

NX electrical and mechanical routing

Accelerating design of electrical and mechanical routed systems in complex assemblies

fact sheet

Siemens PLM Software

www.siemens.com/nx

► Summary

NX™ digital product development solutions include an integrated suite of tools that facilitate the entire design process for routed systems, including wire harnesses, cables, piping, tubing, conduit and raceways. These process-specific tools reduce detailed design time, improve product quality and transfer product information seamlessly between the logical design, physical design, analysis, manufacturing and service sectors.

Benefits

Re-uses logical design – eliminates redundant data creation

Predicts accurate wire lengths for early analysis

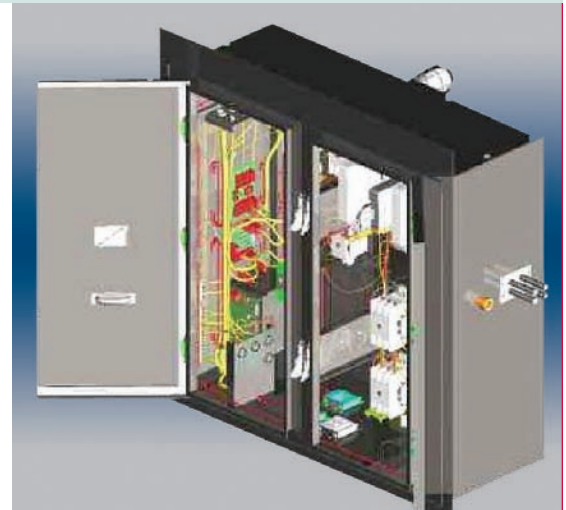
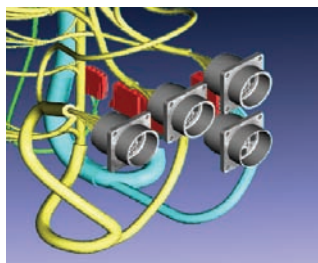
Predicts accurate bundle diameters for interference checking and space allocation

Improves quality by enforcing design standards and verifying complete connections

Eliminates physical prototypes and rework – your harnesses fit the first time

NX electrical routing

NX includes a fully integrated 3D electrical harness routing application that allows users to design and route harnesses in complex assemblies. Built upon the NX routing applications architecture, the electrical routing tools provide electrically smart features and functions to automate the design, modification and analysis of wire harnesses. This powerful capability imposes no limits on the number of components or wires in a design and includes a complete set of robust interfaces to electrical design technology providers. NX electrical routing enables integration with all electrical disciplines including system design, logical design, PCB design, physical design, electrical analysis, manufacturing, installation, service documentation and service delivery.



Speed to production by eliminating prototypes

The powerful design and manufacturing capabilities available in NX electrical routing enable users to produce a wire harness directly from NX product assembly models. The need to build a physical prototype before producing the wire harnesses is eliminated, significantly reducing product development time.

Features

Provides a flexible interface to logical connectivity data

Connection and component creation wizard

ASCII format, XML and PLMXML Netlist support

Supports rapid path creation between components

Includes automatic wire routing between components with length determination

Calculates wire bundle diameters

Enables interference checking in the assembly

Produces manufacturing documentation

Analyzes built-in and customer specified design rules

Allows easy access to libraries of connectors, devices and other support hardware

Automates the entire design, analysis and manufacturing process

Intended to leverage connection information provided by logical design, NX offers tools to manage wire lists as they are imported into the 3D assembly and are exported back to the logical design system. For example, a list of wires and the connections they make is imported to NX electrical routing, which then determines the lengths of the wires. The list is updated with wire lengths and may then be exported, in the same format or a different format, to a circuit analysis package.

Automatic creation of smart 3D manufacturing models

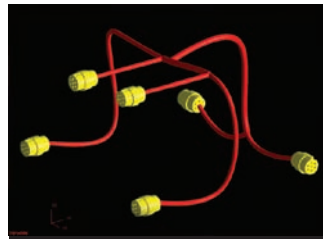
NX electrical routing goes beyond just flattening a harness – it generates a full assembly, with all electrical connectivity information intact. The result is identical to the 3D assembly, but is laid out on a single plane. Also included is the advanced capability of maintaining the relative position of each connector to the bundle as the harness is flattened.

NX electrical routing reduces system development time by creating virtual prototypes of electrical wire harnesses within complex product assemblies, such as this power distribution module.

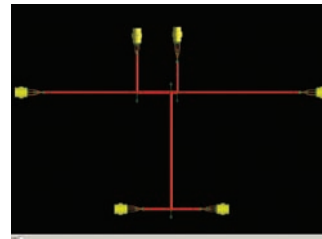
Not only does Routing Electrical generate a 2D formboard drawing but it also takes the unique approach of creating a smart 3D manufacturing model.



