

M226476

Automatic Drawing Creation with AutoCAD Electrical

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Learning Objectives

- Edit the Spreadsheet to PLC Excel file
- Automatically create standard and custom ladder style PLC drawings
- Configure the Spreadsheet to PLC tool to create other types of ladder style drawings
- Understand & exploit the capabilities and limitations of the Spreadsheet to PLC tool

Description

Automatic drawing creation is a dream of everyone. Imagine selection options into a spreadsheet and having schematics appear before your eyes. Is this possible? Yes! Using the Spreadsheet to PLC tool in AutoCAD Electrical can get you most of the way there. Don't be fooled by the name of the tool, we can create more than just PLC type drawings, almost any type of ladder style schematic drawing can be created entirely from information in a spreadsheet. We take you behind the curtain to show you how.

Speaker(s)

Randy Brunette is the sole proprietor of Brunette Technologies, LLC, a consulting firm specializing in AutoCAD Electrical and related products including Inventor, Vault, and the Substation Design Solution (SDS) Toolkit. As an Electrical Subject Matter Expert, Randy's duties include helping channel partners and customers through mentoring and understanding their business issues and finding solutions that solve their challenges. Randy has been in the design field using Autodesk products for over 33 years, with experience across many different segments of the manufacturing industry. He has been in an application engineer role for 22 years, traveling throughout the world providing consulting services. Randy is a top-rated speaker at Autodesk Universities, Technical Academies, and seminars. He has authored AutoCAD Electrical software training manuals, videos, and other materials.

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Overview

The Spreadsheet to PLC tool (SS2PLC) was designed to automatically create drawings from information in a spreadsheet. The tool requires a PLC module to be inserted to enable the program to insert ladder rungs. This has always held back the use of tool for other types of drawings. Until now! Described here is a workflow to enable the use of SS2PLC for pretty much any type of ladder type schematic, including 3PH, Single rung, and PLC types of schematics. Unfortunately, the tool will not work on point-to-point, or wiring diagram style drawings.

One note, the files included will work just fine, but are just intended to give you a starting point to work from when automatically creating drawings. For the example, the SS2PLC_20 module has 20 rungs assigned to it. If your schematics require more or less rungs, you will need to edit the supplied example or copy it to create a new module with the correct number of rungs (recommended).

The best way to make use of this tool is with the use of configuration software, or other tools that would automatically create the spreadsheet from a list of options or selections.

General Spreadsheet to PLC Tool Notes

1. All standard AutoCAD Electrical Spreadsheet to PLC commands work during this operation as they do when creating standard PLC style schematics, including SKIP, BREAK, etc.
2. All spreadsheet setups are very similar for each different type of schematic drawing, but a different setup or WDI file is needed for each type of drawing to maintain the best spacing for component insertion. For example, a 3PH bus is wider than a single line rung and requires a different offset to the insertion of the first component on the connecting rungs.
3. When inserting related symbols such as parent/child type symbols, the link between the components is established by using the same TAG value for all components. Cross Reference updates and so on should be run on a project wide basis after the drawings are created.
4. A suggestion is to copy all SS2PLC sample files into the PLC library folder. This folder is in the AutoCAD Electrical search path and keeps all PLC related files in a single location. These files include the sample ACE_PLC.MDB file (remember to backup original first), all DWG and BMP files and the DEL_BLANK_PLC.LSP file.
5. This workflow is still being tested and developed. If you uncover any challenges or discover any different ways of using these methods, please let me know.

Schematic PLC Module

Since the SS2PLC requires a PLC module to run, and we don't want to see a PLC module in our drawings, we need to create a PLC module to insert without otherwise affecting the schematic drawing. Enter the SS2PLC phantom schematic module!

Phantom I/O Point

To create a phantom module, phantom I/O points are needed. A custom I/O point was created that only has three attributes, all of which are set to be invisible.

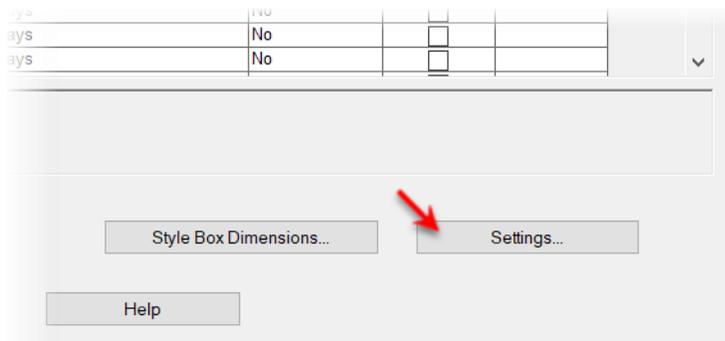
- `_TAG` – the address tag for an I/O point
- `X?TERM??` – the wire connection of an I/O point
- `DELETE_ME` – a custom attribute used as a flag so the included LISP routine can find and erase the module automatically.

The custom I/O point symbol and graphics are created in 9 different styles so it works with any style of display you use for your PLC type drawings.

PLC Module Settings

Next you need to make the new Phantom I/O point available for building new phantom PLC modules. Make sure the `HP?Circuit.dwg` and `HP?Circuit.png` files are located in your search path. I recommend copying them to the same PLC folder used for the standard PLC symbols shipped with the software. (The default path is "C:\Users\user_name\Documents\Academy\AeData\en-US\PLC ")

Now we need to make these symbols available to the PLC Database File Editor. To complete this task we will use the Settings option in the PLC Database File Editor.



