

NI AWRDE QUICK REFERENCE

You can access this file (*Quick_Reference.pdf*) in the NI AWR Design Environment™ (NI AWRDE) by choosing **Help > Quick Reference**.

This menu command opens any document named *Quick_Reference.pdf* in the NI AWRDE installation folder.

ADDITIONAL RESOURCES AVAILABLE

NI AWR Knowledge Base

<https://awrcorp.com/support/help.aspx?id=9> or **Help > Knowledge Base**

- **Application Notes** - Articles written by the NI AWR technical staff or our partners about how to use the software.
- **Examples** - A list of all the examples shipped with the NI AWR installer and other examples only available in the Knowledge Base.
- **Licensing** - A step-by-step guide to resolving most common licensing problems.
- **Questions** - Answers to common customer questions or issues.
- **Scripts** - A collection of scripted utilities to help solve specific problems and a collection of scripting examples.
- **Documentation** - A complete copy of the latest released NI AWRDE documentation.
- **Videos** - Short videos on how to accomplish specific tasks, and longer videos for training on specific topics.

NI AWRDE ONLINE HELP

Hotkey	Description	Hotkey	Description
F1	View context sensitive Help on the selected item	Space bar	Scroll down in the online Help
Shift + Space bar	Scroll up in the online Help	Search tab	Search the Help. There are advanced search options at the bottom of the pane.

PROJECT BROWSER / DESIGN ENVIRONMENT

Design Environment

Most actions are customizable to create your own hotkey, toolbar button, or menu option. Choose **Tools > Customize** to add your own customizations for toolbars and menus, and **Tools > Hotkeys** to add your own hotkey commands.

Use these keystrokes from anywhere in the NI AWRDE:

Hotkey	Description	Hotkey	Description
Ctrl+O	Open a project	Ctrl+D	Duplicate an item in the Project Browser
Alt+1	Open Project Browser	F6	Update an equation display
Ctrl+Y	Redo last operation	F7	Open the Optimizer dialog box
Shift+F7	Display a list of all variables used in a project	F8	Simulate
Ctrl+S	Save a project	F9	Open/close the Variable Tuner
Ctrl+Tab	Cycle through open windows in one direction	Ctrl+Shift +Tab	Cycle through open windows in the opposite direction
F2	Rename a selected item using Rename dialog box	Shift+F2	Rename a selected item directly

Zooming and Scrolling

These keystrokes are common to most window types (circuit schematic, system diagram, layout, EM, global and output equations). Mouse wheel actions are customizable. Choose **Options > Environment Options... > Mouse** to add your own customizations.

Hotkey	Description	Hotkey	Description
mouse wheel	Scroll up and down	Shift+mouse wheel	Scroll right and left
Ctrl+mouse wheel	Zoom in (centers on the cursor) and out	Up Arrow	Scroll up
Down Arrow	Scroll down	Left Arrow	Scroll left
Right Arrow	Scroll right	Num -	Zoom out
Num +	Zoom in	Home	View All
Ctrl+W	View Area	End	View Previous

Project Browser

- **Display additional context menu options** in the Project Browser by **Shift +** right-clicking a Project Browser node.
- **Change model list views** in the Element Browser by right-clicking in the lower pane to select the model display. The **Details** view provides the model name and a brief description of the model.
- **Open a project item by name** by right-clicking in the Project Browser and choosing **Open Project Item** to view and select an item in your project. The list of items is filtered as you type, and the item that best matches your input is highlighted.
- **Open a specific example** by choosing **File > Open Example** or **Help > Open Example** to filter a list of examples by name or keyword. **Ctrl**-click a column header to filter by that column.
- **Show all previously opened projects** by choosing **File > More Projects** to display and filter by rank, project (name), (date) last opened, or path a list of all projects you have opened. **Ctrl**-click a column header to filter by that column.
- **Browse to specific files and folders** by choosing **Help > Show Files/Directories** to display all of the files and folders the NI AWRDE uses. Double-click a folder or file to open it.
- **Add/delete/rename/... an item** by right-clicking it to display a context menu with options to add, delete, rename, import/export, collapse/expand, link to, view properties for, and other actions.
- **Bypass the default deletion confirmation** by pressing the **Shift** key while deleting Project Browser items (such as graphs or schematics).
- **Duplicate an item** by dragging it up to its parent node in the Project Browser and dropping it (schematics/system diagrams, data files, EM structures, graphs and measurements only). The new item has the same root name appended with "1" so it displays next to the original item in the Project Browser. You can also right-click an item and choose **Duplicate <item>** or press **Ctrl + D**.
- **Add a subcircuit to a schematic window** by right-click dragging and dropping a schematic or EM document from the Project Browser onto an open schematic window.
- **Create an output equation identical to a measurement** by dragging and dropping a measurement from the Project Browser into the Output Equations window.
- **Quickly access document options** by right-clicking in a document with nothing selected and choosing **Options**.
- **Copy between different instances** of the NI AWRDE by selecting the item you want to copy and pressing **Ctrl + C**. Select the parent node in the second instance and press **Ctrl + V** to paste.
- **Import items from another project** by choosing **File > Import Project**.
- **Archive a project** by choosing **File > Archive Project**.
- **Open archives** by selecting **Project Archive (*.emz)** as the file type in the Open dialog box.

Floating Windows

- **Classify a window as floating** by right-clicking the window title bar. You can move a floating window outside of the NI AWRDE. This feature is useful when using dual monitors.
- **Maximize a window** by double-clicking the title bar of a floating window; double-click again to restore it to its previous size.

