



Solid Edge Wire Harness Design

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UGS Transforming the process of innovation





Agenda



- ▶ Target markets / customers
- ▶ General process
- ▶ Command set
- ▶ Open Platform
- ▶ Workflow overview
- ▶ Creating Net List files from Excel
- ▶ Solid Edge Wire Harness Highlights
- ▶ Demonstration



Targets



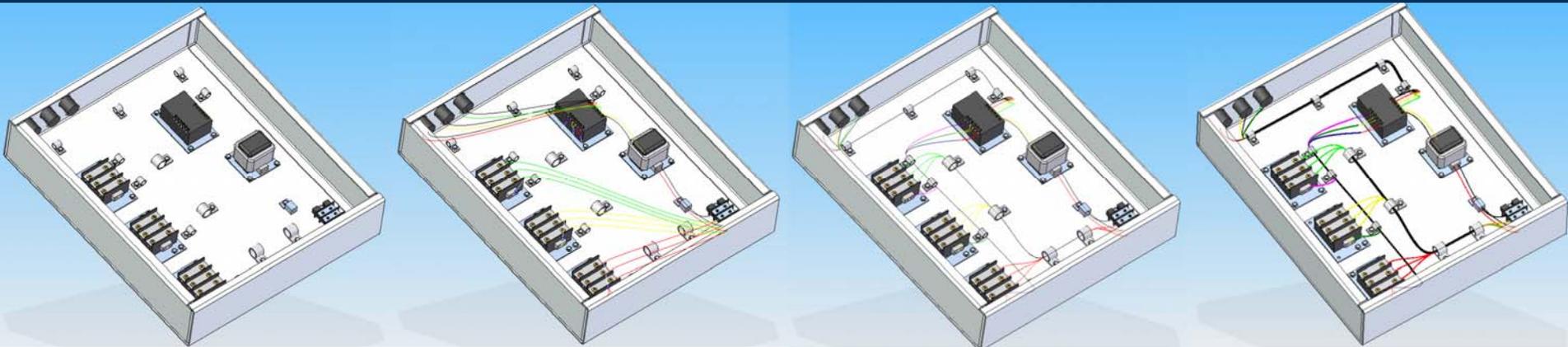
- ▶ Solid Edge Wire Harness Design is targeted at
 - ▶ A design process where the 2D electrical schematic is developed first, and the 3D model is derived from that
 - ▶ A design process where there is no 2D schematic or is not used in conjunction with the 3D model
 - ▶ No specific industry is targeted, any assembly where electric conductors are needed is fair game
 - ▶ No limits on the number of conductors
 - ▶ Designed for round conductors only, not ribbon cables



The General Process



- ▶ Two Classic workflows
 - ▶ Automatic
 - ▶ Starts from a 2D electrical schematic
 - ▶ Import of “net list” files to generate 3D straight line connections
 - ▶ Routing and organization of wires
 - ▶ Solid creation
 - ▶ Drawings, reports, export back to ECAD for manufacturing



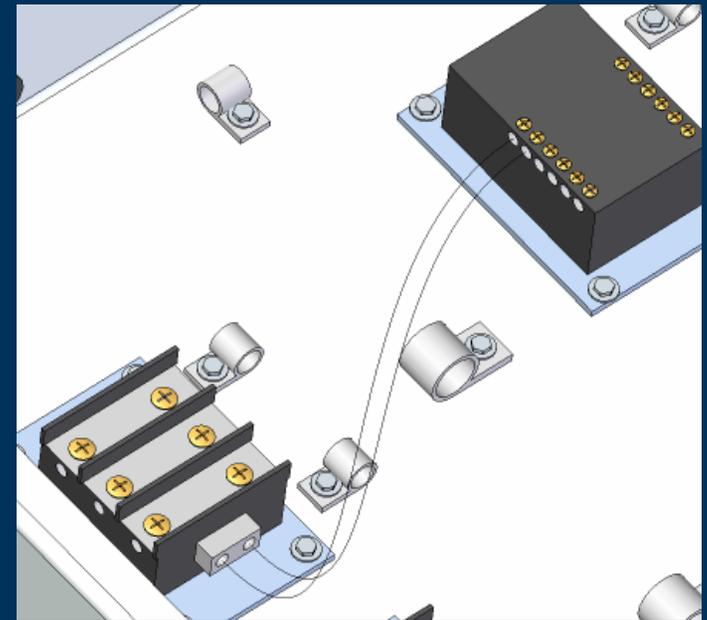


The General Process



- ▶ Manual
 - ▶ User creation of paths/wires
 - ▶ Routing and organization of wires
 - ▶ Export back to electrical system for manufacturing

 Solid Edge Wire
Harness Supports Both

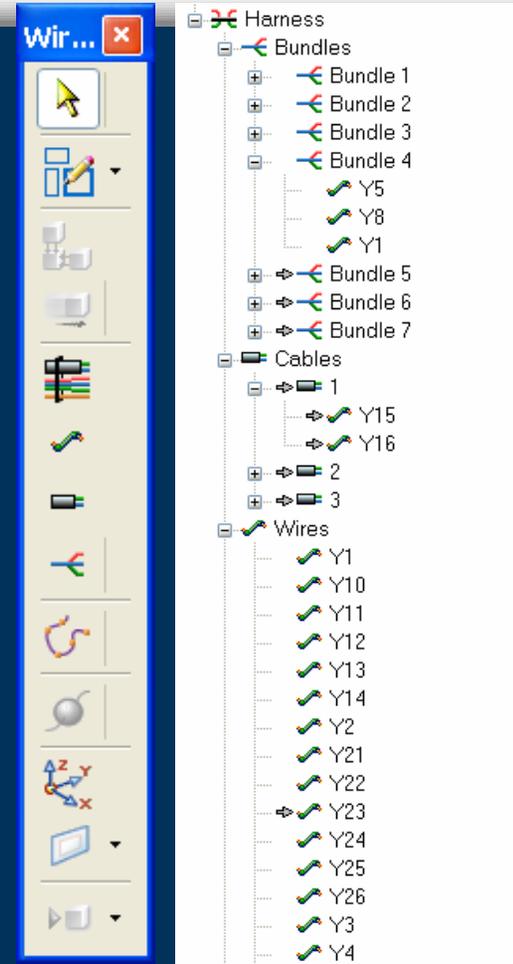




Solid Edge Command Set



- ▶ Dedicated environment
 - ▶ License controlled
 - ▶ Assembly centric
- ▶ Harness Wizard
- ▶ Dedicated wire creation
- ▶ Dedicated cable creation
- ▶ Dedicated bundle
- ▶ Dedicated 3D path creation
- ▶ BlueDots for path connection
- ▶ Assembly commands for placing and positioning
- ▶ Geometry reference tools
- ▶ Organized tree for harness management
- ▶ Wire Harness reports and export tools for manufacturing

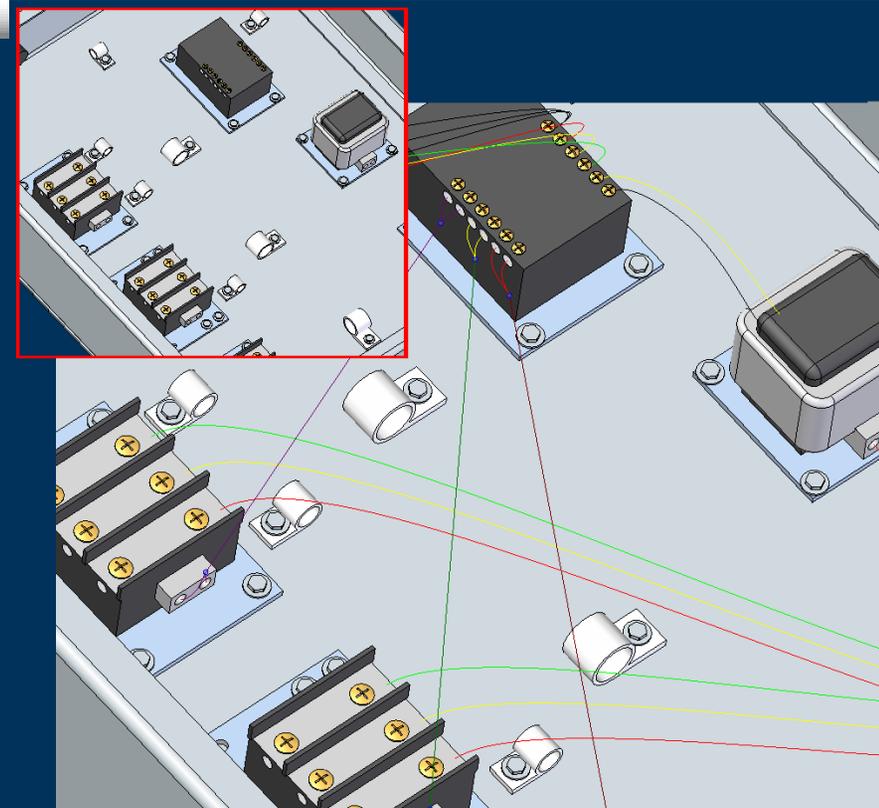




Harness Wizard (Automatic rats nest)