In the Terminal Block Settings dialog box, click in the last row to add a new entry. Then make the entries as shown.

Terminal Block Settings

	Block File Name	Category	Unique Description	Sample Bitmap File Name
33	HP1WX-	Terminal	Terminal Point Wire Leftx	HP1WX-
34	HP1-XW	Terminal	Terminal Point Wire Rightx	HP1-XW
35	HP1-XWC	Output	Contact Output (N.C.) Wire Right	HP1-XWC
36	HP1DWAWC	Output	Contact Output (N.C.) Wire Left and Right	HP1DWAWC
37	HP1-XWO	Output	Contact (N.O.) Wire Right	HP1-XWO
38	HP1D-AWO	Output	Contact Output (N.O.) Wire Right	HP1D-AWO
39	HP1D-AWC	Output	Contact Output(N.C.) Wire Right 2	HP1D-AWC
40	HP1SPACE	Terminal	Blank	HP1SPACE
41	HP1Circuit	Circuits	Blank for Circuits	HP1Circuit

Graphics Style: 

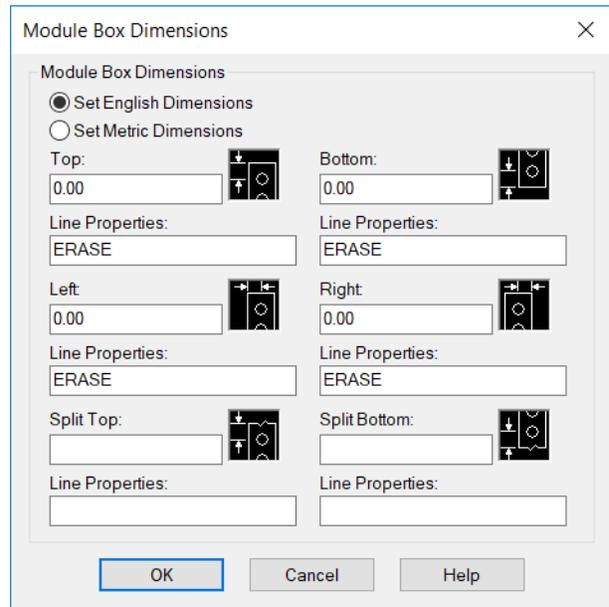
This will create a new Category named Circuits and make the phantom I/O point available in the I/O point listings, just like any of the I/O points supplied with the software.

Phantom PLC Module

The SS2PLC_20 PLC module is built and maintained using the PLC Database Editor just like any other PLC module. There are some important differences:

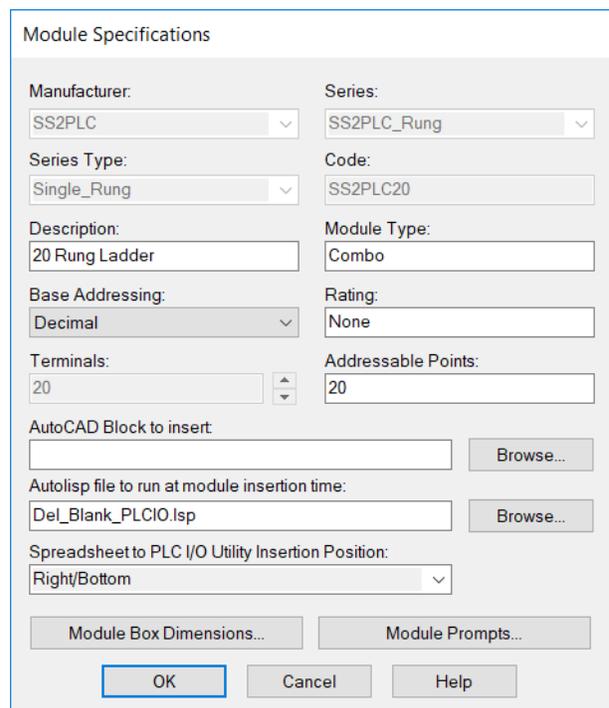
- A phantom PLC module uses a phantom I/O point, HP?Circuit, (described below) for all I/O points.
- The number of I/O points in the module should match the number or rungs required for the ladder. *(Hint: Make a separate module for each ladder size, I.E. Number of rungs in ladder.)*
- Module specifications are custom. Since we don't want anything of the PLC module visible in the drawing, we need to turn off the display of the module box using the ERASE option in the Module Box Dimensions dialog box. Here is an example:

- The phantom PLC module is inserted with a 0.00 offset, on the neutral bus for single line schematics, and to the far end of the bus for 3PH schematics.



- Since we also don't want the phantom PLC module to appear in any reports, we will delete the module as soon as the SS2PLC tool has all the data it needs. We can do this easily by adding a simple LISP routine (included) to the Module Specifications dialog box. An example is shown:

The LISP routine searches the drawing for any PLC that contains the DELETE_ME attribute and deletes it.



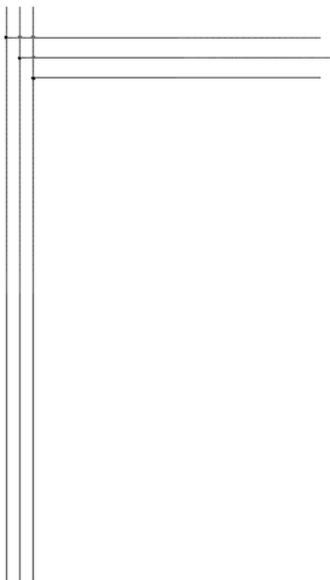
3 Phase Schematic Setup

There are two key challenges to overcome when using SS2PLC to create 3PH schematics. The first is connecting the horizontal wires to the vertical wires, or vice versa. SS2PLC was designed with only single-phase ladders in mind. This means that SS2PLC connects all rungs to only one wire of the 3PH bus.