Window in Window

- **Create a window in a window** by dragging and dropping an item from the Project Browser onto an active window. The cursor changes to allow you to click and drag to draw the desired window size. You can insert multiple, pre-sized windows at once by choosing **Draw > Insert Windows**. If more than one window is selected for insertion, a second dialog is present to allow arrangement into an array pattern.
- **Resize and align multiple windows** by right-clicking the toolbar and choosing **Align** to display the Align toolbar with various alignment options, and then selecting the "window in window" objects and the proper align command. You can also size each selected window identically.
- **Edit "window in window" views** by double-clicking the view or by selecting it, right-clicking and choosing **Activate View**. When editing these windows you are editing the original object (for example, the schematic or graph). Click once to select and move an object.

User Folders

- **Create a user folder** by right-clicking the **User Folders** node and choosing **Add New > Folder**. You can also create subfolders under any folder.
- **Add new items to a user folder** by right-clicking the **User Folders** node or existing user folder, choosing **Add New** and then selecting the item type you want to add.
- **Add existing items to a user folder** by dragging the item(s) to the user folder. You can also right-click the **User Folders** node or existing user folder and choose **Add Existing Item** to select items from a list.
- **Remove items from a user folder** by selecting the item and pressing the **Del** key or right-clicking and choosing **Delete**. A dialog box displays to confirm removal from the folder only, or deletion from the project.
- **Reorder items in a user folder** by selecting the item and pressing the **Alt** key and up or down arrow keys to move it.
- **Organize items in a user folder by type** by right-clicking a folder and choosing **Group by Type**, or alphabetically regardless of type by choosing this option again to toggle it off.
- **Organize folders by type** by right-clicking a folder and choosing **Show Grouping Folders**.
- **Take measurements on user folders** by including angle brackets around the folder name: "<user folder>".
- **Take a measurement on specific sources within a user folder** by using the <user folder> syntax and selecting the measurement source as <user folder=> in the measurement, and then clicking the sources you want to plot in the user folder.

Variable Browser

- To access, choose **View > Variable Browser**.
- **Sort entries in a column** by clicking the column header. Click again to reverse sort.
- **Filter entries** by typing in the filter text box above the column you want to filter. Hover the cursor over the filter text box to display tool tips for different filter mechanisms.
- **Select multiple items in a column** by **Shift**-clicking them. You can also press the **Shift** key in combination with the arrow keys. Press **Ctrl + A** to select the entire column.
- **Go to an element or equation** by clicking the link in the **Element** column.
- **Enter constraint values quickly** by typing "%" or "#" after the value. When applied to the value field, both lower and upper constraints are computed and set.

Measurement Editor

- To access, right-click a source document or graph and choose **Edit All Measurements**.
- **Sort entries in a column** by clicking the column header that you want to sort on. Click again to reverse sort.
- **Filter entries** by typing in the filter text box above the column you want to filter. Hover the cursor over the filter text box to display tool tips for different filter mechanisms.
- **Select multiple items in a column** by **Shift**-clicking them. You can also press the **Shift** key in combination with the arrow keys. Press **Ctrl + A** to select the entire column.
- **Change measurement simulators, modifiers, or parameters** by modifying the appropriate column in the Measurement Editor. For setting the simulator to APLAC, simply type AP and the system deduces the correct simulator string, e.g., AP vs. AP_HB vs. AP_DC.

CIRCUIT SCHEMATIC / SYSTEM DIAGRAM

Keyboard/Mouse Shortcuts

Hotkey	Description	Hotkey	Description
Ctrl+G	Add a ground connection (schematic only)	Ctrl+P	Add a port (schematic only)
Ctrl+E	Add an equation	Ctrl+K	Add a subcircuit
Ctrl+L	Add an element	Ctrl+T	Add text
Mouse 5	Descend into SUBCKT	Mouse 4	Ascend out of SUBCKT

Common Operations

- **Unit modifiers:** Add the following standard unit modifiers to element models to simplify the entry of model parameters: a, f, p, n, u, m, c, d, mil, k, meg, g, t. These modifiers follow SPICE rules; they are not case sensitive, they must follow the number directly without a space, and any characters directly following the modifier are ignored. Unrecognized modifiers are treated as a unit multiplier (x1).
- **Auto-wire elements:** Press the **Shift** key when inference lines appear during wiring.
- **Edit parameters in a schematic:** Double-click a model parameter value in a schematic to display a text box for editing. Press **Tab** to move to the next parameter and **Shift+Tab** to move to the previous parameter.
- **Edit the same parameter for multiple elements:** Select all of the elements to edit, right-click any of the elements and choose **Properties**. Edits are applied to all common (by name) parameters.
- **Replace an element:** Double-click a model name and type a new name. For example, double-click "RES" and type "CAP" to replace a resistor with a capacitor. Any parameters that match by name are preserved just like swap element.
- **Replace multiple elements:** Select all of the elements to replace, then in the Element Browser find the element with which to replace them. Right-click that element and choose **Replace Schematic Selection**. The **Preserve Parameters** option retains any common parameter values while **Replace Parameters** uses the element's default parameters (useful when replacing with library elements).
- **Change element layout or symbol:** In the Element Options dialog box for each element, **Symbol** and **Layout** tabs allow changes to the element symbol and layout.
- **View subcircuit contents:** Press the **Shift** key while double-clicking to open the subcircuit in the same window. Press the **Ctrl** key while double-clicking to open the subcircuit in a new window. **Ctrl** double-clicking works with any element that references another document like PORT_TN, LIN_S, etc.
- **Work with linked documents:** Right-click a schematic and choose **Link** to display the Save As dialog box and convert from imported to linked, **Embed** to convert from linked to embedded, **Load** to update a linked schematic after it is edited, **Save** or **SaveAs** to save edits to file, and **Explore** to open the folder containing the linked schematic.
- **Make a measurement a favorite:** Click the **Favorite** button in the Add/Modify Measurement dialog box.