- ▶ Import ready-to-use net list files from
 - ▶ Cimteam Vesys, Promis-e, Zuken
 - ▶ Others being considered
 - ▶ Expandable to read ANY net list file (minimal data needed)
- ▶ Automatically adds missing components as listed in the net list file
- ▶ Users can re-assign occurrences (light:1 to light:2)
- ▶ Automatic tangency on from / to connections
- ▶ Dedicated commands in Part for component attributing—can be done on the fly.
- ▶ Preview capability
- ▶ Created straight line connections can be directly edited—no data recreation



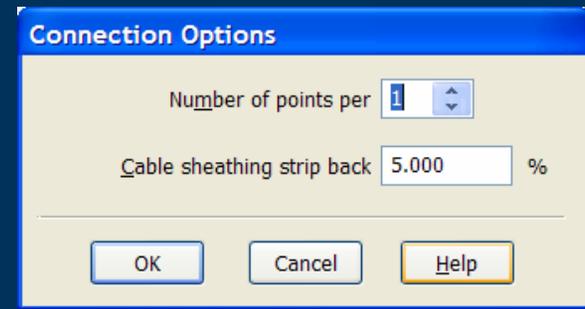
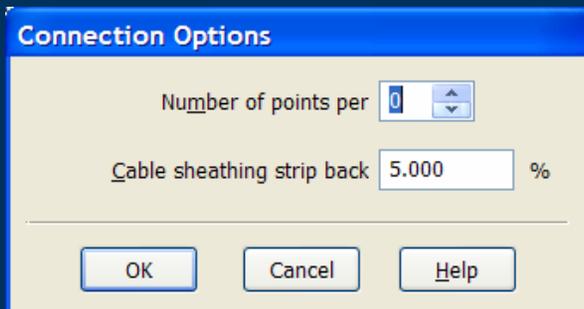
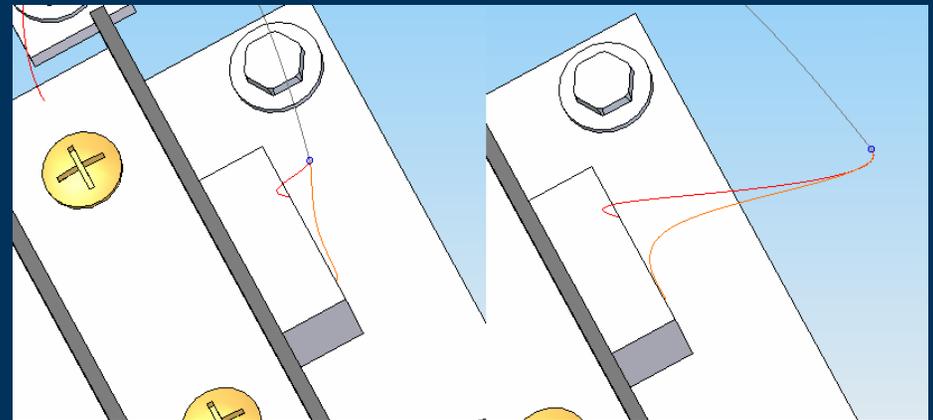
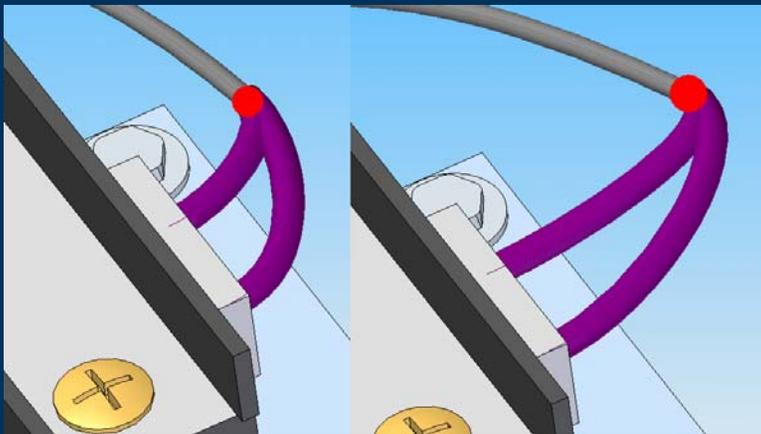


Harness Wizard (Automatic rats nest)



Tip

Set the edit points to 0 for super simple curve, easier to edit initially, and edit points can always be added later for refining the shape of the curve





Wire Creation



- ▶ Choose an existing path or create one
- ▶ All wires include a minimum bend radius, color, linear density, and many other popular attributes
- ▶ Wires created automatically can be modified
- ▶ Wire attributes include the most common solid or stranded wires
- ▶ Edit Path / Edit Definition
- ▶ Slack compensation

Properties - Y23

Material: 24-gage Stranded Copper Black

Property Name	Value
Description	24-gage Stra...
Diameter	0.51 mm
Gage	24
Outer Diameter	1.33 mm
Part Number	
Type	Stranded
Material	Copper
Linear Density	0.0 lbm/ft
Minimum Radius	0.51 mm
Color	Black
From Component	200142
From Terminal	c
To Component	200523

Pre-Defined Properties

Use default values*

Slack: 5.000 %

Added length: 5.00 mm

Clearance through holes: 20.000 %

Clearance through bundles: 10.000 %

*Default values can be set from Tools > Options

Computed Properties

True length: 298.83 mm

Cut length: 318.77 mm

Mass: 0.001 kg

Custom...

OK Cancel Help

Ribbon Bar

Return

Cancel

Select: Single

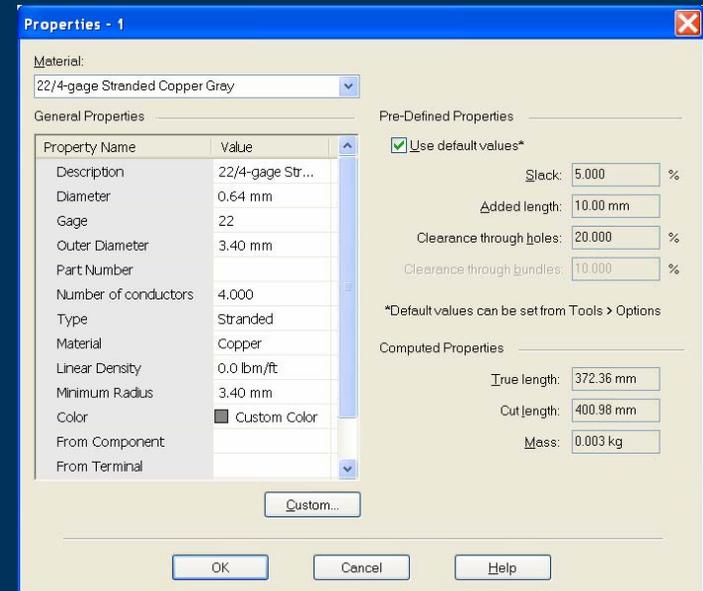
OK Cancel Help



Cable Creation



- ▶ Choose existing wires, or create a simplified cable
- ▶ All cables include a minimum bend radius, color, linear density, and many other popular attributes
- ▶ Cables created automatically can be modified
- ▶ Cable attributes include several multi-conductor cables
- ▶ Edit Path / Edit Definition
- ▶ Slack compensation