To work around this issue, circuits are inserted representing the 3PH wiring. In the spreadsheet placing an asterisk in front of the symbol name tells SS2PLC to automatically explode the symbol into its individual components, in this case, the individual wires for the 3PH wiring.

Four 3PH wiring circuits are included in the example dataset, two for 0.75 horizontal rung spacing, and two for 1.00 horizontal rung spacing. The first circuit in each set, *First_3PH_Bus_???.dwg*, includes the vertical common 3PH bus and the first horizontal 3PH wiring. The second circuit, *Horz_3phase_Wires_???.dwg*, is used for all each additional 3PH bus. Here are the images for the two buses.

First_3PH_Bus_075.dwg



Horz_3phase_Wires_075.dwg

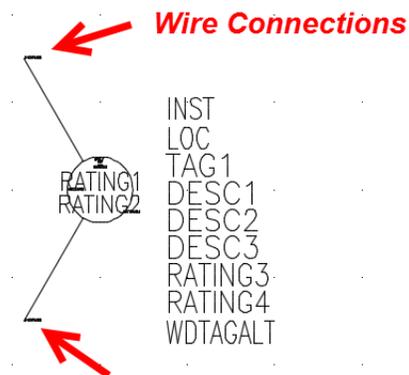


The second challenge is that a wire must exist in the drawing before components in a row can be inserted. The work around that solves this challenge is to offset the insertion point of the 2+ circuits by the same amount as the rung spacing. In the spreadsheet, a row inserts the 3PH wiring, and the next rows insert the components for each 3PH circuit. The drawback to this method is that you have a blank or empty rung between each 3PH circuit.

3PH Motor Symbol

Another challenge is when inserting the 3PH motor symbols, the SS2PLC workflow does not take advantage of the radial attributes in the modern 3PH motor symbol. A simple solution to this problem was to create a custom 3PH motor symbol for each different rung spacing used in the ladders. The custom symbol includes the wire branches and wire connection attributes for the outlying 3PH wires.

The HMO13_075 symbol for 3/4" ladder rung spacing is shown here:



Single Line Schematic Setup

Single line schematic creation using SS2PLC is mostly identical to creating standard PLC style drawings. The differences are in the use of the above-mentioned phantom PLC module and the use of a different WDI setup file that uses the proper offsets for the insertion of the components.

PLC Spreadsheet Control Codes Reference

This is copied from the AutoCAD Electrical Help file.

Special PLC values

There are some special values that can be placed in a row to direct special PLC module features:

BREAK	Insert this keyword in the ADDRESS column of the spreadsheet where you want the PLC module to break and continue on the next ladder column. There should not be any other data in the spreadsheet row; only the word "BREAK" in the address column.
SPACER	Insert this keyword in the ADDRESS column of the spreadsheet where you want to add extra space between adjacent I/O points. There should not be any other data in the spreadsheet row; only the word "SPACER" in the address column.
SKIP	Insert this keyword into the CODE module part number column right after the end of the data on the spreadsheet of the previous module. This keyword triggers the utility to skip a ladder before it begins the next module in the spreadsheet. There should not be any other data in the spreadsheet row; only the word "SKIP" in the part number code column.
NEW_DWG	Insert this keyword into the CODE module part number column right after the end of the data on the spreadsheet of the previous module. This keyword triggers the utility to skip to the next sheet before it begins the next module in the spreadsheet. There should not be any other data in the spreadsheet row; only the word "NEW_DWG" in the part number code column.
*	Place an asterisk (*) in front of a device block name to trigger an Insert Circuit instead of an Insert Component. Any associated TAG, DESC, MFG, and CAT column values for this entry are annotated onto the first AutoCAD Electrical symbol found on the inserted circuit.

You can predefine other attributes on the module, such as Installation, Location, and Ratings, using the format "mainval;attributename2=attributevalue2," and so on. For example, you want the module to have a Rack value of "2", an Installation value of "MACH1", and a Rating2 value of "Hazardous Duty". In the spreadsheet, in the RACK column, enter "2;INST=MACH1;RATING2=HAZARDOUS DUTY". When the module is generated these extra attribute values are assigned.

Guideline Review

- All included files and materials are for reference and will probably need to be edited to match your company standards.
- Only ladder style drawings are supported by this utility.
- The Phantom I/O point, HP?Circuit.dwg must be added to the PLC Database. ([See Phantom I/O Point](#))
- The Phantom PLC module must be entered into the PLC Database. ([See Phantom PLC Module](#))
- A PLC module must be inserted for the SS2PLC tool to run. In the case of non-PLC ladder drawings, this should be the Phantom PLC module.
- The number of inputs on the PLC module must match the number of desired ladder rungs. If multiple ladders of different rung numbers are required, create multiple PLC modules to match.
- 3 Phase drawings require the insertion of two separate circuits, the circuit inserted first will include both vertical and horizontal rungs, and all other circuits which contain just horizontal rungs. ([See 3 Phase Schematic Setup](#))

Exercises

* Setup to Run Exercises

To run the exercises as listed you will need to complete the following setup steps. This is based on the default installation of AutoCAD Electrical. You may have to make changes to match your company standard file locations.