- **Add a favorite measurement to a graph directly from a schematic or system diagram:** Right-click in an open area of the document and choose **Add Measurement**.
- **Repeat commands with a single click:** Click the **Command Repeat Mode** button on the toolbar.

Adding/Placing an Element

Add/Place an element by pressing **Ctrl+L** or choosing **Draw > More Elements** to filter a list of elements by name, description, or path. **Ctrl-click** a column header to filter by that column. Searches can use multiple words: "**micro line**" displays matches for both words.

After dragging an element from the Element Browser into the work area, or copying and pasting an element, you can:

Keystroke	Description	Keystroke	Description
Click	Place at current location	Right-click	Rotate counter-clockwise 90-degrees per click
Ctrl-right-click	Mirror about the Y-axis	Shift-right-click	Mirror about the X-axis

Setting up a Sweep

- **Create a sweep for a parameter or variable** by right-clicking the parameter or variable and choosing **Setup Sweep**.
- **Edit the sweep parameters of an existing sweep** by right-clicking the element parameter using the swept variable. You can change the sweep type (linear or log), the way the sweep is specified (step size or number of points), and the range of the sweep.

Schematic/Diagram Connectivity

- For models requiring a **substrate or model block**, right-click the model and choose **Add Model Block**.
- **Start a wire from the middle of another wire or node** by right-clicking to select the wire and then choosing **Add Wire**.
- **Remove a previous point** by right-clicking while you add a wire.
- **Control wire direction** after starting a wire by changing the location of the cursor relative to the starting point of the wire.
- **Set auto wire deletion** by selecting the **Auto wire cleanup** check box in the Project Options dialog box on the **Schematics/Diagrams** tab (choose **Options > Project Options**). When deleting an element, the wires connected to it are also deleted. If not selected (the default setting), the wires remain.
- **Highlight a net** by selecting a wire, right-clicking and choosing **Highlight On** to highlight a net through hierarchy in a different color. Any iNets in layout for these nets are also highlighted in this color.
- **Create a bus net** by selecting a wire, right-clicking and choosing **Create BusNet**.
- **Edit net properties** by selecting a wire, right-clicking and choosing **Edit Net Properties** (circuit schematics only).
- **Disconnect an element** by pressing the **Ctrl** key while dragging the element (wires are deleted).
- **Move an element orthogonally only** by pressing the **Shift** key while dragging the element to constrain its movement to horizontal and vertical directions from the original position.

Symbols

- **Create a custom symbol for a subcircuit** using the **Symbol Generator Wizard** located under the **Wizards** node in the Project Browser. These symbols can place nodes based on the schematic or layout representation of your subcircuit.
- **Add a default subcircuit symbol** to schematics, EM structures, and data files by right-clicking these documents in the Project Browser, choosing **Options**, and on the Options dialog box **Symbol** tab setting the default.
- **Quickly edit a user-defined symbol** by right-clicking the symbol and choosing **Edit Custom Symbol**.

Element Selection

Restrict items for selection by right-clicking anywhere in a circuit schematic/system diagram with nothing selected and choosing **Restrict Selection** to turn on/off different items for selection. When items are turned off they cannot be selected for the following operations:

- **Shift-click** to **select multiple models** or remove models from those selected.
- Click and drag to **select all objects completely inside the drawn selection area**.
- **Shift-click and drag** to **select all elements that are even partially enclosed in the drawn selection area**.
- Press **Ctrl+A** to **select all objects**.
- Press **Ctrl+Shift-click** to **cycle through elements** if elements overlap.

Elements on Schematics/System Diagrams

Select an element and right-click its symbol (not the parameter text) to display a context menu to:

- **Edit element properties/parameters** in the Element Options dialog box.
- **Toggle enable or disable** the element in the schematic or diagram.
- **Swap** the element with another element.
- **Rotate** or **flip** or **freeze in place** the element.
- **Zoom In/Out, View Area, View All** to change the view.
- Display the **Help** for the element.
- **Select or place the element in the layout** for the schematic.
- **Edit the element symbol** in the Symbol Editor.

Buses and Vector Instances

- **Make a vector instance:** Edit the ID and add the iteration count; for example, change "ID=R1" to "ID=R1[0:3]" to make four resistors for simulation and layout.
- **Make a bus:** Connect a wire to a vector instance. A bus label displays on the wire. You can edit the label to name it or resize it. You can also give an NCONN a bus or bundle name. The attached wire resizes to match.
- **Name a bus using vector notation:** B[0:3] denotes a bus named B with 4-bits.
- **Bundles are names separated by commas:** B1,D,E3,A is a 4-bit wide bundle containing nets B1, D, E3 and A.

Tuning

-  **Tune Tool (F10):** Click on a variable or parameter to make it tunable.
-  **Variable Tuner (F9):** Open the Variable Tuner with controls for each tunable parameter, or click the **Tune** button on the toolbar.
- **Control the tuning step size** by changing the **Step**.
- Press the **Shift** key while tuning to **Start a simulation** only when you release the mouse button.
- Press the **Ctrl** key while tuning to **update the layout at every tuner point** instead of when you release the mouse button.
- In the Variable Tuner, **turn off an item for tuning** by clearing its check mark in the **Tune** column.
- **Filter variables in the Variable Tuner** by assigning the parameter or variable a tag in the Variable Browser or Tuner.

- If an element parameter is set for tuning but the element is not constrained, the upper tuning limit is 2X the nominal value and the lower tuning limit is 0.5X the nominal value. Change this by **setting constraint limits on each parameter**. If a parameter has constraints, those values are used as the tuning limits. You can also edit these values in the Variable Tuner to edit the constraints for that parameter.