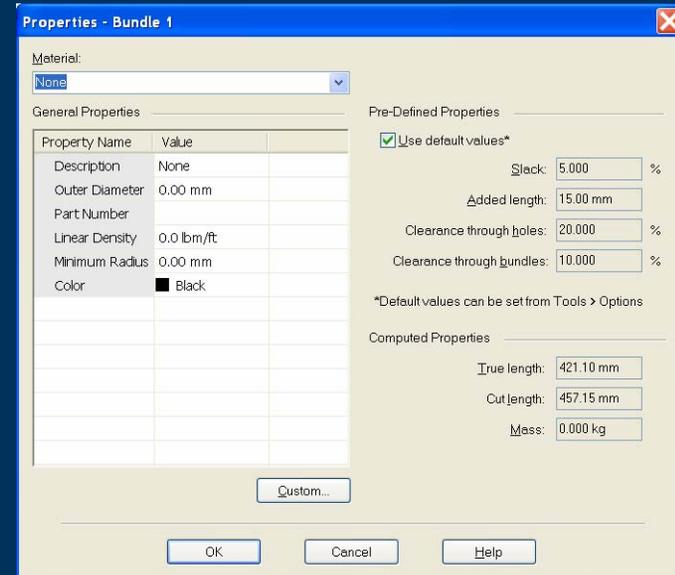




Bundle Creation



- ▶ Bundle cables, wires, even other bundles for easy routing
- ▶ All bundles include a minimum bend radius, color, linear density, and many other popular attributes
- ▶ Bundle attributes include some common plastic and metal casings. “None” can be used for cable tie simulation
- ▶ Edit Path / Edit Definition
- ▶ Slack compensation



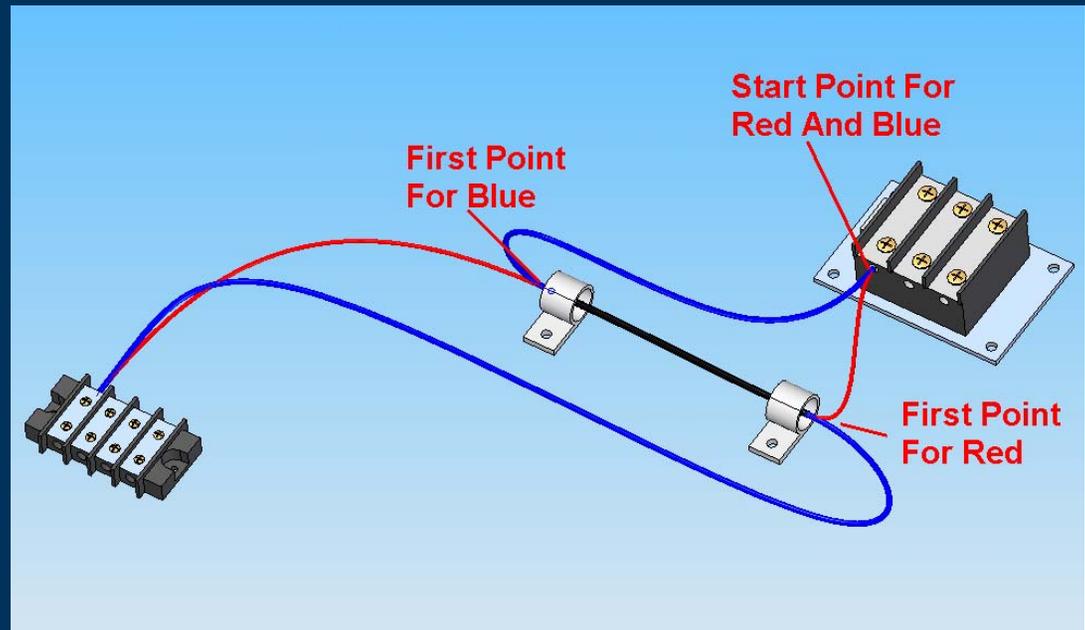


Direction Control



Tip

- ▶ Control the direction of a route (Bundle) by selecting the “start” points of:
 - ▶ Start of the Wire/Cable/Bundle
 - ▶ Start of the route point





Conductor Table



Tip

- ▶ SEConductors.txt file lists some common Wires, Cables, Bundles
- ▶ Modify the table to include your standards, sizes and colors

```

SEConductors.txt - Notepad
File Edit Format View Help

// Solid Edge SEConductors.txt file.
// The contents of this file are used by Solid Edge Wire Harness Design
// and lists the wires, cables, and bundles the user can choose.
// The location of this file is set by Tools | Options; File Locations.

// You can add, modify, or delete entries provided the following format is used:

// Description: conductor description as listed in the interface
// wireDia: conductor diameter in meters and with a "." as the decimal separator
// Gage: name or other to identify the conductor size (Solid Edge will choose by gage over wireDia)
// PartNumber: user defined field representing raw material or spool number for the conductor
// OuterDia: outer diameter including insulation in meters and with a "." as the decimal separator
// NumOfConductors: lists the number of conductors in a cable
// Type: indicates conductor and can be any value
// Material: indicates conductor and can be any value
// MassPerUnitLength: lists the mass/length in kg/m and with a "." as the decimal separator
// MinBendRadius: lists the minimum bend radius in meters with a "." as the decimal separator.
// Color: indicates the color in long RGB value

// Localization requirements are that only comments, gage and description are to be localized.

// wires must be listed between BeginWires and EndWires
// cables must be listed between BeginCables and EndCables
// bundles must be listed between BeginBundles and EndBundles

// The decimal delimiter must be the "." character.
// The separator between various fields must be a semi colon ";"
// All lines starting with "//" are ignored

// Description; WireDia; OuterDia; NumOfConductors; Type; Material;
// MassPerUnitLength; MinBendRadius; Color

BeginWires
10-gage Solid Copper Red; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 255
10-gage Solid Copper Orange; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 33023
10-gage Solid Copper Yellow; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 65535
10-gage Solid Copper Green; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 65280
10-gage Solid Copper Blue; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 16711680
10-gage Solid Copper Dk Blue; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 8388608
10-gage Solid Copper Dk Magenta; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 8388736
10-gage Solid Copper Black; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 0
10-gage Solid Copper White; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 16777215
10-gage Solid Copper Gray; 0.00259; 10; ; 0.00341; ; Solid; Copper; 0.04713; 0.00259; 8421504
  
```

Properties - Cable (Contactor 1)

Material:

- 10/2-gage Solid Copper White
- 10/2-gage Stranded Copper Gray
- 10/3-gage Solid Copper White
- 10/3-gage Stranded Copper Gray
- 12/2-gage Solid Copper White
- 12/2-gage Stranded Copper Gray
- 12/3-gage Solid Copper White
- 12/3-gage Stranded Copper Gray
- 14/2-gage Solid Copper White
- 14/2-gage Stranded Copper Gray
- 14/3-gage Solid Copper White
- 14/3-gage Stranded Copper Gray
- 22/11-gage Solid Copper White
- 22/11-gage Stranded Copper Gray
- 22/15-gage Solid Copper White
- 22/15-gage Stranded Copper Gray
- 22/2-gage Solid Copper White
- 22/2-gage Stranded Copper Gray
- 22/4-gage Solid Copper White
- 22/4-gage Stranded Copper Gray
- 22/6-gage Solid Copper White
- 22/6-gage Stranded Copper Gray
- 22/8-gage Solid Copper White
- 22/8-gage Stranded Copper Gray
- 22/9-gage Solid Copper White
- 22/9-gage Stranded Copper Gray
- 24/11-gage Solid Copper White
- 24/11-gage Stranded Copper Gray
- 24/15-gage Solid Copper White
- 24/15-gage Stranded Copper Gray

Pre-Defined Properties

- Use default values*
- Slack: 5.000 %
- Added length: 10.00 mm
- Clearance through holes: 20.000 %
- Clearance through bundles: 10.000 %