1. ** IMPORTANT**

Backup your PLC library folder. The default PLC library folder location is:

`C:\Users\{username}\Documents\Acade {ver}\AeData\{language}\Plc`

2. Download the SS2PLC files from the Autodesk University website.

3. Copy all SS2PLC files into your PLC library folder.

4. (Optional) For convenience, copy all SS2PLC *.XLS and *.WDI files to your user folder. The default user folder is:

`C:\Users\{username}\AppData\Roaming\Autodesk\AutoCAD Electrical {ver}\{release}\{language}\Support\User`

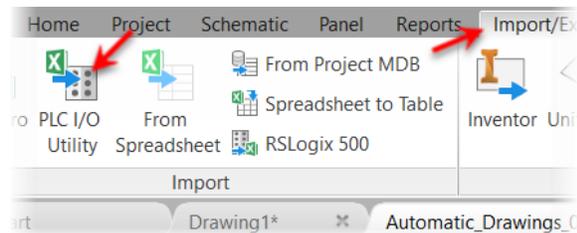
5. Download *IM226476-Automatic Drawing Creation.zip*. dataset from the Autodesk University website.

6. Unzip the project dataset, and in the AutoCAD Electrical Project Manager, open the Automatic_Drawings project.

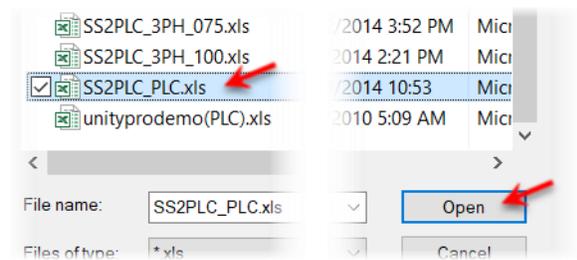
* Automatically Create PLC Ladder Style Drawings

In this demonstration, you create three drawings using the standard spreadsheet and settings file supplied with AutoCAD Electrical as an example. The standard files were just renamed to match the rest of the SS2PLC files. Then you compare the values in the spreadsheet with the drawings that were created.

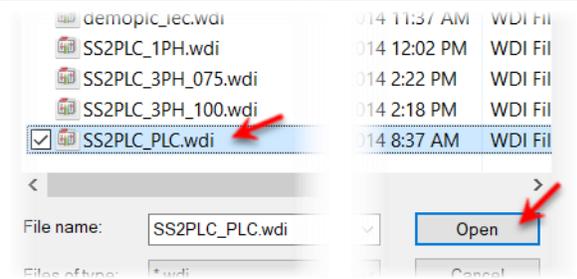
1. In Project Manager, open the Automatic Drawings project.
2. Expand the project and expand the Standard PLC sub-folder.
3. Open Automatic_Drawings_10.dwg.
4. On the Import/Export Data tab, Import panel, click PLC I/O Utility.



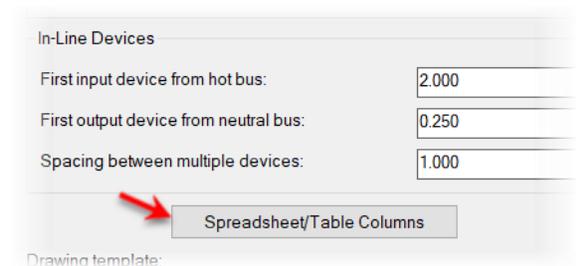
5. In the Select PLC I/O Spreadsheet dialog box, select *SS2PLC_PLC.xls*. Click Open.



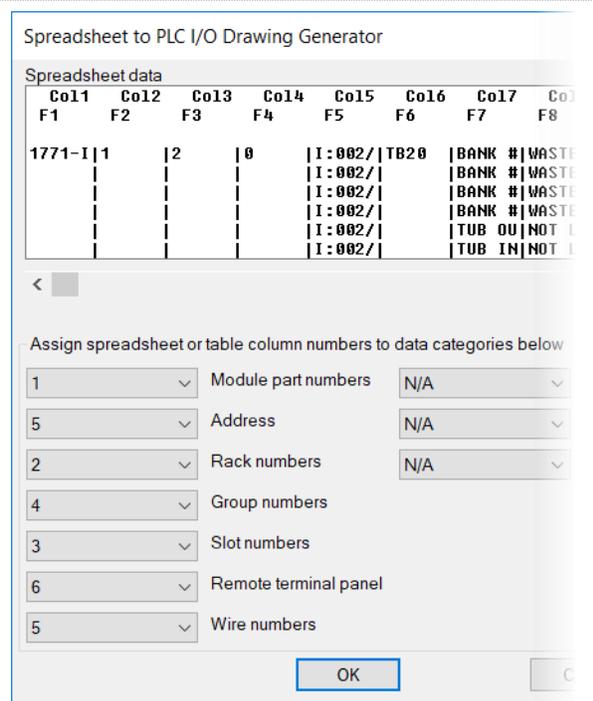
6. In the Spreadsheet to PLC I/O Utility dialog box, for Settings, click Browse.
7. In the Read Settings From dialog box, select *SS2PLC_PLC.wdi*. Click Open.