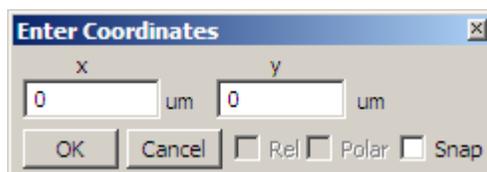
LAYOUT

Keyboard Shortcuts

Hotkey	Description	Hotkey	Description
Ctrl+T	Add text	Ctrl+E	Draw ellipse
Ctrl+L	Draw path	Ctrl+P	Draw polygon
Ctrl+B	Draw rectangle	Ctrl+G	Toggle grid snap
Ctrl+O	Toggle orthogonal mode	Ctrl+D	Start Measure tool

Common Operations

- **Coordinate entry:** While drawing a rectangle, polygon, or path, or while dragging an object or placing a cell, press **Tab** or the **Space bar** to specify a location using relative or absolute coordinates.



- **Snap shape:** Press **Ctrl** to snap the mouse to endpoints, midpoints, and edges during dragging, moving, stretching, and measuring operations.
- **Aligning shapes:** Select all shapes to align, then choose **Draw > Align Shapes** to view alignment options. The first item selected is the reference point for the alignment.
- **Boolean operations:** Select all the shapes for the Boolean operations (such as AND, OR, XOR), and choose **Draw > Modify Shapes** to view the operators.
- **Move or Copy shapes using commands:** Choose **Edit > Move** or **Edit > Copy with reference**.

Parameterized Layout Modifiers

- **Parameterize a layout** by selecting the shape(s) to be parameterized and then choosing **Draw > Parameterized Modifiers** and selecting one of the many modifiers.
- **Verify the order of the parameterization** by choosing **Layout > Modifier Properties**. The order of execution of layout modifiers can affect the final layout.

Layout Selection

Restricted selection: Right-click in a layout (with nothing selected) and choose **Restrict Selection** to display a dialog box to turn on or off different items for selection. Items that are off cannot be selected for the following operations:

- **Select a shape** by clicking it.
- **Shift-click** to **select multiple objects** or remove objects from those selected.
- Press **Ctrl+Shift** to cycle through overlapping shapes when **selecting a shape that overlaps other shapes**.
- Click/drag to **Select all objects completely inside a drawn selection area**.

- **Shift-click and drag to select all objects that are even partially enclosed in a drawn selection area.**
- Choose **Layout > Layout Mode Properties** to specify manual or auto-selection in **Selection mode**. **Auto select** selects any item clicked. **Manual select** requires a **Shift-click** to select and deselect objects.

Measuring Distances

- Display a **temporary ruler** to measure a distance when you click and drag. Choose **Draw > Measure**, press **Ctrl+D**, or click the **Measure** button on the toolbar to activate. When you release the mouse button the ruler goes away. Hold down the **Ctrl** key while measuring to snap to vertices, midpoints, etc. Hold down the **Shift** key for cumulative measurements.
- Display a set **layout ruler** to measure a distance when you click and drag. The layout ruler remains on the screen and has configurable properties. Choose **Draw > Layout Ruler** to activate. To configure ruler properties, select the ruler, right-click and choose **Shape Properties**.
- Display **dimension lines** that show the distance between two selected points when you click and drag. Choose **Draw > Dimension Line** to activate. To configure dimension line properties, select the line, right-click and choose **Shape Properties**.
- Display **smart dimension lines** that show the length of an edge of a polygon. Select a polygon and choose **Draw > Parameterized Modifiers > Edge Length** to activate. Edge length modifiers track any changes to the edge length and can be used to control edge length.

Layout Modes

Layout modes allow you to configure different layout settings and then easily switch between them while working in the Layout Editor.

- **Layout Mode Setup:** To set up different layout modes, in a Layout window, choose **Layout > Layout Mode Manager** to open the Layout Mode Properties dialog box. Click **Edit** to view the Layout Editor Mode Settings dialog box with tabs and options for controlling different layout modes.
- **Layout Mode Selection:** To quickly select different layout modes, in a Layout window, click the **Layout Editor Mode** toolbar button.

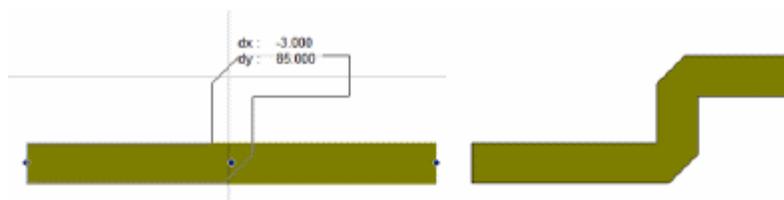


Routing MTRACE2 or MCTRACE Elements

- To **display "drag handles"**, double-click a cell.



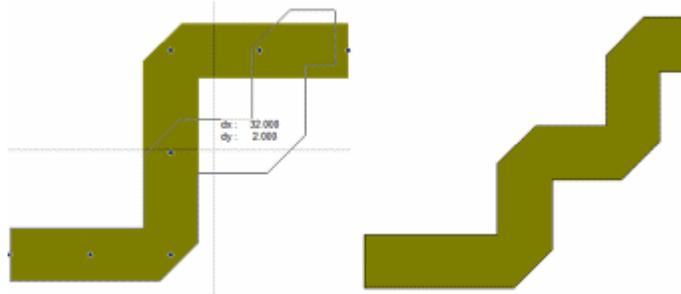
- When a cell is a straight line, drag the middle handle to **add a "dogleg" bend**.