*Default values can be set from Tools > Options

Computed Properties

- True length: 376.71 mm
- Cut length: 405.54 mm
- Mass: 0.003 kg

The length of this cable is being computed from

Y20

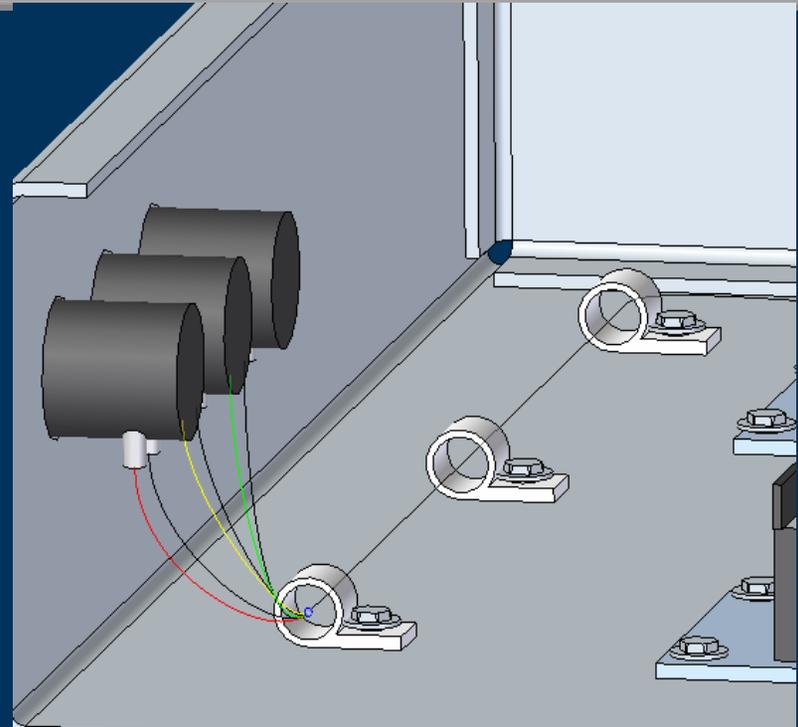
Cancel Help



3D Path Creation



- ▶ Wires, cables, bundles are based on a Path
- ▶ Paths can use
 - ▶ Key Points
 - ▶ Points in space
- ▶  Cylinder axis
- ▶  Dynamically edit points and adjust tangent magnitudes for quick live changes
- ▶ Alt + Click to add/remove points for quick routing
- ▶ Use the familiar Orient XPress to control free space edits



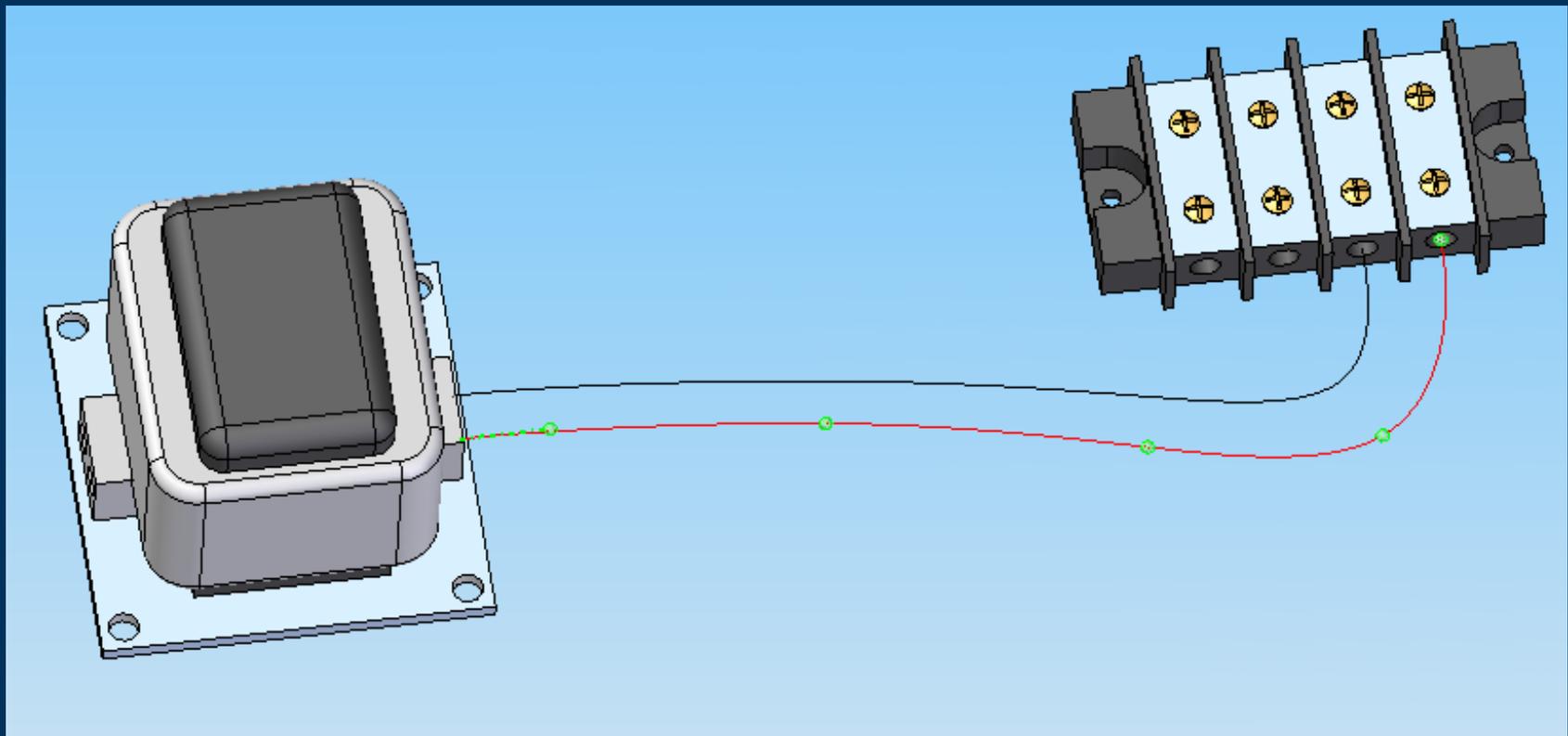


3D Path Editing



Tip

- ▶ Make edits to the shape of a wire/cable/bundle by double clicking it from the graphic (even other paths)
- ▶ Paths locate and select first!

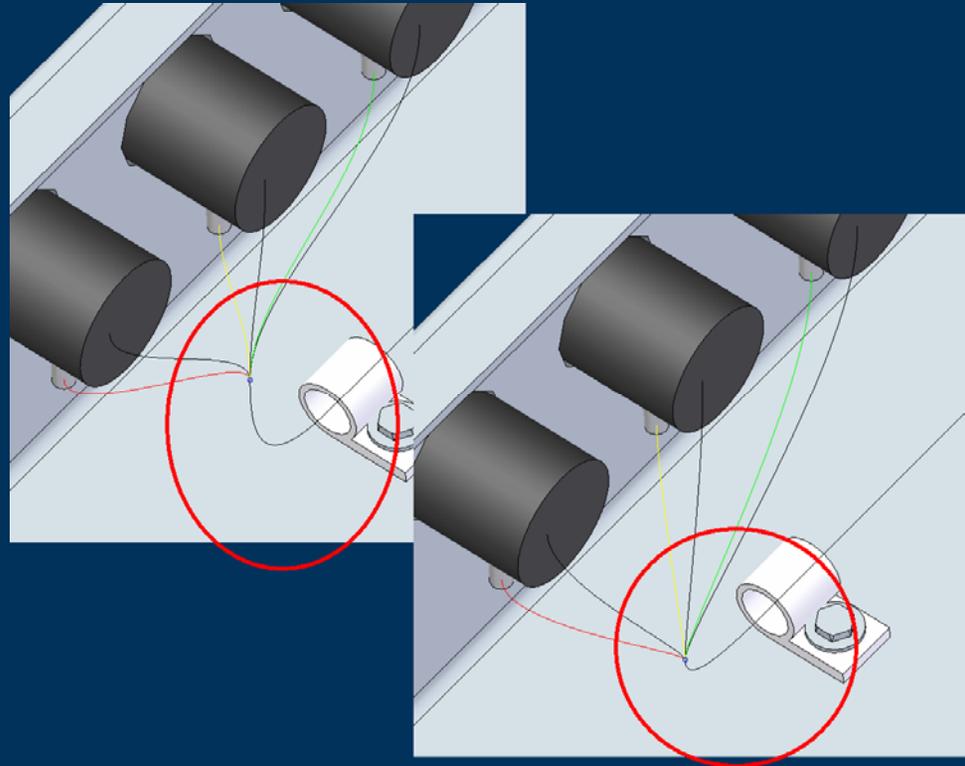




BlueDot Connectivity



- ★ Patent Pending technology for path connectivity
 - ▶ Edits to curve position is order-free
 - ▶ Familiar Orient XPress to control free space edits
 - ▶ Locate order will find BlueDots first for super quick edits
 - ▶ Patented Dynamic Edit will update paths in real-time
 - ▶ While editing, jump from BlueDot to BlueDot for fast editing

