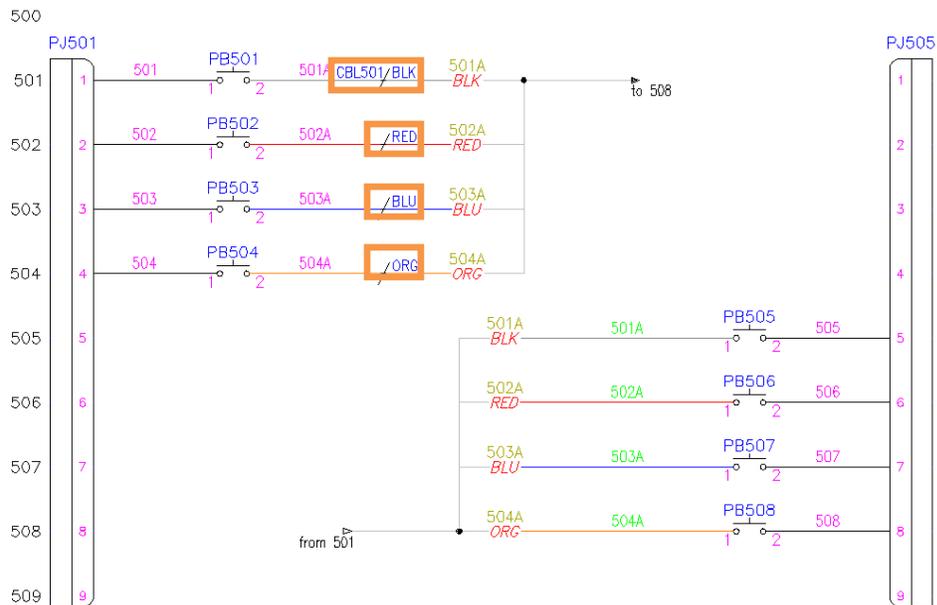
- Set unique wire IDs. Navigate to the Project Properties for your wire numbers and toggle on the **On per Wire Basis** option, as shown below. This prevents duplicates when imported into Inventor.



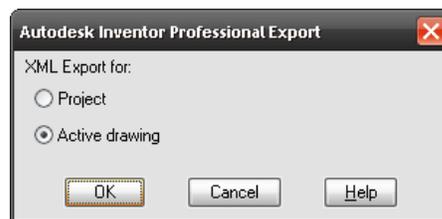
- Fix your wire numbers (recommended) so that subsequent imports into Inventor do not dramatically change the design in Cable and Harness. You can change your normal wire number to fixed with the  Project-Wide Utilities or  Insert Wire Numbers command. An example is shown below.



- When using the  Cable Markers command, make sure you place the children, not just the parent. The figure below shows a Cable with fan in/out signals and individual Cable markers with their children on their respective wire layers.



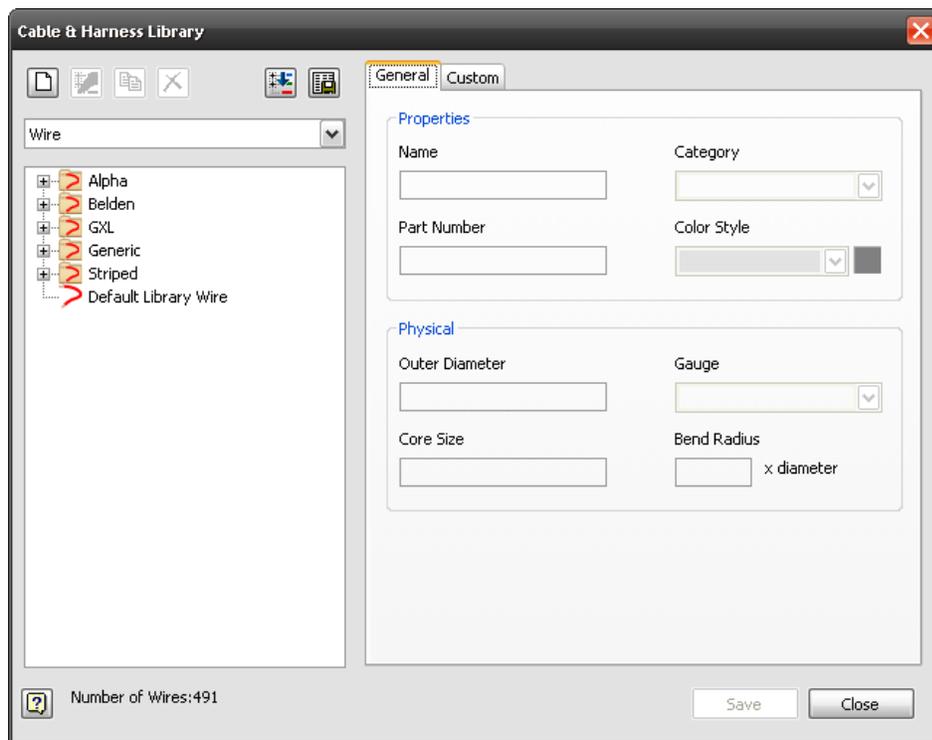
- Use the  Autodesk Inventor Professional Export command to export your data in XML format to Inventor. This command opens the dialog box shown below, and enables you to export the active drawing (**Active drawing**) or choose multiple files from which to extract information (**Project**). You can access this command under **Projects > Reports** or from the Schematic Reports flyout on the ACE: Electrical Main 2 toolbar. The XML file will export component, splice, wire, and cable information about the design.