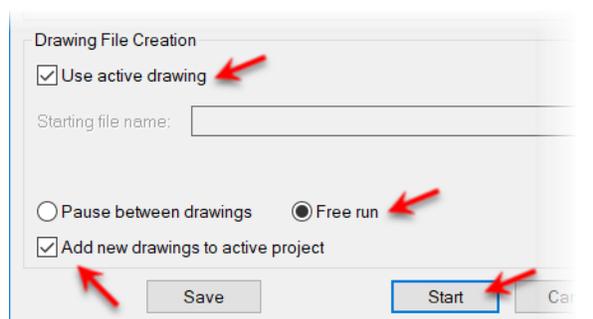
8. In the Spreadsheet to PLC I/O Utility dialog box, click Setup.
9. In the Spreadsheet to PLC I/O Utility Settings dialog box, review various settings.
10. Click Spreadsheet Table Columns.



11. In the Spreadsheet to PLC I/O Drawing Generator dialog box, review the mappings of the spreadsheet columns to the AutoCAD Electrical data categories.
12. Click OK.
13. In the Spreadsheet to PLC I/O Utility Settings dialog box, click OK.

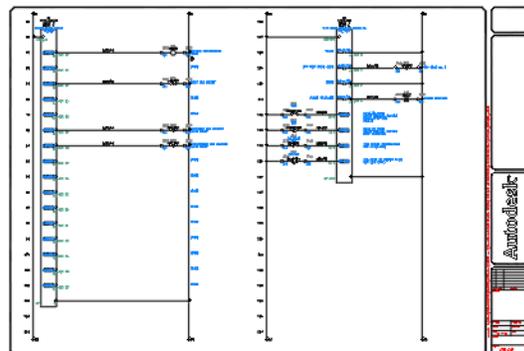


14. In the Spreadsheet to PLC I/O Utility dialog box, for Drawing File Creation, select Use Active Drawing.
15. Select Free Run.
16. Select Add New Drawings to Active Project.
17. Click Start.



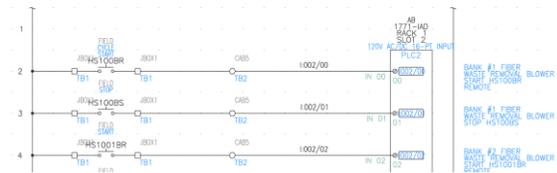
Three drawings are automatically created that include input and output PLC modules of various types.

18. After all three drawings are created, on the Quick Access toolbar, click Qsave.



19. In Project Manager, open *Automatic Drawings_01.dwg*.

20. Zoom into Rung 2, and pan to top of drawing canvas.



21. On the Import/Export Data tab, Import panel, click PLC I/O Utility.

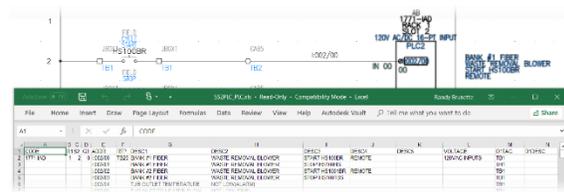
22. In the Select PLC I/O Spreadsheet dialog box, right-click *SS2PLC_PLC.xls*.

23. Click Open With...

24. Select Excel. Click OK.

25. In AutoCAD Electrical, close the Select PLC I/O Spreadsheet dialog box.

26. Reposition the Excel spreadsheet to enable display of both Rung 2, and the top row of the spreadsheet.

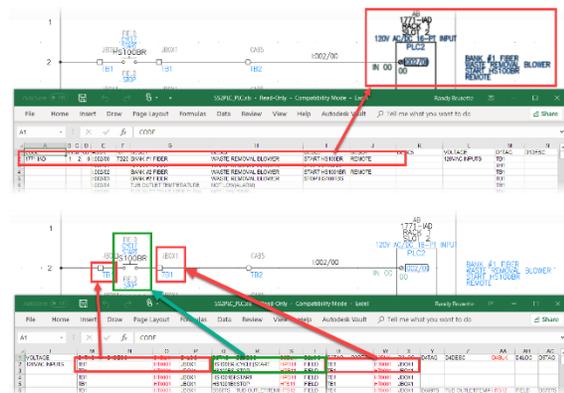


A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	IB1	NO	1	4	0.0028	STOP												
2	IB2	NO	1	4	0.0028	STOP												
3	IB3	NO	1	4	0.0028	STOP												
4	IB4	NO	1	4	0.0028	STOP												
5	IB5	NO	1	4	0.0028	STOP												

27. Compare entries in spreadsheet with symbols inserted in drawing.

28. Close *SS2PLC_PLC.xls*.

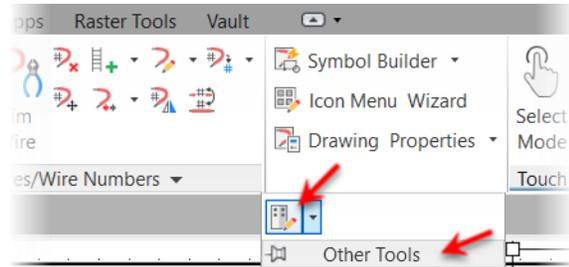
This completes the exercise.