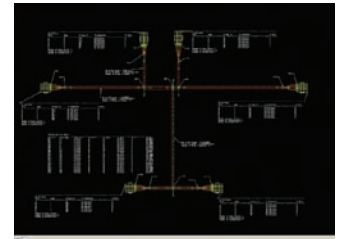
NX electrical routing reduces system development time by creating virtual prototypes of electrical wire harnesses within complex product assemblies, such as this power distribution module.



Step 1 – 3D Harness.



Step 2 – Flattened Harness remains a smart 3D assembly.



Step 3 – Formboard Drawing.

NX electrical routing provides the connection list management, standard parts support, path creation, wire routing capabilities, design rules and manufacturing instructions that deliver a complete system for design of electrical wiring harnesses.

Driven by logical design

NX electrical routing integrates logical connectivity data, electrical wire information and component properties with physical harness geometry to capture the full definition of the electrical wire harness design. NX accepts logical connectivity data from a variety of sources, including schematic capture applications like NX Schematics, CIM-Team E3 Series and Mentor Graphics' LCable and CHS tool suites. This flexibility allows the user to tailor NX electrical routing to the organization's electrical design processes and tools.

NX electrical routing adds electrical content on the fly with a Connection and Component List wizard. The wizard supports interactive creation and editing of connection and/or component list records. From/to information, stock properties and part placement may all be specified from within the wizard.

Connection and component list management

The PLM XML netlist feature in NX electrical routing enables import and export of PLM XML files containing route list information, accommodating ECAD data that complies with the NX schema definition for electrical data. This format is utilized within the Mechatronics framework of Teamcenter® 2005+ software.

NX electrical routing also features a basic (native only) XML netlist that includes wire, cable, space reservation, logical connection and component information. This feature provides the following functionality in addition to the extension of standard netlist:

- Enhanced route list navigator to display the connections in an hierarchical fashion
- Interactive creation/deletion/modification of connections through a wizard interface
- Definition and modification of wire and cable properties
- Manual assignment of wires/cables to the logical connections
- Cable support and cable length calculations
- Modeling of splice, shields, stowed wires and dressings (overstock)
- Topology information is exportable and can be utilized to create manufacturing reports and diagrams
- Embedded format and filter information can be in the XML netlist
- Flexible import formats with minimal data required during the conceptual design stage
- User-friendly display and reporting on components and connections
- All information stored as objects within the virtual prototype
- Adaptable to a wide variety of processes from the initial concept to detailed logical design
- Information needed to back annotate the logical design automatically created so a more complete analysis can be performed

Part definition, selection and placement

- Built-in capability for specifying the electrical and connectivity intelligence associated with connectors and devices. Port-to-port connections allows parts to snap into place.
- Libraries of customizable, parameterized standard connectors, devices, clips and clamps quickly defined and selected
- Automatic assignment of reference designators to components

Routing

- Specialized tools for path creation between components in crowded assemblies with full associativity
- Automatic creation of wire bundles and automatic calculation of wire length and bundle diameters
- User control of object blanking based on connectivity and option content

Design rules

- Reflecting the knowledge-driven approach of NX, design rules check and enforce standard practices to reduce production costs and assembly defects. Rules can be checked during design, on demand or in a batch for extensive analysis.
- NX is pre-loaded with extendible design rules to ensure that wire harnesses follow company design standards. Customers can add custom design rules.
- Violations – which are stored with the assembly – notify the user of problems
- Violations may be reviewed and corrected at any time
- Current out-of-the-box design rules are integrated into NX Check-Mate validation tools; new rules can be added

Output to manufacturing

- NX readily generates output needed to communicate the harness design to a manufacturing facility. The output is a flattened model accompanied by various reports and Bill of Materials (BOM).
- Flattened 3D model retains electrical intelligence in a true assembly structure
- Additional components such as tie wraps, clips and grommets may be added to either the 3D or the flattened model
- Flattened model may be used as reference for full 3D jig design
- Connectors may be clocked to maintain the correct relative positioning between the 3D model and the flattened model
- Easily produces a one-to-one or scaled formboard drawing

Focused on completion of routing tasks

NX electrical routing aims at completing routing tasks in the shortest time – placing components, routing all interconnecting wires and ensuring paths avoid other equipment.

NX electrical routing helps designers create and verify wire routing and connectivity to components. It automatically connects components as defined by the netlist, calculates wire lengths and wire bundle diameters, identifies minimum bend radius violations and produces site-specific manufacturing reports and drawings. It's easy to validate the design using component usage reports, design rule checking and clearance analysis.