Configuring Autodesk Inventor

Autodesk Inventor also needs to be set up for the import from Electrical. You can control this import by defining commands “on the fly”, as needed, as well as having a predefined library in place.

- Inside an assembly, start the  Create Harness... command and create your harness subassembly. Create and place your segments and electrical parts using conventional assembly modeling and part placement methodologies.
- The  Cable & Harness Library command can be configured so most error conditions do not appear. Most companies use a certain set of components that almost always meet their needs. Setting this up once and sharing it can save time and hassle. The Cable & Harness Library dialog box is shown below.



- The library can be configured for cables, labels, looms, plug, raw ribbon cables, seals, splices, terminals, wires, and other miscellaneous categories. You will focus on what Electrical brings over: cables, wires, and splices. You can configure the following parameters in the library:

Option	Description
Cables	Name, Category, Part Number, Outer Diameter, Bend Radius, Conductor Ids and their wire information, and optional custom properties.
Wires	Name, Category, Part Number, Color Style, Outer Diameter, Gauge, custom properties and optionally the Core Diameter and Bend Radius.
Splices	Name, Category, Part Number, # of Pins, Embedded Length, Gauge and Core Size (can be ranged, none, or fixed).

- You can manually make modifications in the dialog box or automate them with an import/export option. You need two files for the import/export of library information: CFG file and CSV data file
 - A configuration file (CFG) that describes the format of a CSV file. The file contains input parameters, their data types, and corresponding units. It is created as a space- or tab-delimited text file. This can be created or edited with the  Report command, Excel, or more commonly, Notepad. Examples are shown below.

Wire CFG File Example:

```
libwires
C:\libwires.log
Wire Name,Color Style,Outer Diameter, Category,Gauge
text,text,length,text,text
none,none,inch,none,none
```

Splices CFG File Example:

```
libsplices
C:\libcables.log
Library Name,Category,Part Number,Embedded Length,MyCustom
text,text,text,length,text
none,none,none,inch,none
```

Cables CFG File Example:

```
libcables
C:\libcables.log
Cable Name,Category,Part Number,Outer Diameter,Conductor ID,Wire Name
text,text,text,length,text,text
none,none,none,inch,none,none
```

- A CSV data file that maps the import/export library values based on the CFG file. Certain library objects require different mapping (example, cables require multiple lines for multiple conductors).

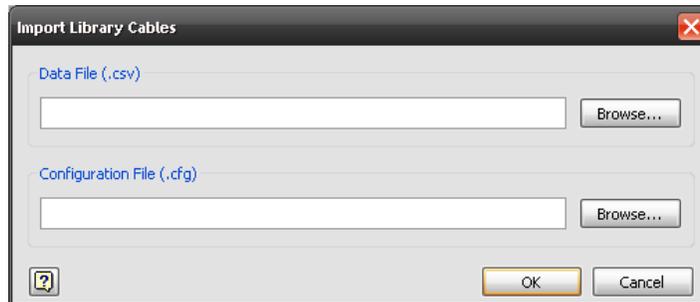
Wire CSV file

```
10AWG-BLK,Black,0.115,Generic,10
10AWG-BLU,Blue,0.115,Generic,10
```

Cable CSV file

```
1172C,Alpha,1172C,0.160,1,22AWG-BLK
1172C,Alpha,1172C,0.160,2,22AWG-RED
1173C,Alpha,1173C,0.170,1,22AWG-BLK
```

- Use the   (Import and Export Library Objects) commands to merge or modify your library. In addition, make sure everyone on your team is using the same IWL file (Cable and Harness Library). This is stored with your Design Data folder. The Import Library Cables dialog box is shown below.

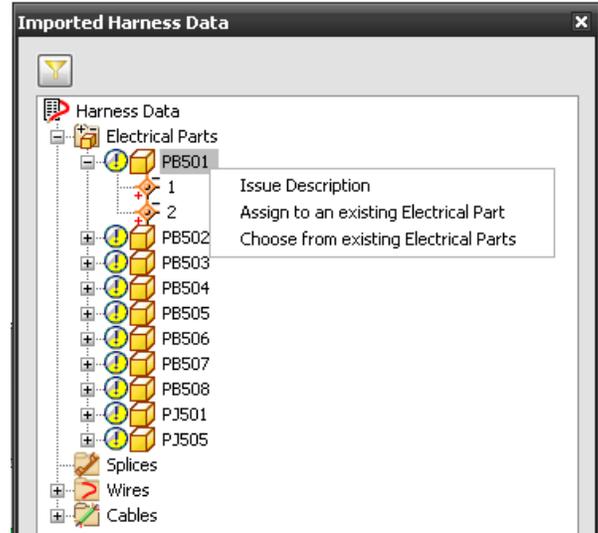


- Use the  **Import Harness Data** command to import data from XML Electrical into the current harness. With this command, the exported XML file from Electrical imports component, splice, wire, and cable information about the design. You will also look at the error codes as well for when items do not exist in the Cable and Harness Library.