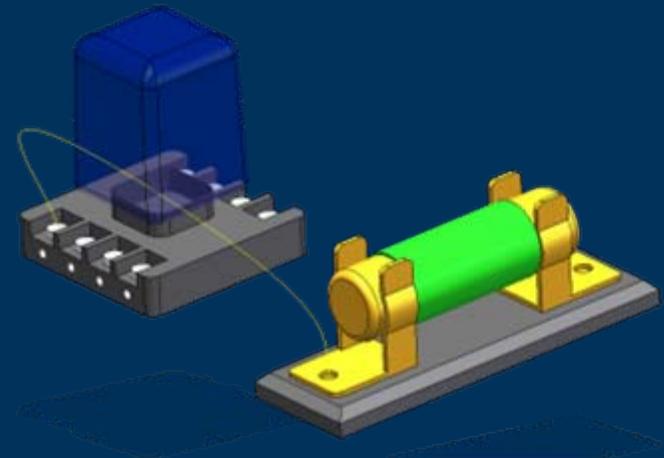
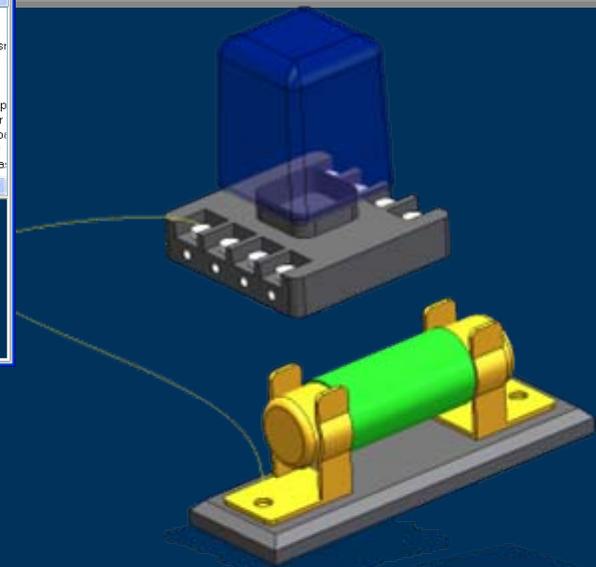
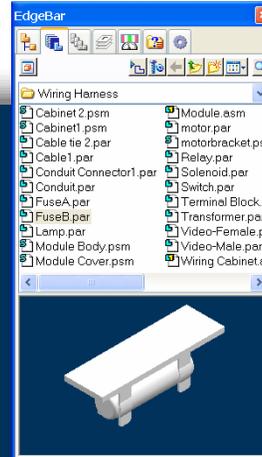




Assembly Commands Available



- ▶ Parts Library is available for adding last-minute components
- ▶ Assemble and Move are available for positioning
- ★ Connected conductors update automatically after each move
- ▶ The Harness Wizard will add missing components automatically

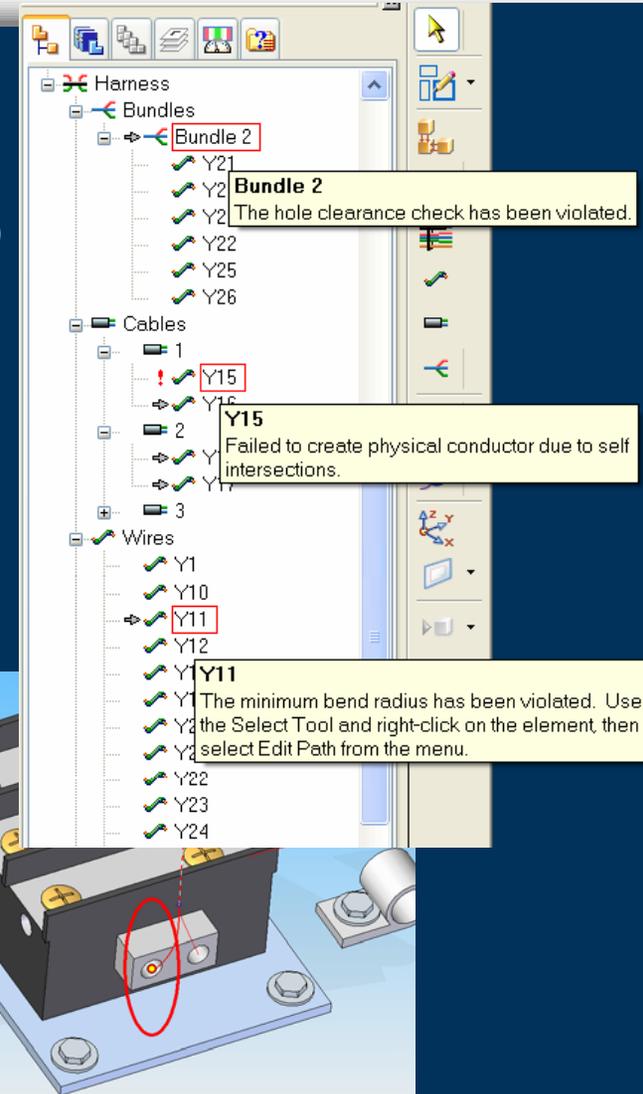




Complete Error And Warning System



- ▶ EdgeBar Icons and messages for warnings
 - ▶ Minimum bend violations
 - ▶ Hole clearance violations (even without a solid)
 - ▶ Bundle clearance violations (even without a solid)
 - ▶ User can set a required clearances globally or on each conductor
 - ▶ Users can set the minimum bend radius in the conductor library as well as individual override
- ▶ EdgeBar Icons and messages for Failures
 - ▶ Failed path creation
 - ▶ Failed Physical Conductor creation
- ▶ Graphic Icon
 - ▶ Minimum bend violation

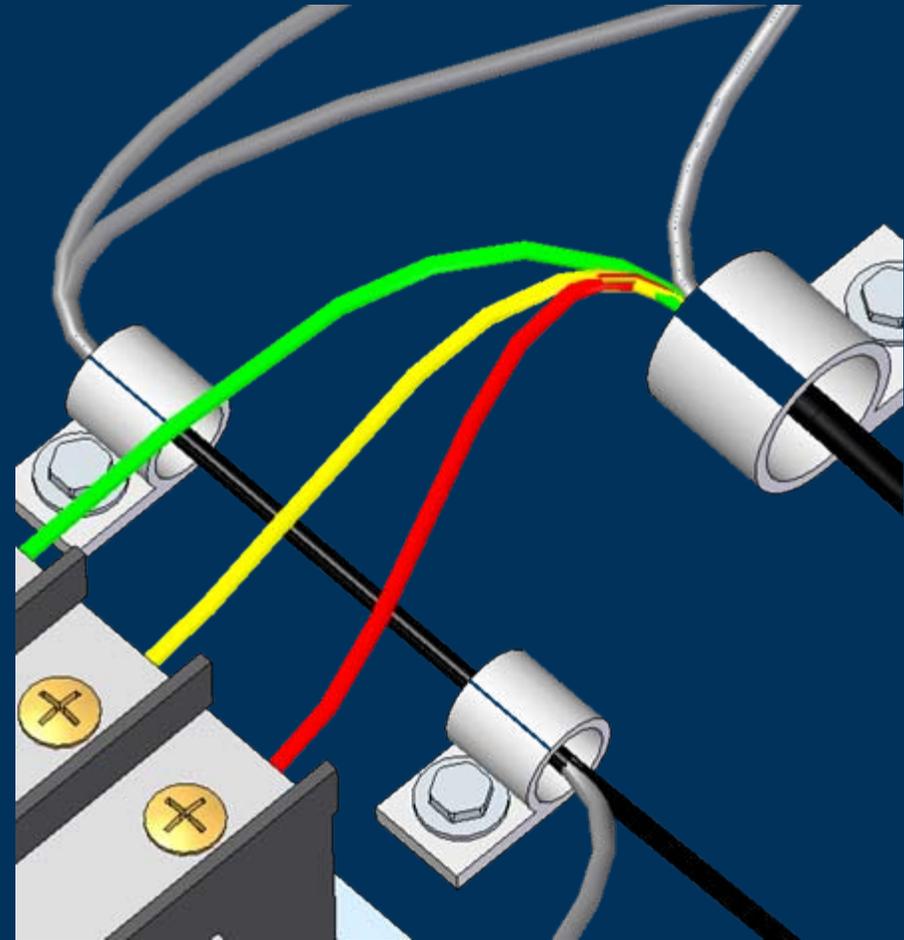




Physical Conductor Creation



- ★ Users can create the solid body “Physical Conductor” when appropriate
 - ▶ Creating the body last improves design performance during harness development
 - ▶ On a per wire/cable/bundle need
- ▶ Automatic update is used to keep the model up to date