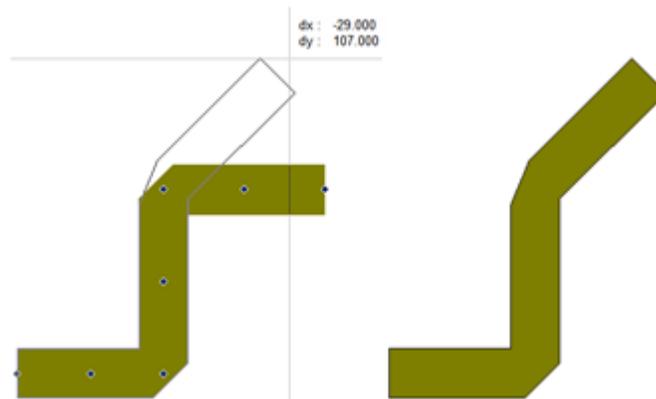
- To **stretch or shrink a trace**, drag the endpoints.



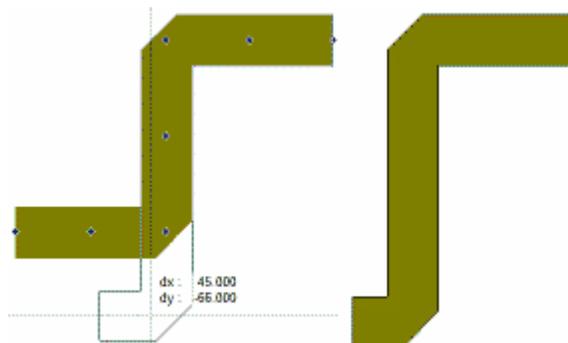
- With one or more bends, press **Ctrl** and drag a "midpoint" handle to **add another bend**.



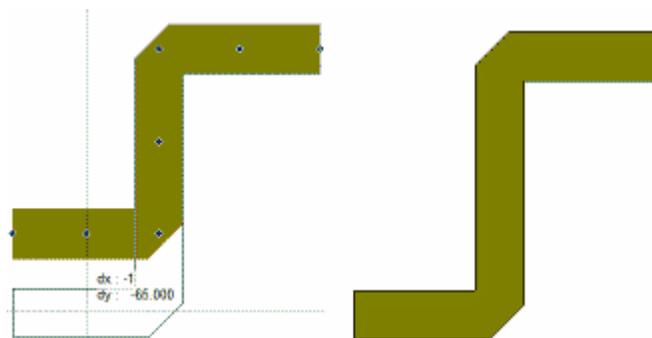
- To **change the angle of the last bend**, press **Ctrl** and drag an endpoint.



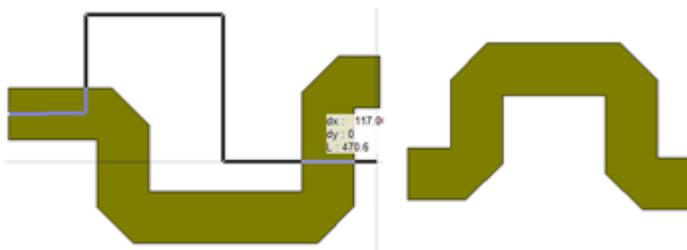
- To **stretch a trace while maintaining a constant length**, drag a "midpoint" handle.



- To **stretch a trace without maintaining a constant length**, press **Shift** and drag a "midpoint" handle.

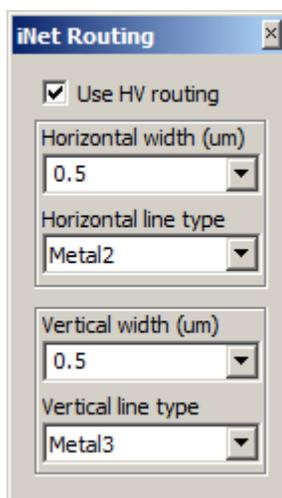


- To **redraw a trace from scratch**, double-click either end point. Click to place vertices, and double-click again to finish the trace. The entire trace must be re-routed; a segment cannot be added from pin2.



Routing iNets

- To **start routing an iNet** double-click a rat line in layout.
-  Click the **Show Routing Properties** button on the toolbar to open the iNet Routing dialog box to **set the default width and line type for routing**. Select the **Use HV routing** check box to use different defaults for horizontal versus vertical lines.

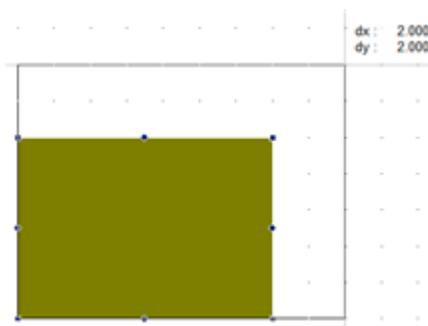


- Set the layout mode settings (choose **Layout > Layout Mode Properties**) in the **Routing options** group to automatically **start a route on the pin layer or start a route the same width as the area pin** connected to the iNet.
- When routing, press the **Shift + Ctrl** keys while scrolling the mouse wheel to **change the line type for the iNet**.
- When routing, right-click to **undo the last segment**.

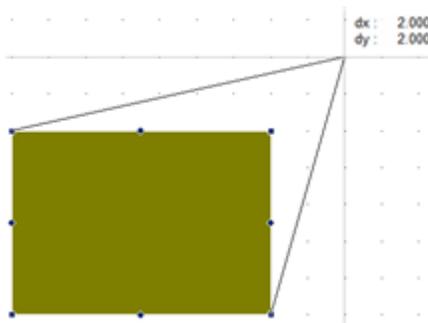
- To **return to drawing mode**, right-click an existing route and choose **Redraw Route**. You can enter new segments to the route or right-click to remove the last segment. The end of the route the cursor is closest to is the end of the route you edit.
- **Shift**-click to **select individual segments of an iNet**, then right-click and choose **Route Segment Properties** to change the width and line type of only the selected segments.
- To **view edit handles** and **resize a via**, double-click an iNet via.