Electric Parts

Use  **Electrical Parts** to display component tags and assigned pin numbers from the imported XML. Right-click on an item to access the following options:

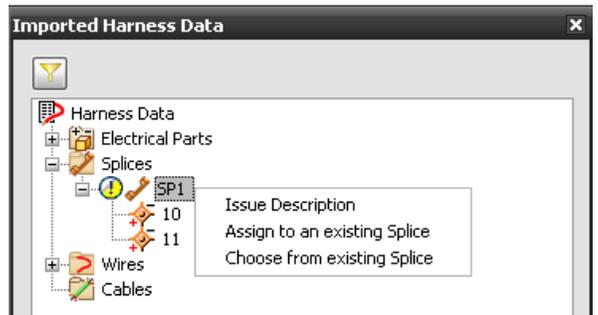
Option	Description
Issue Description	States any error condition and how to fix it.
Assign to an existing Electrical Part or Choose from existing Electrical Parts	Assigns the imported component and its occurrence information in the  Harness Properties of the selected part.
Rename Pin on Electrical Part	Appears if the part already exists and the pins do not match.



Splices

Use  **Splices** to display component tags and assigned pin numbers from the imported XML. Right-click on an item to access the following options:

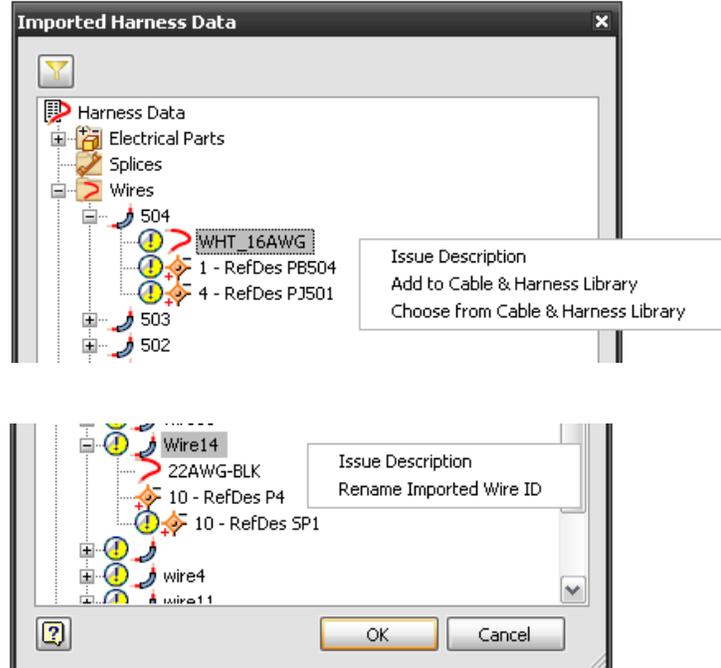
Option	Description
Issue Description	States any error condition and how to fix it.
Assign to an existing Splice or Choose from existing Splice	Assigns the imported component and its occurrence information in the  Harness Properties of the selected part.



Wires

Use  **Wires** to display wire numbers and assigned pin numbers from the imported XML. Right-click on an item to access the following options:

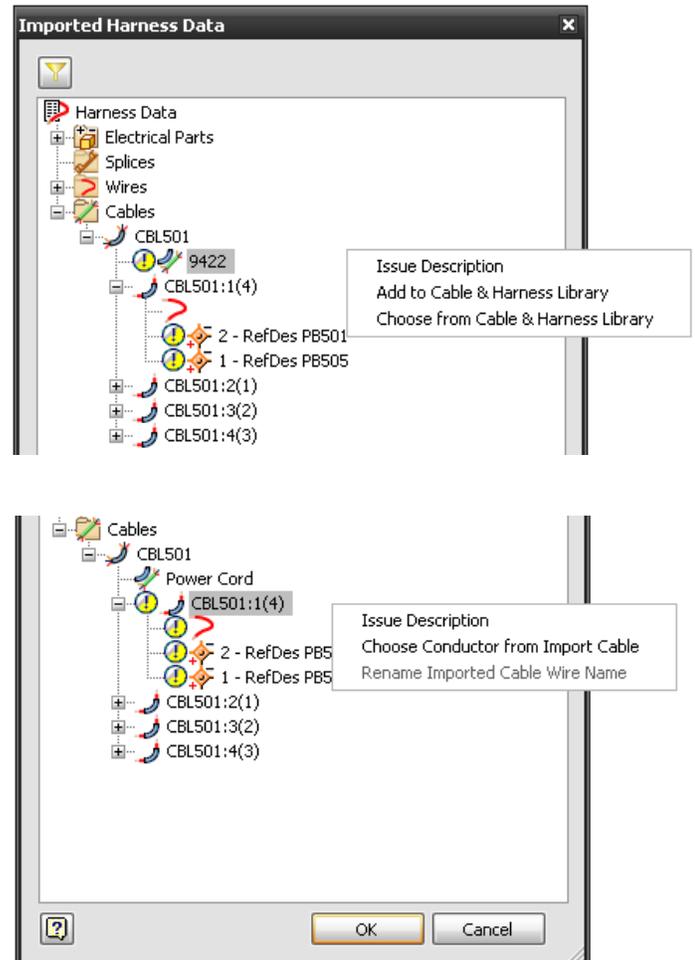
Option	Description
Issue Description	States any error condition and how to fix it.
Add to Cable & Harness Library or Choose from Cable & Harness Library	Create a new user wire definition in the library, or assigns a predefined wire in the library to the imported wire and occurrence information in the  Harness Properties .
Rename Imported Wire ID	Activates an edit field at the wire's browser node for renaming.