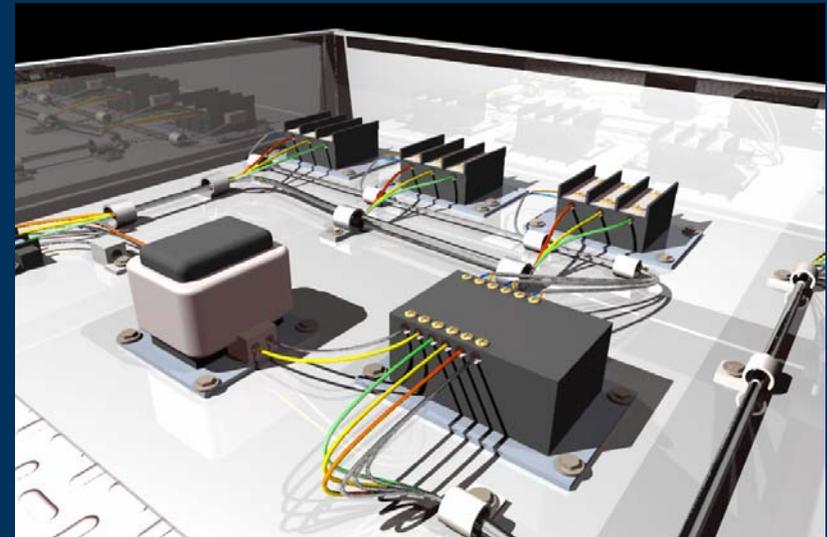
Physical Conductor Creation



Tip

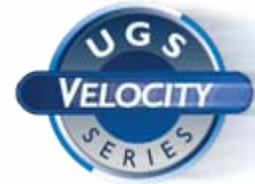
Create a Physical Conductor only when

- ▶ a rendering is needed
- ▶ a detailed drawing is needed
- ▶ Physical Properties are needed
- ▶ Interference between conductors and other parts

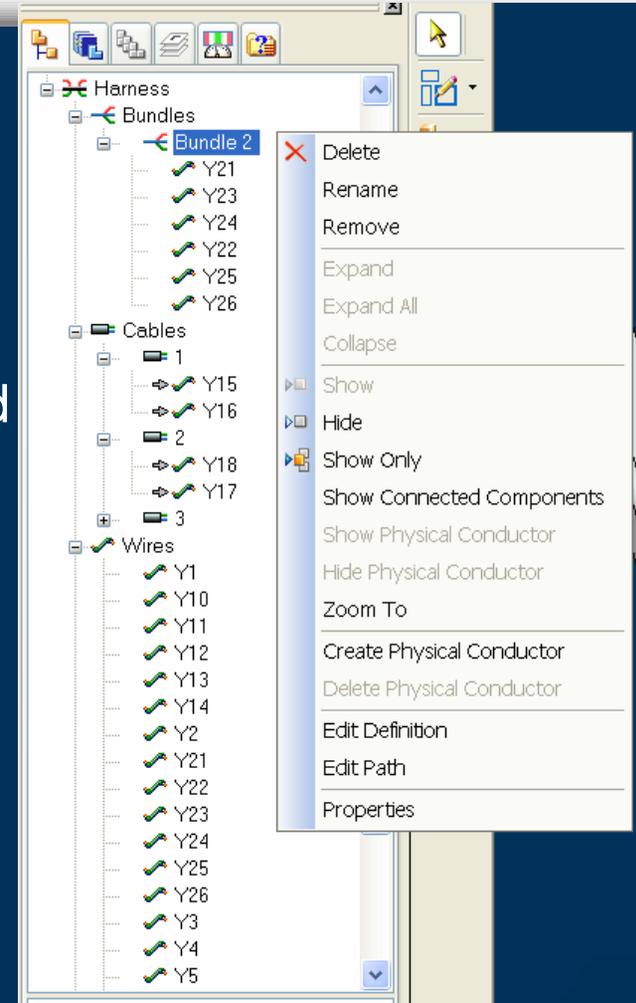




Organized Tree Structure



- ▶ Dedicate placeholder in the Assembly Pathfinder for
 - ▶ Bundles, Cables, Wires, Paths
- ▶ Wire Harness Objects
 - ▶ Show, Hide, Show only, Show Connected Components
 - ▶ Remove – preserves child objects
 - ▶ Delete - deletes
 - ▶ Independent show/hide for objects and Physical Conductors
- ▶ Occurrences
 - ▶ Show Connected Conductors (new)



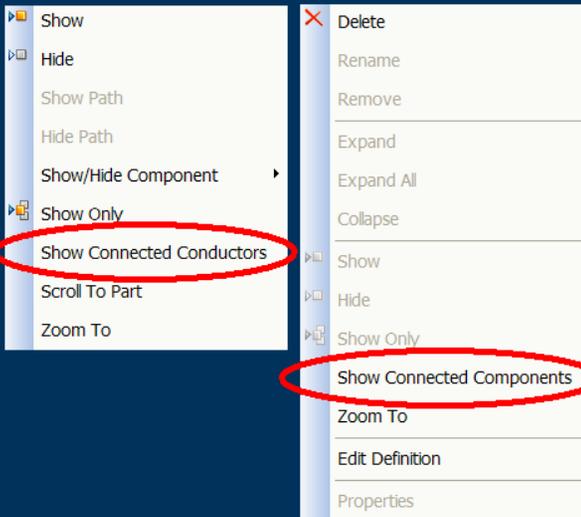
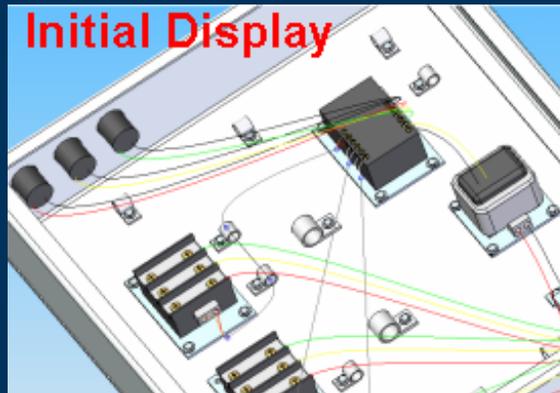
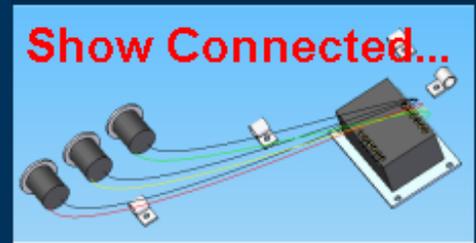


Display Tricks



▶ Make use of...

- ▶ Show Only
- ▶ Show Connected Conductors
- ▶ Show Connected Components





Suggested Assembly Structure



- ▶ Keep Separate Wire Harnesses in their own sub-assemblies
 - ▶ Key for tracking part numbers
 - ▶ Key for display management