Benefits

Eliminates need for physical measurements
Significantly reduces time to market
Reduces overall routing and end-user training costs

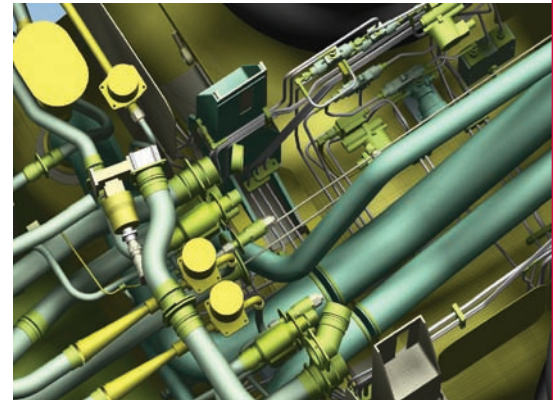
Features

Accelerated path creation
Intelligent part placement
Parametric part selection
Customizable part libraries
Bills of Material automation
Flexible application attributes

NX mechanical routing

NX provides mechanical routed system design tools and example libraries for tubing, piping, conduit and raceways. Mechanical routed system models are fully associative to NX assemblies to facilitate design changes. Automated Bills of Material and bend reports provide information for subsystem manufacturing. Time to market is greatly reduced by eliminating the need to take physical measurements before starting the design of the routed subsystem.

With NX mechanical routing tools, users can design 2D logical and 3D routing subsystems within 3D mechanical models; automatically calculate cut lengths; produce a complete Bill of Material (BOM); and fabricate routing subsystems for timely installation on the first physical product.



Integrated functionality

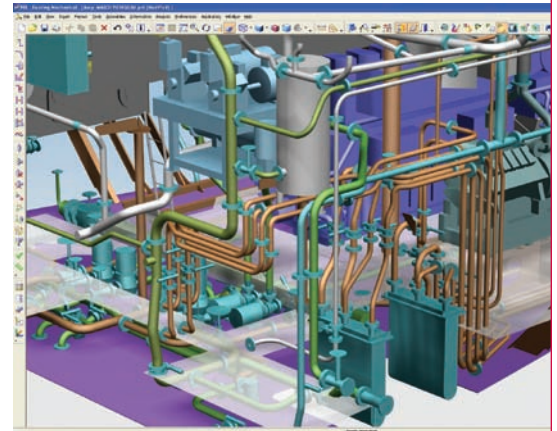
An integrated architecture provides a seamless transition between core NX modeling tools and mechanical routing capabilities. The unified design reduces the overall cost of routing applications and end-user training and provides for seamless interoperability between applications.

Routing systems

NX provides the common user interface and customization tools for process-specific routing capabilities. Companies can enhance NX with their own standard parts, design rules and system interfaces.

Functionality

- XML file type support in the Application view file. The new XML format offers enhanced features that enable users to define disciplines and specifications that help filter part selection by general application and specific part characteristics.
- NX supports creation of a logical design for mechanical routing. The application allows 2D diagramming of mechanical systems, such as piping and tubing designs. In addition, this toolset lets you drive and compare the 3D model with the 2D diagram, to ensure consistency and aid the creation of the design.
- Run and spool creation and definition wizards assist in designing with manufacturing intent. Defining runs allows designers to permanently identify sections of piping and tubing assemblies. Through such identification, you can directly compare a 2D logical diagram to a 3D mechanical model. Users can create manufacturing instructions using run identifiers as references. After run identification and assignment, users can specify subsections called spools. NX automatically number the parts and stock that make up the spool to identify the items in manufacturing drawings or other product documentation.
- NX mechanical routing now supports and can determine the direction of flow. When flow direction cannot be completely determined automatically, an interface allows the designer to assign flow direction. Flow direction arrows can be displayed temporarily or placed as permanent annotations.
- Automatic default elbow placement at corners
- Template assemblies allow designers to define families of assemblies and place them in routed subsystem designs in a single step. For example, a pump may always require a valve and two flanges. Instead of placing each component individually, they can be placed all at once with the correct assembly structure.
- General stock definitions make it possible to support many types of routing applications. Round stock may be defined for tubes, hoses, pipes, conduits. General stock cross sections may also be used for raceway, HVAC or any other type of stock including insulation. All stock may share a common path.
- Path creation tools accelerate the design of 3D paths within an assembly. Path creation drag handles and slope definitions are incorporated into the simple path toolset. Geometric path constraints can be automatically created. Users can also create complex geometric constraints to adjacent 3D geometry. Users may also take advantage of NX curve creation and use existing curves to define routing paths.