Cables

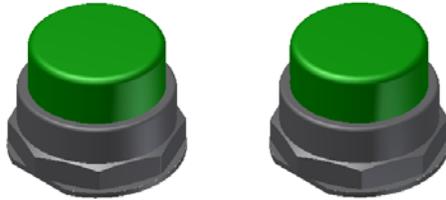
Use  **Cables** to display cable markers, their children, and assigned pin numbers from the imported XML. Right-click on an item to access the following options:

Option	Description
Issue Description	States any error condition and how to fix it.
Add to Cable & Harness Library or Choose from Cable & Harness Library	Create a new user cable definition in the library, or assigns a predefined cable in the library to the imported cable and occurrence information in the  Harness Properties .
Rename Imported Cable ID	Activates an edit field at the cable's browser node for renaming.
Choose Conductor from Imported Cable	Opens the Select Conductor dialog box so you can select a different conductor for the wire ID.
Rename Imported Cable Wire	Activate an edit field at the wire's browser node for renaming.



Creating Electrical Parts

Q. What is the difference between the two parts shown below?



A. One is an electrical part; the other is a normal Inventor part.

The Pins, Harness Properties, and the RefDes are what define an electrical part as an electrical part in Inventor. The part can be fully modeled or a simple representation, as long as there is geometry to designate for pins. Harness properties get mapped from Electrical and are used for Reports and Gender selection. The RefDes property found in the Harness Properties is used as a placeholder to identify and standardize the increment in the occurrence. "RefDes = PB?" is beneficial for additional multiple push buttons, so that the naming scheme stays the same after it is identified.

Use the following steps to create an electrical part:

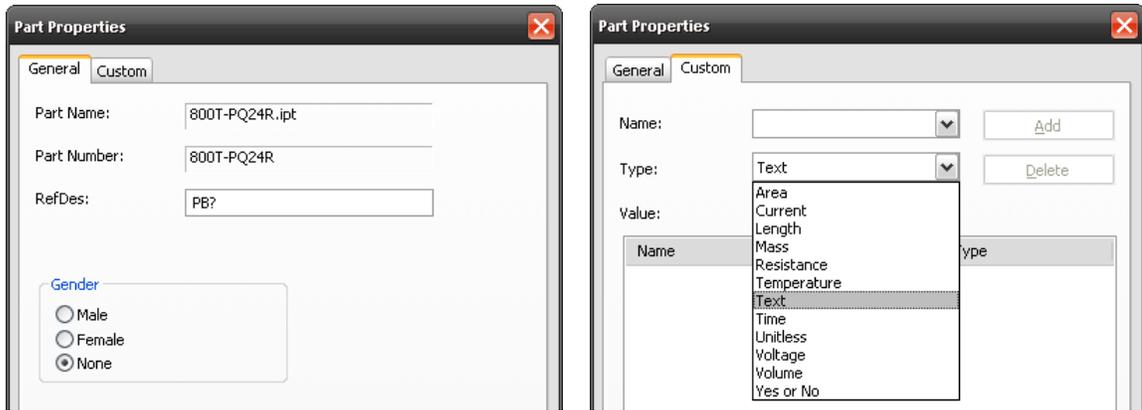
1. Create or open a part file that represents your electrical part. Examples are shown below.



2. Switch to the Harness Features Panel, as shown on the right.



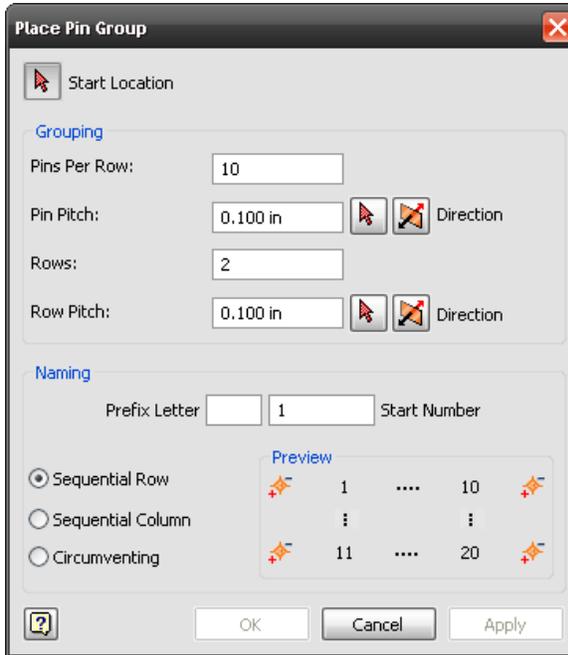
3. Start the  **Harness Properties** command. Create the RefDes placeholder and Gender information in the General tab and any specific electrical properties in the Custom tab (e.g., Area, Current, Length, Mass, Resistance, Temperature, Voltage, or any other information). When the electrical information is imported these properties either update or create their own properties from the imported XML. The General and Custom tabs of the Part Properties dialog box are as follows.