Reports



▶ Harness Reports

▶ Bundles

▶ Cables

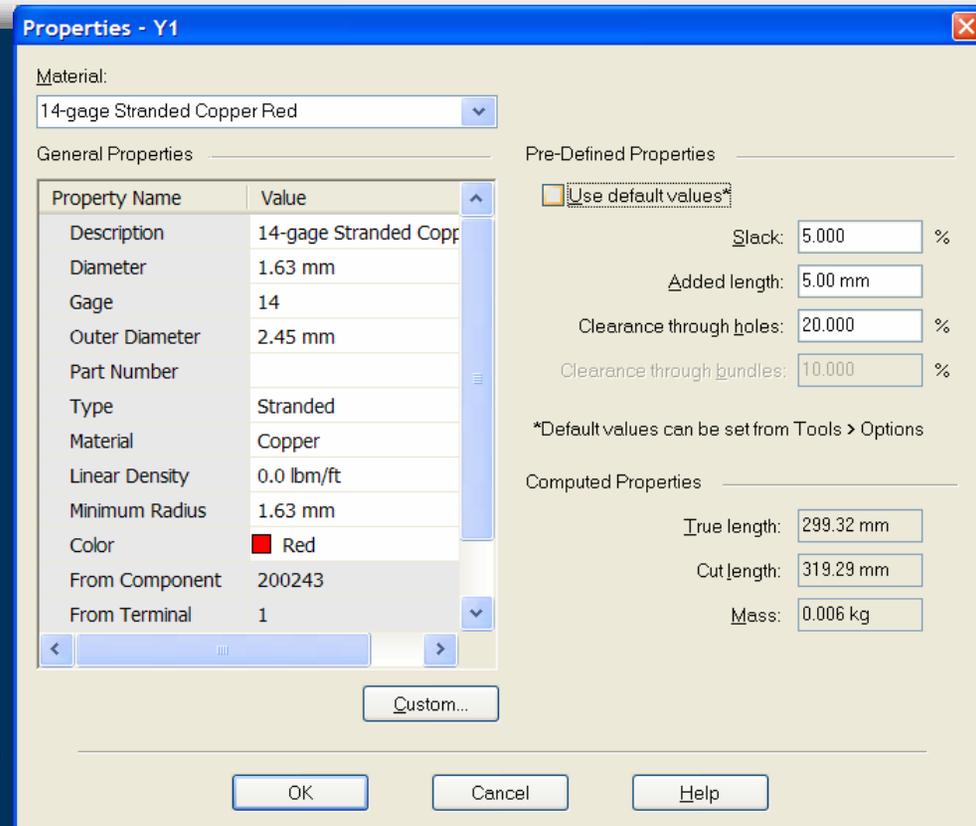
▶ Wires

▶ Cut lengths

▶ All attributes

 Quick Element reports
via properties

▶ Get a conductors cut length or mass without creating
a Physical Conductor



Properties - Y1

Material: 14-gage Stranded Copper Red

General Properties

Property Name	Value
Description	14-gage Stranded Copp
Diameter	1.63 mm
Gage	14
Outer Diameter	2.45 mm
Part Number	
Type	Stranded
Material	Copper
Linear Density	0.0 lbm/ft
Minimum Radius	1.63 mm
Color	Red
From Component	200243
From Terminal	1

Pre-Defined Properties

Use default values*

Slack: 5.000 %

Added length: 5.00 mm

Clearance through holes: 20.000 %

Clearance through bundles: 10.000 %

*Default values can be set from Tools > Options

Computed Properties

True length: 299.32 mm

Cut length: 319.29 mm

Mass: 0.006 kg

Buttons: Custom..., OK, Cancel, Help



Manufacturing Support



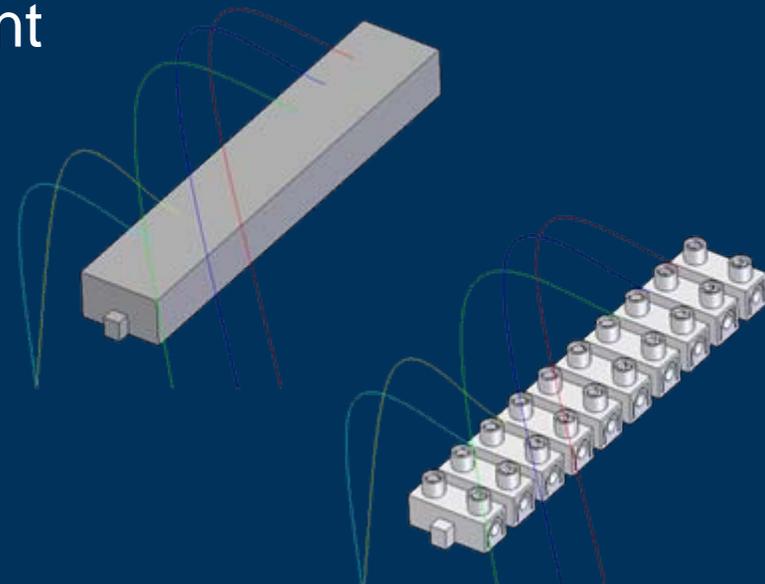
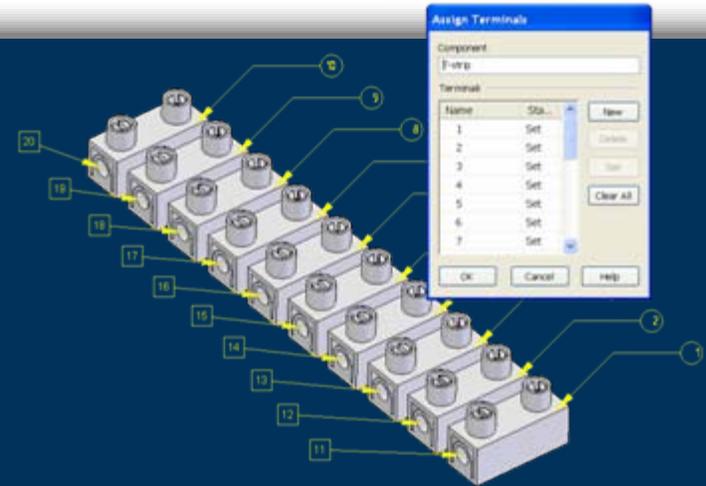
- ▶ Export to ready-to-use net list files for
 - ▶ Cimteam, Vesys, Promis-e, Zuken
 - ▶ Others being considered
- ▶ Expandable to export to ANY net list file provided columnar positions are known



Component and Terminal Attribution



- ▶ Attributing is essential for automatic straight line connections from a net list import, but is done once
- ▶ User can open each electrical component and assign pins (terminals) and the component name
- ★ Attributes can be applied to the Design Model, the Simplified Model for part and sheet metal

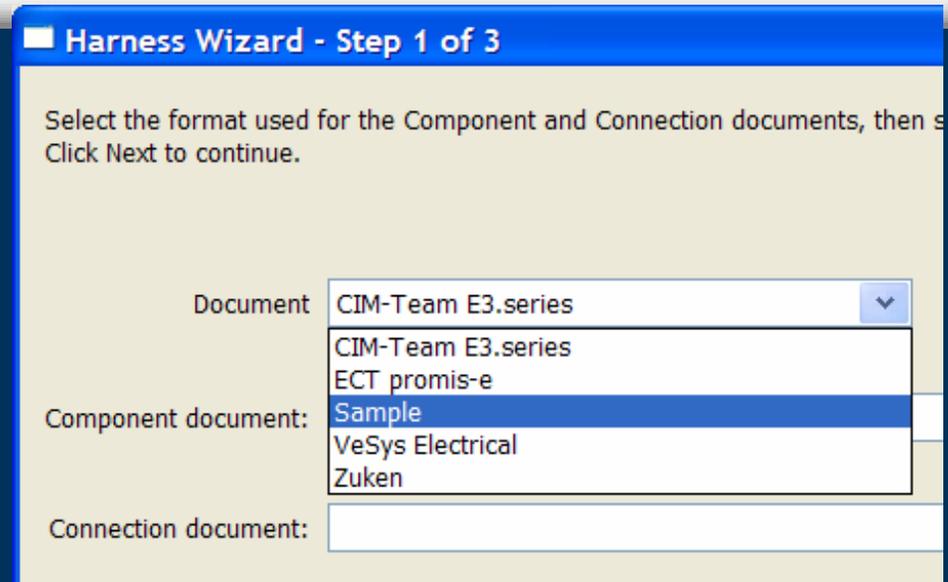




Open system



- ▶ Direct integration with:
 - ▶ Cimteam
 - ▶ ECT
 - ▶ Vesys
 - ▶ Zuken
 - ▶ Others being considered
- ▶ Configurable for any net list
- ▶ Wire library is easily expandable
- ▶ Public interface document for future integrations
- ▶ Works with Excel





Workflow #1



- ▶ Creation of a wire harness from a net list file
 - ▶ First attribute all required electrical components (one-time)
 - ▶ Generate the 2D electrical schematic with appropriate tools, export the net list file
 - ▶ Import the net list file in Solid Edge
 - ▶ Adjust the from/to for any instances
 - ▶ The wizard will create from/to connections automatically
 - ▶ Verify wire type assignment
 - ▶ Adjust the position of any automatically placed components
 - ▶ Bundle and route wires and cables as needed
 - ▶ Add any wires or cables that were not included in the net-list
 - ▶ Verify all conductors exceed the minimum bend radius, have the proper slack and cut back lengths
 - ▶ Create manufacturing reports and build a Solid if needed



Workflow #2



- ▶ Creation of a wire harness manually
 - ▶ Build the assembly with all required components (component placement can be done in the Wire Harness Environment)
 - ▶ Create Wires and or cables to suite the electrical needs
 - ▶ Bundle and route wires and cables as needed
 - ▶ Verify all conductors exceed the minimum bend radius, have the proper slack and cut back lengths
 - ▶ Create manufacturing reports and build a Solid if needed