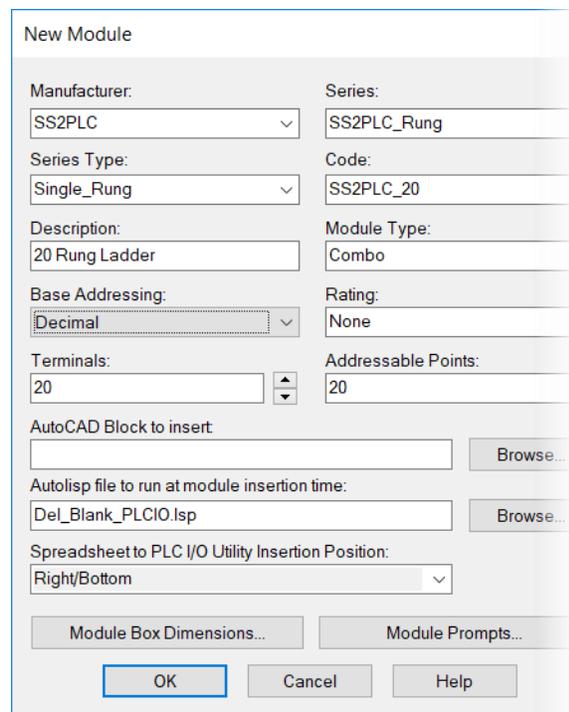
* Add Phantom PLC to PLC Database

In this exercise, you add a phantom PLC with 20 I/O points to the PLC Database.

1. On the Schematic tab, Other Tools expansion panel, click PLC Database File Editor.

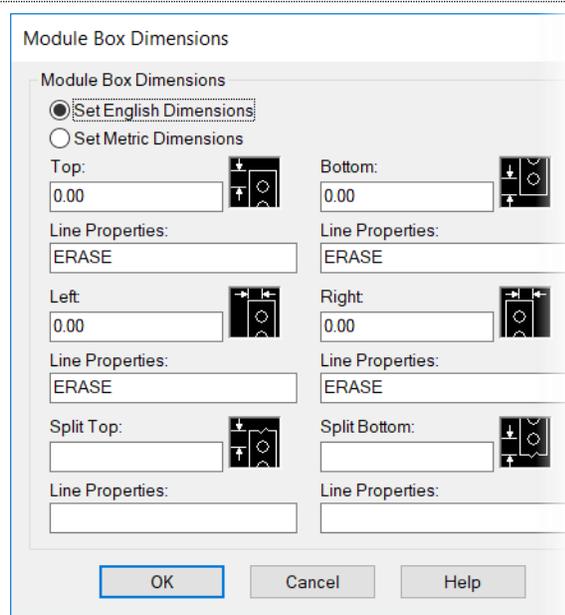


2. In the PLC Database File Editor dialog box, click New Module.
3. In the New Module dialog box, for Manufacturer, enter **SS2PLC**.
4. For Series, enter **SS2PLC_Rung**.
5. For Series Type, enter **Single_Rung**.
6. For Code, enter **SS2PLC_20**.
7. For Description, enter **20 Rung Ladder**.
8. For Module Type, enter **Combo**.
9. For Base Addressing, select **Decimal**.
10. For Rating, enter **None**.
11. For Terminals, enter **20**.
12. For Addressable Points, enter **20**.
13. For Autolisp File to Run, enter **Del_Blank_PLCIO.Isp**.
14. Click Module Box Dimensions.



New Module	
Manufacturer:	Series:
SS2PLC	SS2PLC_Rung
Series Type:	Code:
Single_Rung	SS2PLC_20
Description:	Module Type:
20 Rung Ladder	Combo
Base Addressing:	Rating:
Decimal	None
Terminals:	Addressable Points:
20	20
AutoCAD Block to insert	
<input type="text"/>	Browse...
Autolisp file to run at module insertion time:	
Del_Blank_PLCIO.Isp	Browse...
Spreadsheet to PLC I/O Utility Insertion Position:	
Right/Bottom	
Module Box Dimensions...	Module Prompts...
OK	Cancel
	Help

15. In the Module Box Dimensions dialog box, for Top, enter **0.00**.
16. For Top Line Properties, enter **ERASE**.
17. For Bottom, enter **0.00**.
18. For Bottom Line Properties, enter **ERASE**.
19. For Left, enter **0.00**.
20. For Left Line Properties, enter **ERASE**.
21. For Right, enter **0.00**.
22. For Right Line Properties, enter **ERASE**.
23. Click OK.

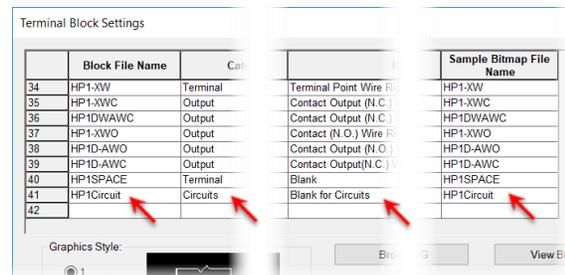


24. In the New Module dialog box, click OK.
25. In the PLC Database File Editor dialog box, click Settings.

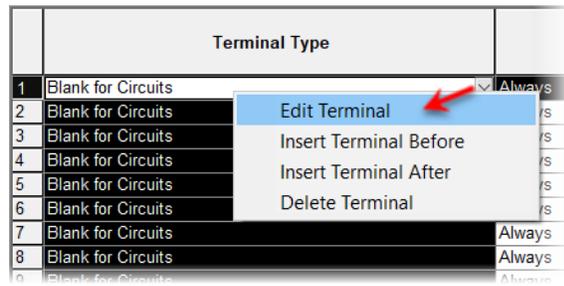
26. In the Terminal Block Settings dialog box, scroll to the bottom of the list, and click in the last row.