4. Add a pin () or a pin group () to the model.
 - Use the  **Place Pin** command to place a single pin. You can place a single pin using non-associative or associative geometry. Non-associative are points placed arbitrarily on any face of a part. Associative points can be vertices, work points, sketch points, and center points. These points update with model changes and are strongly recommended. By default, Pins increase sequentially and can have properties for individual pins. The dialog boxes are shown below.

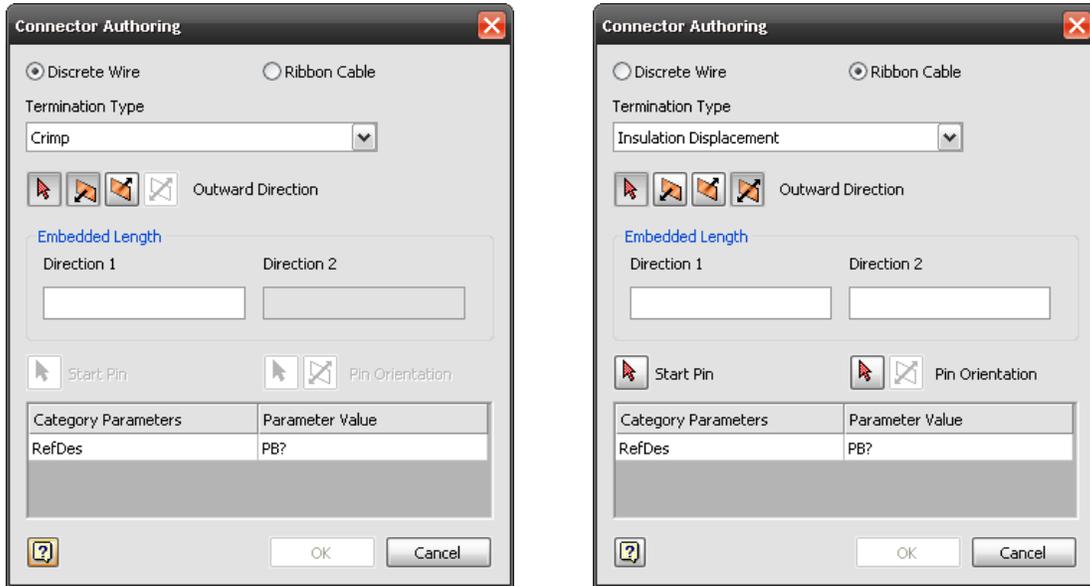


- Use the  Place Pin Group command if the part has predefined rules for how pins are placed, or if you prefer to quickly create an associated group with a large number of pins. This command only works in a rectangular fashion and cannot create circular pin groups. Place work points with a circular pattern and individual pins for this intent. The Place Pin Group dialog box is shown below.



Option	Description
Start Location	Select a non-associative or associative point for the starting pin.
Grouping	Enter the number of pins per row. Enter the pin pitch (value and direction). Enter the number of rows. Enter the row pitch (value and direction).
Naming	Enter a prefix for your pins and/or start from a designated number. Select Sequential Row or Sequential Column to increase pin number by row or column. Circumventing is only available for two rows at a time and increments from left to right for the first row and right to left for the second row.

5. Author the connector using the  **Connector Authoring** command to prepare the part or iPart for placement into the Content Center, and to make it more appropriate for your design. The Connect Authoring dialog box is shown below for the **Discrete Wire** and **Ribbon Cable** options.



The Connect Authoring parameters are described in the table below.

Option	Description
Type	Select Discrete Wire for individual wires and cables or Ribbon Cable to specify the connector is used in a ribbon cable.
Termination	Select Crimp for terminal connectors only. Select Insulation Displacement for ribbon cables and terminal connectors.
Outward Direction	Click  to select geometry to specify the direction. Click  or  to specify the direction as normal or away from the normal. Click  when using Ribbon Cable for Insulation Displacement and enables the Ribbon cable to pass through the connector.
Embedded Length	Creates a custom iProperty to document how much wire or cable is inserted into a part for one or two directions.
Start/Orientation (Ribbon Cable only)	Specifies the starting pin and its orientation.
Category Parameter (iParts only)	Maps the RefDes property to a column in the iPart.