Creating Net List Files With Excel



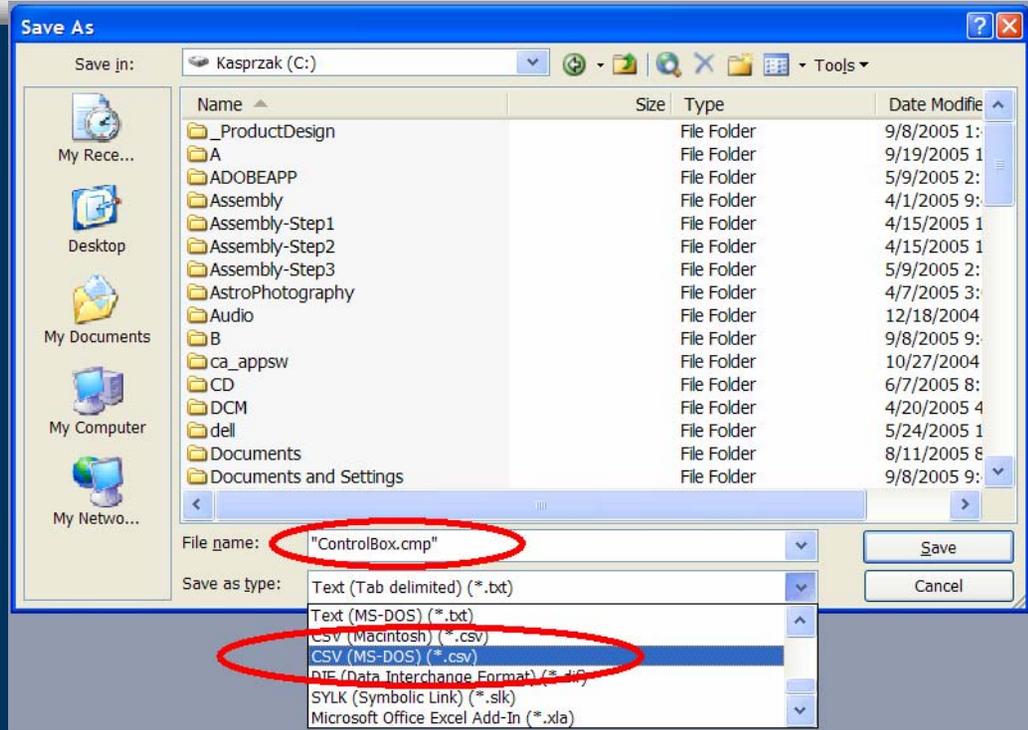
- ▶ Fast easy way to create automatic connections when no ECAD is available
 - ▶ Create schematic in Draft, Visio, PSP, etc
 - ▶ Create Net List in Excel
- ▶ Supply 2 CSV files
 - ▶ Component List
 - ▶ Connection List
 - ▶ Use “Sample” field lists
 - ▶ See SEHarness.txt
 - ▶ Save as DOS based CSV file



Creating Net List Files With Excel



- ▶ Component List
 - ▶ .CMP
- ▶ SEHarness.txt field lists
 - ▶ Components fields
 - ▶ ComponentID=1
 - ▶ ComponentName=2
 - ▶ ComponentDescription=3



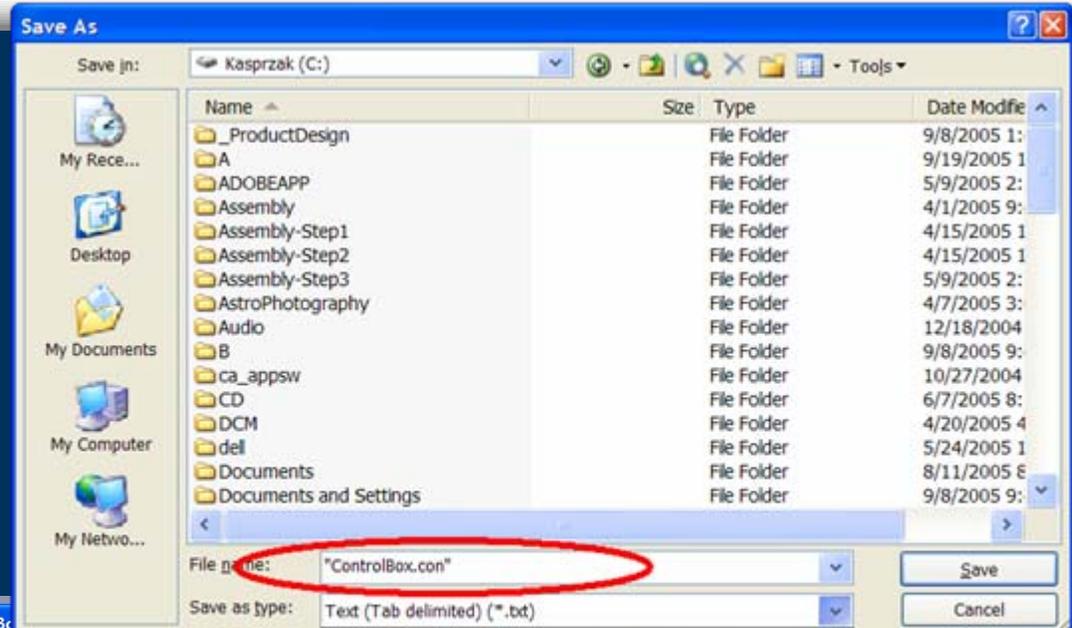
	A	B	C	D	E
1	x1	200243	4-Pole power block		
2	x2	200984	Transformer 120/24 50 VA		
3	x3	200142	step control module 3 step		
4	x4	200456	3-pole contactor 24 VAC		
5	x5	200456	3-pole contactor 24 VAC		
6	x6	200456	3-pole contactor 24 VAC		
7	x7	200623	Panel light 24VAC		
8	x8	200623	Panel light 24VAC		
9	x9	200623	Panel light 24VAC		
10	x10	200153	Ground lug		
11					



Creating Net List Files With Excel



- ▶ Connection List
 - ▶ .CON
- ▶ SEHarness.txt
 - ▶ WireID=1
 - ▶ FromComponentID=2
 - ▶ FromComponentTerminal=3
 - ▶ ToComponentID=4
 - ▶ ToComponentTerminal=5
 - ▶ CableID=6
 - ▶ WireDiameter=7
 - ▶ WireGage=8
 - ▶ WireColor=9
 - ▶ WireMaterial=10
 - ▶ WireType=11
 - ▶ WireDescription=12
 - ▶ CutLength=13



	A	B	C	D	E							L
1	Y1	X1	1	X4	1							L1 supply line C1
2	Y2	X1	1	X5	1							L1 supply line C2
3	Y3	X1	1	X6	1							L1 supply line C3
4												
5	Y5	X1	2	X4	2	0.00163	14	65535	Copper	stranded		L2 supply line C1
6	Y6	X1	2	X5	2	0.00163	14	65535	Copper	stranded		L2 supply line C2
7	Y7	X1	2	X6	2	0.00163	14	65535	Copper	stranded		L2 supply line C3
8												
9	Y8	X1	3	X4	3	0.00163	14	65280	Copper	stranded		L3 supply line C1
10	Y9	X1	3	X5	3	0.00163	14	65280	Copper	stranded		L3 supply line C2
11	Y10	X1	3	X6	3	0.00163	14	65280	Copper	stranded		L3 supply line C3
12												
13	Y4	X1	gx	x10	x	0.00163	14	0	Copper	stranded		Ground wire
14												
15	Y11	X1	1	X2	1	0.00102	18	255	Copper	stranded		Transformer supply x
16	Y12	X1	2	X2	2	0.00102	18	0	Copper	stranded		Transformer supply y
17	Y13	X2	x	X3	x	0.00102	18	65535	Copper	stranded		Control module supply



Solid Edge Wire Harness Highlights



- ▶ Automatic or manual from / to connectivity
- ▶ Super easy bundling and routing
- ▶ Smart paths through cylinders and automatic tangency
- ▶ Patented (pending) BlueDot technology for path connectivity
- ▶ Patented (pending) Dynamic Edit for real time feedback of path edits
- ▶ Automatic path color based on conductor type
- ▶ Graphical identification of minimum bend violations
- ▶ Display management tools for show, hide, show only, show connecting components
- ▶ Complete harness design with no solid geometry (work in 3D wire frame)
 - ▶ Interference check for conductors and bundles—with no solid body
 - ▶ Harness mass—with no solid body
 - ▶ Work in 3D wire for improved performance
- ▶ Quick edit tools Edit definition, edit path, detach, delete
- ▶ Cut lengths can accommodate additional lengths for slack and strip backs



Demonstration



- ▶ Automatic wire harness generation
- ▶ Bundling
- ▶ Display management
- ▶ Edit conductor attributes
- ▶ Edit Parts position
- ▶ Component attributing
- ▶ Physical Conductor Creation
- ▶ Reports