Stretching Layout Shapes

- To **stretch orthogonally**, drag corner handles.



- To **stretch without angle snap**, start dragging an element, then press the **Shift** key and drag the corner handles.



GRAPHS

Keyboard Shortcuts

Hotkey	Description	Hotkey	Description
Ctrl+F	Freeze traces	Ctrl+U	Clear frozen traces
Ctrl+M	Add marker	Ctrl+mouse wheel	Zoom in (centers on the cursor) and out

Common Operations

- **Save data from a graph** to a text file by choosing **Graph > Export Trace Data**.
- **Add a measurement on a graph** by right-clicking the graph and choosing **Add New Measurement**.
- **Modify a measurement on a graph** by right-clicking the graph and choosing **Modify Measurement**.
- **Change measurement order** in a graph by selecting a measurement in the Project Browser and dragging it to the desired order location, or pressing the **Alt** key and up or down arrow keys to move it.

- **Modify trace properties, modify or toggle the measurement, or view the source document** by right-clicking measurements in the graph legend.
- **Modify optimization and yield goal properties** by right-clicking the goals.
- **Change multiple trace properties** by selecting multiple traces when making edits on the graph Options dialog box **Traces** tab.

Tabular Graphs

- **Change the display precision of tabular graph numbers** by right-clicking a graph and choosing **Options** to display the Tabular Graph Format dialog box to specify options.
- **Change column header text** by right-clicking a graph and choosing **Options** to display the Tabular Graph Options dialog box to change the display for each measurement.
- **Sort** by clicking a column header.

Rectangular Graphs

- **Limit the axes of a rectangular graph** after a simulation by right-clicking and choosing **Zoom Data**, and then clicking and dragging to define an area for magnification. Click and drag over the x-axis of the graph to zoom only in the x-direction.
- **Reset the axis limits** by right-clicking and choosing **Restore Axis Setting**.

Markers

To **view marker options**, right-click a marker. Marker options are dependent on the graph type. Most graphs support markers.

- **Reference Marker:** Any markers attached to the same trace show a delta value from the reference marker. Any markers on the graph show a delta value when selecting **Ref marker all traces** on the graph Options dialog box **Markers** tab.
- **Marker Search:** Search for values of the trace.
- **Marker→Max and Marker→Min:** Search for min and max values of the trace and add horizontal and vertical line markers on a Rectangular graph.
- **Use markers as sweep indexes** for other measurements by selecting the marker in the variable drop-down in another measurement.
- **Add Auto Search Markers to track specific features of a trace** by right-clicking on a graph and choosing **Add Auto Search Marker**. Auto search markers can track maximums, minimums, and specific peaks or valleys, as well as a specific y-value or x-index.
- **Move markers** to the previous/next sweep point by selecting one and pressing **Shift left/right arrow**.

ELECTROMAGNETIC STRUCTURES

The NI AWRDE has both 3D planar EM simulators, EMSight and AXIEM, as well as a full 3D Finite Element Method simulator, Analyst™. See the Help for information on each simulator.

User Interface

- **To access controls for drawing and viewing EM structure layout objects in the Layout Manager**, in an EM structure window, click the **Layout** tab.
- **To see the simplified structure after shape pre-processing rules are applied**, right-click an AXIEM or Analyst EM structure and choose **Preview Geometry**.

Viewing Mesh, Currents, and E-fields

- **Currents and E-fields** are viewed in an EM structure 3D view, while **mesh** is viewed in a 2D or 3D view. These are added as annotations.
-  **Show 2D Mesh** or **Show 3D Mesh** toolbar buttons quickly turn mesh on or off in 2D or 3D views.

- To **add mesh, currents, and E-fields**, right-click an EM structure in the Project Browser and choose **Add Annotation**.

Data Sets

- **View results of previous iterations of a structure** by right-clicking a data set and choosing **Update Results**, or by **Shift**-clicking a data set.
- **Force the use of a specific data set in simulations** by right-clicking the data set and choosing **Pin Results**.
- **View the geometry of the EM structure that created a data set** by right-clicking the data set and choosing **View Geometry**.

EQUATIONS / VARIABLES

Equations

- **Display the value of an equation** by typing its name followed by a colon (":"). When you simulate or press **F6**, the variable updates to display its evaluated value.
- **Add multiple equations in one block** by pressing **Ctrl+Enter** to add a new line.
- Equations and variables **display matching values** as you type. For equations, arguments are also listed.
- For **Help on an equation**, press **F1**.

Output Equations

- **Create an output equation of a measurement** by selecting and dragging the measurement into an Output Equations document.
- **Create an output equation of the values on a marker** by using the marker() function in an Output Equations document.
- **Edit output equations** in the Edit Equation dialog box by **Shift**-double-clicking the output equation.

Variables

- **Set variables to pass down into lower levels of hierarchy** by right-clicking the variable and choosing **Properties**, then the **Pass Down Mode** in the Edit Equations dialog box.
- **Pass variables up** to be set at higher levels of hierarchy by using “<<” instead of “=”.

ANALYST 3D EDITOR

Accessing the 3D Editor

- Create, import, or link to an **Arbitrary 3D EM structure** in an NI AWRDE project.
- In the NI AWRDE Project Browser, right-click the Arbitrary 3D EM structure and choose **Open in 3D Editor**.

Online Help



3D Editor Help is available by clicking the **Application** button at the top left corner of the main window and choosing **Help**, or by clicking the question mark button at the top right corner of the main window.