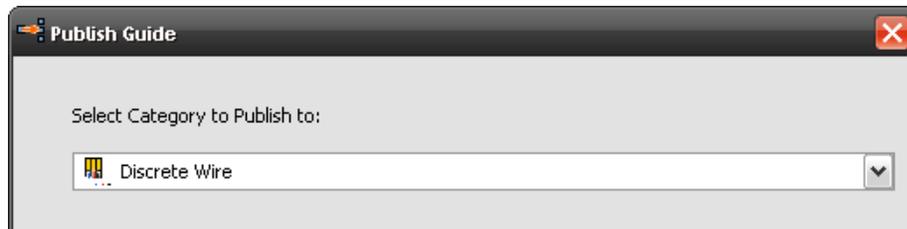
Publishing to the Content Center

Use the following steps to publish to the Content Center:

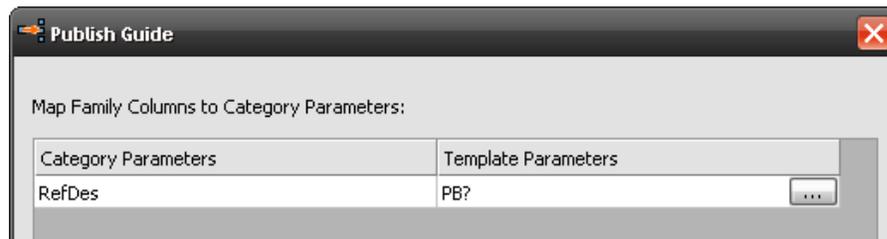
1. Publish the part to a writable Content Center using the  Publish Part... command from the Tools menu.
2. Select the writable library to publish to and select the language, as shown below. You must have a writable library set up in your Content Center and mapped to your project file.



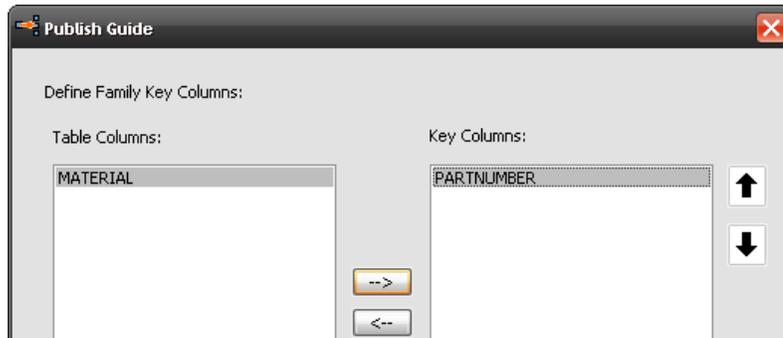
3. Select the category to publish to, as shown below. The type that was selected during the  Connector Authoring command will appear if it has a match in the writable library.



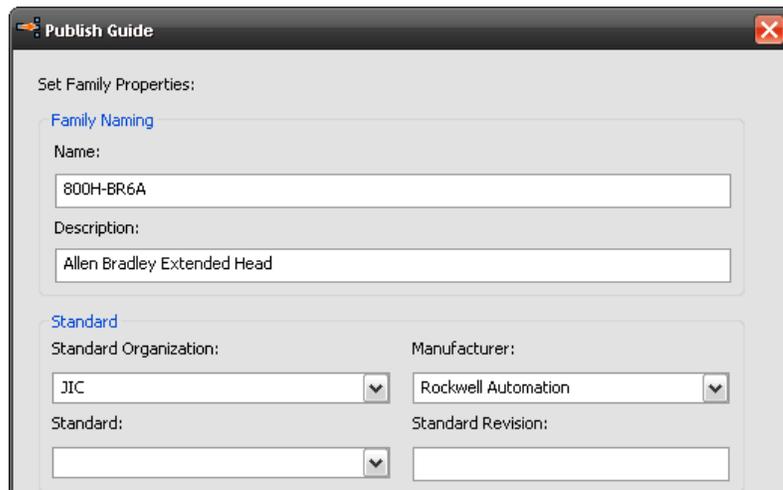
4. Select or verify your category parameters for the Content Center part so they are mapped correctly to the template file's parameters, as shown below (should be done from Authoring).



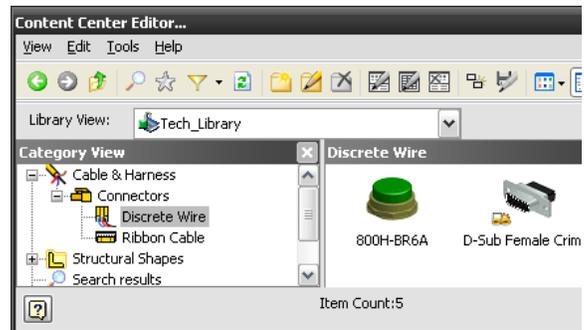
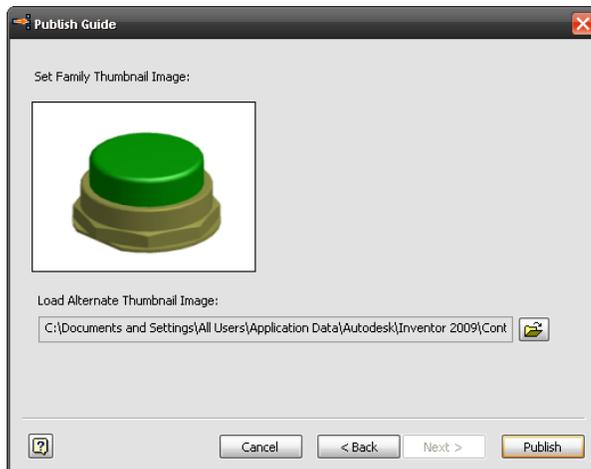
5. Select Key Columns, as shown below, for assembly placement if you are publishing an iPart.



6. Fill out the Family Naming, Description, Standard, and Manufacturer fields, as shown below (minimum information required).