This adds a new blank row to the listings.

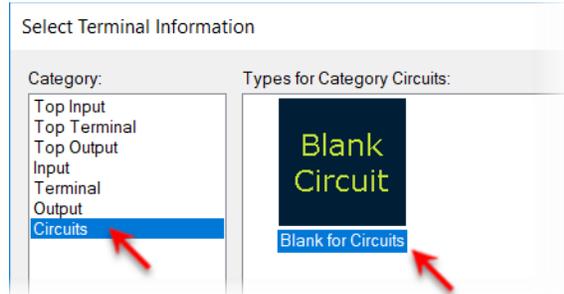
27. In the new row, for Block File Name, enter **HP1Circuit**.
28. For Category, enter **Circuits**.
29. For Unique Description, enter **Blank for Circuits**.
30. For Sample Bitmap File Name, enter **HP1Circuit**.
31. Click OK.



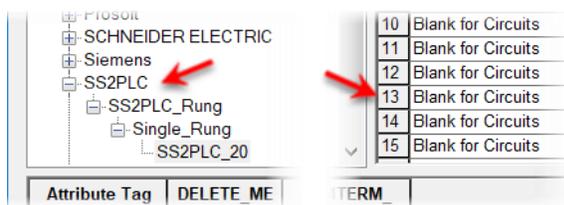
- 32. In the PLC Database File Editor dialog box, select SS2PLC > SS2PLC_Rung > Single Rung > SS2PLC20.
- 33. In the I/O Grid, select all rows.
- 34. Right-click in any row, select Edit Terminal.



- 35. In the Select Terminal Information dialog box, for Category, select Circuits.
- 36. Under Types for Category Circuits, Select Blank for Circuits.
- 37. Click OK.



- 38. In the PLC Database File Editor dialog box, click Save Module.
- 39. Click Done.

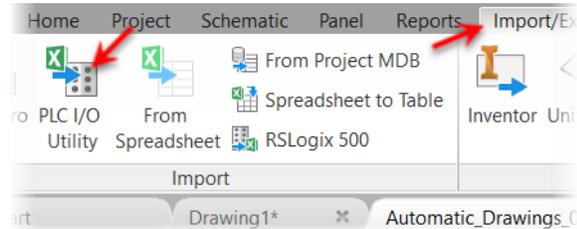


This completes the exercise.

* Automatically Create Single Phase Ladder Style Drawings

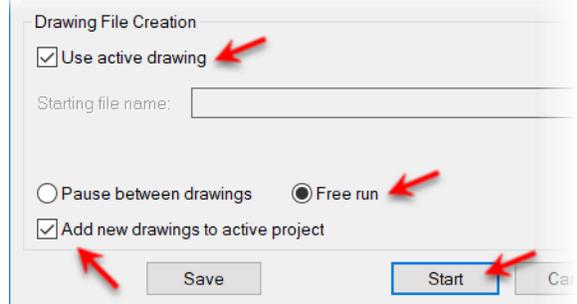
In this demonstration, you create three drawings using the standard spreadsheet and settings file supplied with AutoCAD Electrical as an example. The standard files were just renamed to match the rest of the SS2PLC files. Then you compare the values in the spreadsheet with the drawings that were created.

1. Expand the Schematic Ladder sub-folder.
2. Open Schematic_Ladder_20.dwg.
3. On the Import/Export Data tab, Import panel, click PLC I/O Utility.



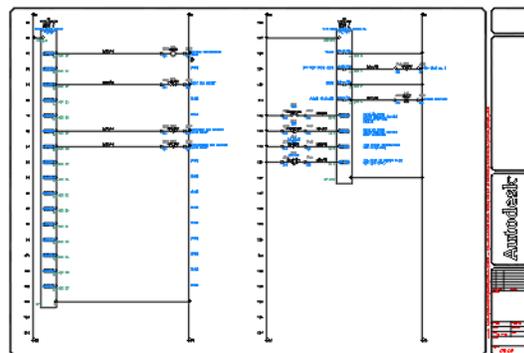
4. In the Select PLC I/O Spreadsheet dialog box, select SS2PLC_1PH.xls. Click Open.
5. In the Spreadsheet to PLC I/O Utility dialog box, for Settings, click Browse.
6. In the Read Settings From dialog box, select SS2PLC_1PH.wdi. Click Open.

7. In the Spreadsheet to PLC I/O Utility dialog box, for Drawing File Creation, select Use Active Drawing.
8. Select Free Run.
9. Select Add New Drawings to Active Project.
10. Click Start.

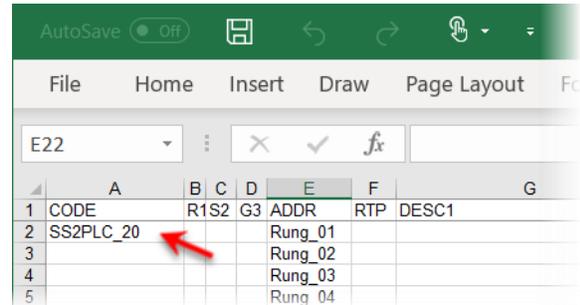


Two single phase drawings are automatically created that Do Not include any PLC modules.