- Part selection is from a part library mechanism that supports selection based on the desired characteristics. Parts can be further filtered by discipline.
- Part placement uses intelligent algorithms that detect the way standard parts attach to the routing assembly. Typically, a part is placed by selecting a single object. NX positions the part correctly and cuts the stock back to the correct engagement. In addition, NX can determine a part by choosing characteristic values. When a destination object is selected, NX pre-filters only those parts that are appropriate for the location. This eliminates part misuse and errors.
- NX includes a custom flange placement interface that handles the details of making flange connections. This includes the selection of nuts, bolts, studs, gaskets and weld rings.
- Editing functions make it easy to change the routing assembly at any time during the design process.
- Fabrication creation helps designers decide how to best manufacture the routing system by selecting separate fabrications for drafting and assembly. This allows the user to design routing systems in the context of the entire product assembly.
- A BOM template is included that accelerates the creation of BOMs by importing a user's standard format and by including all routing parts and stock in the parts list.

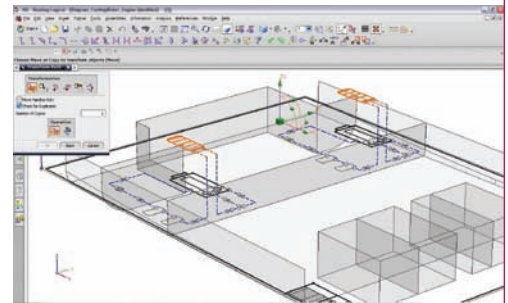
Process-specific routing tools

NX mechanical routing includes example parts, design rules and system interfaces.

- *Part libraries* – NX provides an example library of parts and stock definitions. Each sample part is a fully parameterized part family. A large number of sample part specifications are also included. Companies can modify these specifications to meet the requirements of a specific industry or standard.
- *Design rules* – ensure that routing assemblies follow standard design practices to reduce cost and improve product quality. Design rules may be set to run concurrently, interactively or in a batch process. When a concurrent or interactive design rule is violated, the designer is warned immediately. The designer can fix the violation or enter the reason for the exception. Design rule violations are stored with the NX assembly and may be reviewed at any time.

NX mechanical routing includes the following design rules, which can be customized. Users may also create and add new design rules.

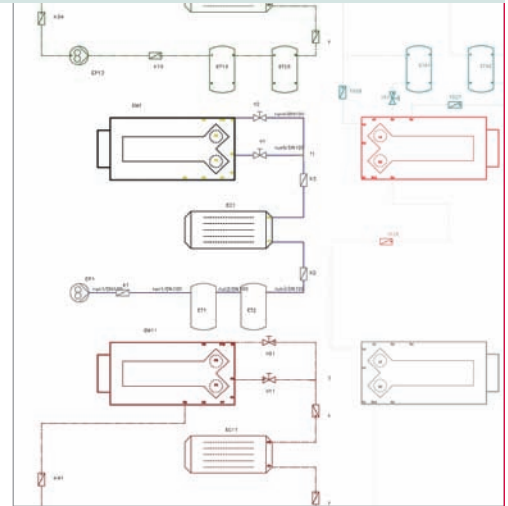
- *Minimum bend radius* – a violation is created when a bend radius is too small. Splines are also supported.
- *Minimum strength length* – a violation is created when the length of stock is too short between two bends.
- *Connection compatibility* – a violation is created when an invalid connection is made between two parts, or between stock and a part.
- *Flow direction* – checks flow direction characteristics on ports to ensure the orientation is correct based on the overall path flow.
- *Unique reference ID rule* – verifies that no two objects utilize the same reference ID characteristic.



Process support

Modeling the routing assembly is merely one step in the design and manufacturing process. Most routing applications begin with a 2D schematic that defines the logical connections between the devices within the assembly. During design, various analyses may be required. Procurement and manufacturing typically require a BOM as well as drawings.

NX supports creation of a logical design for routing mechanical systems with 2D diagramming of mechanical systems, such as piping and tubing designs. This toolset enables designers to compare the 3D model with the 2D diagram, ensuring consistency and aiding in the creation of the design.



Routing application programming interfaces

Users may create and add custom routing functionality to the main routing toolbar.

Journaling and automation support – Use Journaling and Automation to quickly generate source code and re-usable macros for automating and customizing tasks in NX Routing.

Availability and packaging

NX electrical and mechanical routing tools are available standalone with basic prerequisites or as an add-on to any NX Mach Design solution.

► **Contact**
Siemens PLM Software – www.siemens.com/nx
Americas 800 498 5351
Europe 44 (0) 1276 702000
Asia-Pacific 852 2230 3333

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