3D Editor Help is independent of the NI AWRDE Help.

Hotkey	Description	Hotkey	Description
F1	View context sensitive Help on the selected item	Space bar	Scroll down in the online Help
Shift+Space bar	Scroll up in the online Help	Search tab	Search the Help. There are advanced search options at the bottom of the pane.

Navigator / User Interface

Keyboard Shortcuts

Hotkey	Description	Hotkey	Description
Ctrl+S	Save	Ctrl+C	Copy
Ctrl+V	Paste	Ctrl+Z	Undo
Ctrl+Y	Redo	Shift+U	Edit working units

To set or change keyboard shortcuts, on the **Home** ribbon in the **Settings** group, click the **Hotkeys** button.

Commands

- **Command hints** that include mouse and keyboard instructions often display at the bottom of the main window in yellow.

Default/Rotate (Select solids to rotate.)

- **Complete a command and specify the remaining input** by pressing the **Space bar**.
- **Specify the next command step in a command** by pressing the **Tab** key.
-  **Cancel a command** by pressing the **Escape** key, clicking the **Cancel** button on the Structure view toolbar, or choosing **Cancel** from the Structure View context menu.

Controls and Views

- **Toggle visibility of a control** by clicking **Control Visibility** and choosing an option on the **Window** ribbon in the **Controls** group.
- **Show/Hide all controls** by clicking **Show All Controls** or **Hide All Controls** on the **Window** ribbon in the **Controls** group.
- **Load a default window layout** by clicking **Standard Layout** on the **Window** ribbon in the **Controls** group. This is useful for reopening a window.
-  **Change window placement to floating, dockable, or tabbed document** by right-clicking the window header to access the context menu, or clicking the **Window Position** button on the window header. You can also float a window by dragging the window by the header.
-  **Auto Hide a window** by clicking the push-pin button on the window header. To quit Auto Hide mode, click this button again.

Copying and Pasting

Geometric entities, materials and attributes can all be copied within and between instances of the 3D Editor.

- **Copy an object in the Browser** by dragging it to its parent node and dropping it. The new item uses the same root name appended with "_1" so it displays next to the original item in the Browser. You can also right-click an item and choose **Copy**, then right-click its parent node and choose **Paste**.
- **Copy an entity in a 3D view** by picking the entity and pressing **Ctrl+C**.
- **Paste an entity in a 3D view** by pressing **Ctrl+V**.

Navigator

- **Add notes** on your structure by clicking the **Notes** node.
- **Restore your Structure view** by clicking the **Structure** node.

Structure View

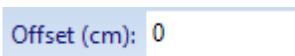
Working Plane

The working plane is a grid used primarily for drawing entities; it represents the active coordinate system.

- **View current grid spacing** in the upper left corner of the Structure view.
-  **Change grid spacing** by clicking the **Use Snap Grid** button on the Structure view toolbar and selecting an option.
-  **Change grid visibility** by clicking the **Working Plane Visibility** button (default hotkey is **V**) on the Structure view toolbar.
- **Change working plane orientation** by clicking **Plane** on the **Structure** ribbon in the **Working Coordinate System/Plane** group and choosing **XY**, **YZ**, or **ZX**.



- **Change the working plane offset from the origin** by specifying a value in **Offset** on the **Structure** ribbon in the **Working Coordinate System/Plane** group.



Units

- **Change the working units** by clicking the **Units** button on the **Home** ribbon in the **Settings** group.
- **Choosing an appropriate distance unit** is essential. The 3D Editor supports geometric sizes and positions over a range of $1e-5$ to $1e+4$ working distance units. For example, if your working **Distance** units are set to **cm**, you should avoid geometry smaller than $1e-5$ cm and larger than $1e+4$ cm.

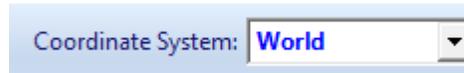
Common Operations

- The **location of your cursor**, expressed in working distance units in the active coordinate system, displays at the bottom of the Structure view.
-  **Measure distances** by clicking the **Calculations and Queries** button on the Structure view toolbar, and choosing **Distance Point, Point** from the drop-down menu. Follow the command hint at the bottom of the main window.
-  **Zoom in on an area of the view** by clicking the **Zoom Area** button on the Structure view toolbar (default hotkey is **W**) or by choosing **Zoom Area** from the Structure view context menu. Click and drag your mouse to define the zoom area.
-  **Fit the view to your structure** by clicking the **Fit** button on the Structure view toolbar (default hotkey is **F**) or by choosing **Fit** from the Structure view context menu.

Coordinate Systems

All entities are defined with respect to a coordinate system. The 3D Editor provides a default World coordinate system and you can create two types of local coordinate systems.

-  **Create a new relative coordinate system** by clicking the **New Coordinate System** button and choosing **New Relative Coordinate System** on the **Structure** ribbon in the **Working Coordinate System/Plane** group.
- **Create a new face coordinate system** by clicking the **New Coordinate System** button and choosing **New Face Coordinate System** on the **Structure** ribbon in the **Working Coordinate System/Plane** group. Follow the command hint at the bottom of the main window.
- **Specify an active coordinate system** by choosing a coordinate system on the **Structure** ribbon in the **Working Coordinate System/Plane** group. Your selection impacts subsequently drawn entities.



- **Change an entity's coordinate system** by selecting the entity in the Browser and using the Browser property grid to change the **Coordinate System** parameter.