11. After drawings are created, on the Quick Access toolbar, click Qsave.



12. On the Import/Export Data tab, Import panel, click PLC I/O Utility.
13. In the Select PLC I/O Spreadsheet dialog box, right-click SS2PLC_1PH.xls.
14. Click Open With...
15. Select Excel. Click OK.
16. Notice the only major change is replacing a standard PLC with SS2PLC_20.
17. Close SS2PLC_1PH.xls.



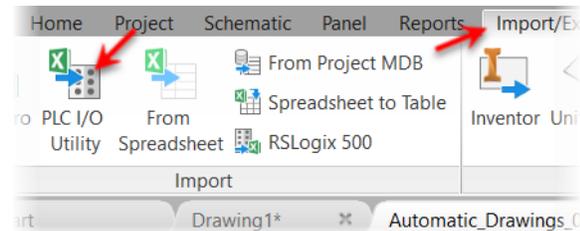
	A	B	C	D	E	F	G
1	CODE	R1S2	G3	ADDR	RTP	DESC1	
2	SS2PLC_20			Rung_01			
3				Rung_02			
4				Rung_03			
5				Rung_04			

This completes the exercise.

* Automatically Create 3 Phase Ladder Style Drawings

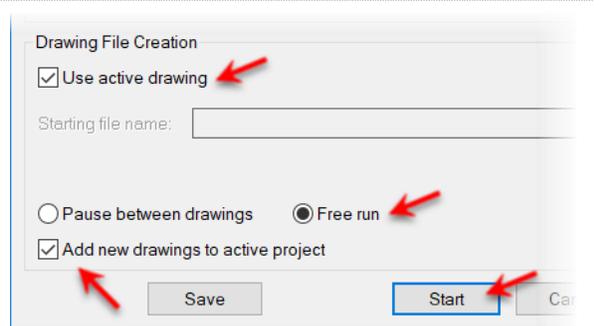
In this demonstration, you create three drawings using the standard spreadsheet and settings file supplied with AutoCAD Electrical as an example. The standard files were just renamed to match the rest of the SS2PLC files. Then you compare the values in the spreadsheet with the drawings that were created.

1. Expand the Schematic Ladder sub-folder.
2. Open 3Phase_Ladder_30.dwg.
3. On the Import/Export Data tab, Import panel, click PLC I/O Utility.



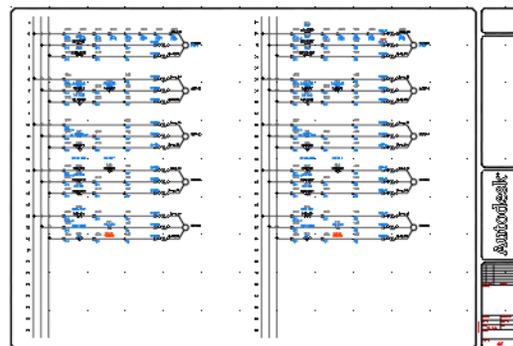
4. In the Select PLC I/O Spreadsheet dialog box, select SS2PLC_3PH_075.xls. Click Open.
5. In the Spreadsheet to PLC I/O Utility dialog box, for Settings, click Browse.
6. In the Read Settings From dialog box, select SS2PLC_3PH_075.wdi. Click Open.

7. In the Spreadsheet to PLC I/O Utility dialog box, for Drawing File Creation, select Use Active Drawing.
8. Select Free Run.
9. Select Add New Drawings to Active Project.
10. Click Start.

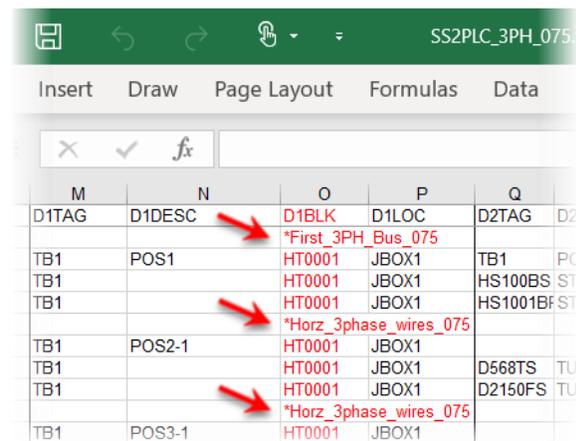


One three phase drawing is automatically created that Do Not include any PLC modules.

11. After drawings are created, on the Quick Access toolbar, click Qsave.



12. On the Import/Export Data tab, Import panel, click PLC I/O Utility.
13. In the Select PLC I/O Spreadsheet dialog box, right-click SS2PLC_3PH_075.xls.
14. Click Open With...
15. Select Excel. Click OK.
16. The SS2PLC_20 PLC module is used, the same as the Single Phase setup, but also notice the insertion of the circuits for 3 Phase in Column O, Rows 2, 6, 10, and so on.
17. Close SS2PLC_3PH_075.xls.



M	N	O	P	Q	D2
D1TAG	D1DESC	D1BLK	D1LOC	D2TAG	D2DESC
TB1	POS1	*First_3PH_Bus_075	JBOX1	TB1	PC
TB1		HT0001	JBOX1	HS100BS	ST
TB1		HT0001	JBOX1	HS1001BF	ST
TB1	POS2-1	*Horz_3phase_wires_075	JBOX1		
TB1		HT0001	JBOX1	D568TS	TU
TB1		HT0001	JBOX1	D2150FS	TU
TB1	POS3-1	*Horz_3phase_wires_075	JBOX1		
TB1		HT0001	JBOX1		

This completes the exercise.