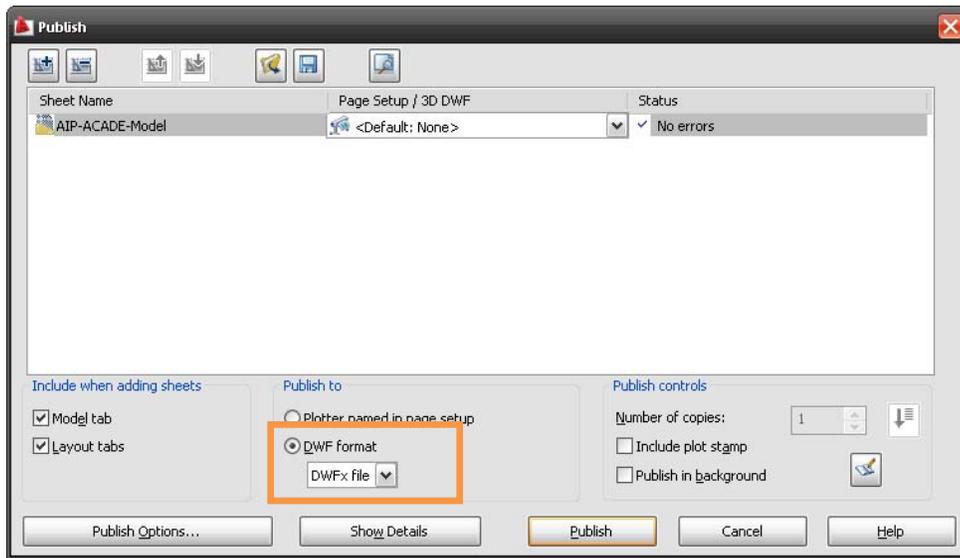
7. Select a Thumbnail Image (BMP or JPG) for use in the Content Center, as shown below on the left. The graphic on the right shows the Content Center with the selected thumbnail.



Publishing a DWF or DWFx

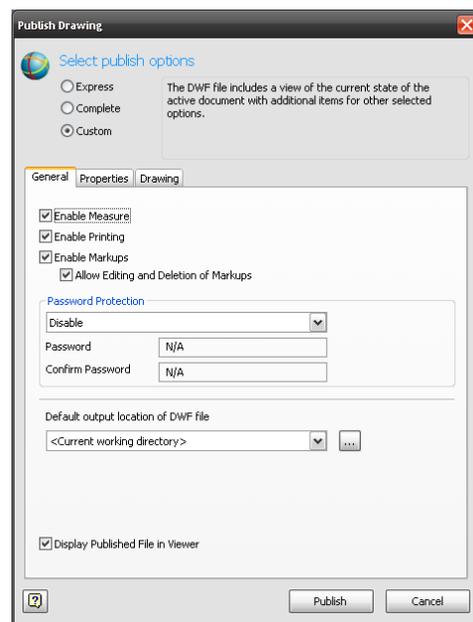
To complete the design and fully document your results, you can create a single file to share with your team. Start by first creating a file (DWF or DWFx) that can be marked up and measured electronically without modifying an Inventor or Electrical CAD file. DWF files are an older format. They are usually smaller than a PDF but provide greater flexibility. DWFx files are a newer format designed to be opened directly in Microsoft Vista and Internet Explorer 7, without having to use a separate Viewer to open them.

- **In Electrical:** Use the **Publish** or the **Plot** command (**Publish** provides more options, such as Batch Publishing). The Publish dialog box is shown below.



- **In Inventor:** Use the Publish DWF... or Save Copy As... command. Click **Options...** in the Save dialog box when using the latter command. The Publish Drawing dialog box is shown below.

Option	Description
Express	Publishes the selected file.
Complete	Publishes the selected file and all references. The Custom option is similar to Express but with more options.
Enable Measure/Printing and Markups	Enables you to restrict Markups, Printing, and Measurements. You can also password protection on the document.

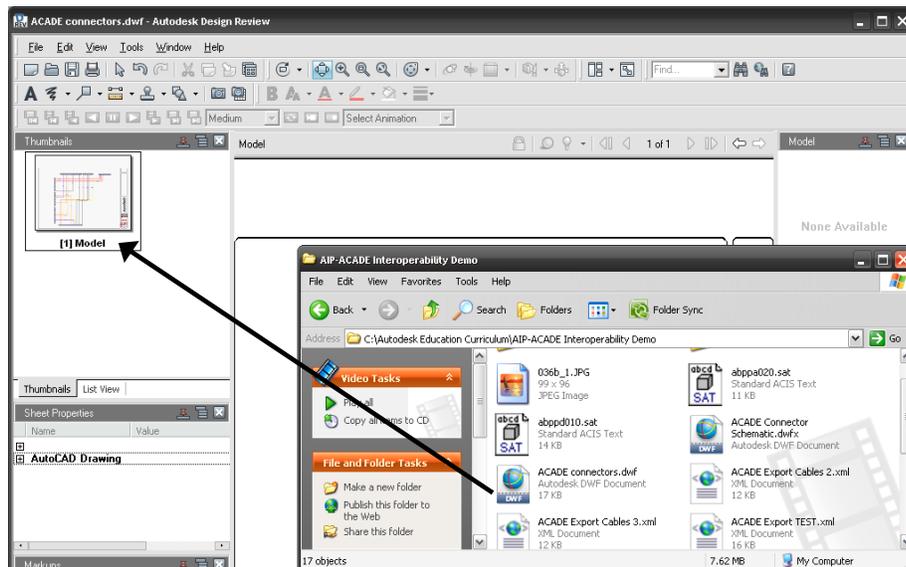


Combining the Design

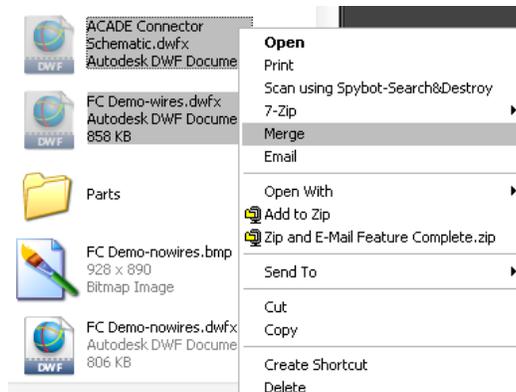
Once you've completed a design, the last step is to combine the Electrical and Inventor files. Consider that the manager of the Electrical and Mechanical group wants to see both sets of prints, but does not want to search or minimize through multiple windows. A DWF file from Electrical and Inventor can be combined for a complete look at the design in a lightweight format. Two major advantages is they cannot accidentally change the design and they do not need the source CAD programs, just Design Review (available for Free).

To combine multiple DWF or DWFx files into a single file, you can use one of the following methods:

- Open Design Review, and drag and drop the merging files from Windows Explorer into the Thumbnails area of Design Review to create a new file.



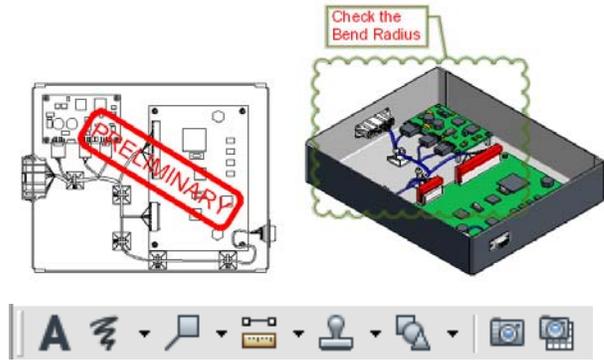
- Press <Shift> or <Ctrl>, and then select two DWF or two DWFx files in Windows Explorer. Right-click and select **Merge**. Select a new name for the file (note that a DWF and DWFx will not merge).



Mark Up and Comparing Revisions

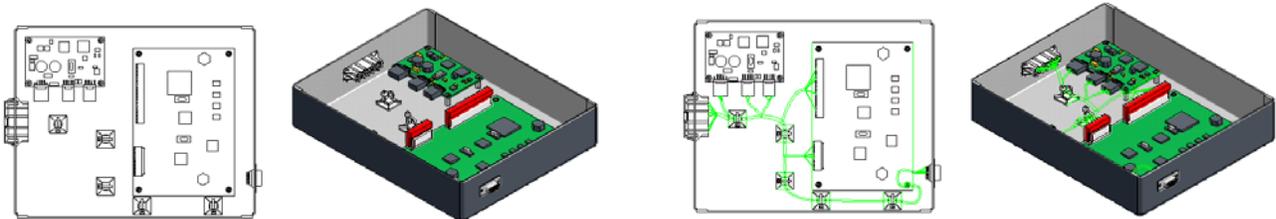
Design Review enables you to mark up a design in numerous ways. The following Design Review Markup tools are beneficial for the red-liner/checker:

- Screenshot tools (to make more sheets in Design Review to eliminate clutter/obscurity).
- Stamps (standard and custom).
- Revision Clouds (includes many different styles and shapes).
- Measurement tools (length, polylines, area, etc.).
- Options to specify the type of markup (Review or Question the design).



Current Design Review roundtrip work is only available with 2D sheets, not 3D. Therefore, if a markup is made on the 3D model, it will not come through with the Load DWF Markup Set... command from Inventor or Electrical and 2D will not work correctly from a merged DWF. To avoid this, try to develop a habit of having Design Review open at the same time as an engineering design change or quick fix.

To compare geometry from different DWF or DWFX files (different revision levels), select **Tools > Compare** in the Design Review menu bar. Select a file to compare with and then select the sheet in that file. Currently, you can only compare 2D sheets, but you will be able to see additions and deletions in your design. Click **Options...** in the Compare dialog box to select colors for the additions and deletions. The images below show the original and compared geometry.



Original: Without Routed Wires (Revision A)

Compared: Referencing file with Routed Wires (Revision B)

Class Summary: With Autodesk Inventor Professional, AutoCAD Electrical, and Autodesk Design Review, you can more easily document, share, and revise an entire project with very little redundant data. In addition, you can create the documentation needed after a design is shipped or when repair work is needed. Digital Prototyping your company's data will save you time, money, paper, internal confusion, and help bring your product to market that much quicker.