Entities

Creation and Deletion

- **Draw an entity** by clicking **Draw Entity** and choosing an option on the **Structure** ribbon in the **Entity Creation** group. Follow the command hint at the bottom of the main window.
- **Import entities (SAT, IGES, DXF, GDS2, etc)** by clicking **Import Entities** and choosing an option on the **Structure** ribbon in the **Entity Creation** group.
- **Export entities** by clicking **Export Entities** on the **Structure** ribbon in the **Entity Creation** group.
- **Delete entities** by selecting the entity node(s) in the Browser, right-clicking and choosing **Delete** from the context menu or pressing the **Delete** key.

Picking

- **Pick a single entity** in the Structure view by clicking it.
- **Pick more than one entity** in the Structure view by **Shift**-clicking entities.
- **Pick all entities** in the Structure view by choosing **Pick > All** from the Structure view context menu, or by pressing **Ctrl+A**.
-  **Pick all visible entities** in the Structure view by clicking **Pick All Visible** on the Structure view toolbar or by choosing **Pick > All Visible** from the Structure view context menu.
- **Pick all entities in a rubber band window** in the Structure view by clicking and dragging the mouse to define the window.
-  **Choose selective pick operations** by clicking the **Pick Filters** button on the Structure view toolbar.

Modification

- **To move an entity**, on the **Structure** ribbon in the **Entity Modification** group, click **Transform** and choose **Translate** from the drop-down menu. Follow the command hint at the bottom of the main window.
- **To rotate an entity**, on the **Structure** ribbon in the **Entity Modification** group, click **Transform** and choose **Rotate** from the drop-down menu. Follow the command hint at the bottom of the main window.
- **To scale, reflect, translate face, or array an entity**, on the **Structure** ribbon in the **Entity Modification** group, click **Transform** and choose the desired transformation from the drop-down menu. Follow the command hint at the bottom of the main window.
- **To union, subtract, or intersect entities**, on the **Structure** ribbon in the **Entity Modification** group, click **Boolean** and choose the appropriate option from the drop-down menu. Follow the command hint at the bottom of the main window.

- To **fillet or chamfer an edge**, on the **Structure** ribbon in the **Entity Modification** group, click **Blend** and choose the desired option from the drop-down menu. Follow the command hint at the bottom of the main window.
- To **simplify an entity by removing specific features from a face** such as holes, protrusions, or depressions, on the **Structure** ribbon in the **Entity Modification** group, click **Defeature** and choose **Remove Faces**. Follow the command hint at the bottom of the main window.

Visibility

- **Change the visibility of an entity** by toggling the light bulb next to the entity in the Browser.

Materials, Boundary Conditions and Excitations

Materials

- **Change an entity's material** by selecting the entity in the Browser and using the Browser property grid to change the **Material** parameter.
- **Change the material of multiple entities** by selecting multiple entities in the Browser (**Shift** or **Ctrl**-click) and using the Browser property grid to change the **Material** parameter.
- **Create a new material** when editing an entity by choosing **<New>** from the **Material** drop down box in the property grid.
- **Edit a material** by selecting the material in the Browser and using the Browser property grid.
- **Determine which entities use a material** by selecting the material in the Browser. Only entities using that material display as shaded.
- **Hide all entities using a material** by locating the material in the Browser and turning off the associated light bulb.
- **Delete a material** by selecting the material in the Browser and pressing **Delete**. All entities using the material revert to using Air.

Ports

- **Apply a port** to a face or edge by clicking **New BC/Excitation** and choosing **Port** on the **Structure** ribbon in the **Attributes** group.
- **Modify port parameters** by selecting the material in the Browser and using the Browser property grid.
- **Delete a port** by selecting the material in the Browser and pressing the **Delete** key.

Boundary Conditions

- **Apply a boundary condition** to a face by clicking **New BC/Excitation** and choosing the desired boundary condition from the drop-down menu on the **Structure** ribbon in the **Attributes** group. Follow the command hint at the bottom of the main window.
- **Modify boundary condition parameters** by selecting the **Material** in the Browser and using the Browser property grid.
- **Delete a boundary condition** by selecting the boundary condition in the Browser and pressing the **Delete** key.

View Manipulation

Zooming and Scrolling

Hotkey	Description	Hotkey	Description
Mouse wheel	Scroll up and down	Shift+mouse wheel	Scroll right and left
Ctrl+Mouse wheel	Zoom in (centers on the cursor) and out	Arrow	Scroll in direction of arrow
Ctrl+Arrow	Rotate camera around rotation center by amount in Camera Rotation Increment environment variable.	Shift+Arrow	Rotate camera around rotation center by 90-degrees.

Hotkey	Description	Hotkey	Description
Alt+Left or Right Arrow	Spin camera around rotation center by amount in Camera Rotation Increment environment variable.		

Variables

A variable is an expression construct that represents a non-constant value. You can use variables in place of numerical values in most parameters. The value of a variable may hold an expression made up of operators, operands and functions. The operators may be unary or binary, and the functions can take arguments that may be variables, functions, or numeric expressions. Unit consistency is enforced in units and parameters.



NOTE: After making changes in the **Variables Control** you must click the **Apply** button for the changes to take effect.

When there are pending variable changes, the rest of the 3D Editor user interface is disabled. You must apply or cancel the variable changes to continue using the 3D Editor.

Creation and Deletion

- Create a variable** by clicking the **Add Variable** button in the Variables window.
- Create a variable** when editing a parameter by entering a new variable in a property grid. The new variable(s) are created automatically and you are prompted to define them if necessary.
- Delete a variable** by selecting it and then clicking the **Delete Variable** button in the Variables window.

Functions

The following functions can be performed on scalars.

Math Operation Functions

Function	Function	Function
abs(x)	acos(x)	acosh(x)
asin(x)	asinh(x)	atan(x)
atan2(y, x)	atanh(x)	ceil(x)
cos(x)	cosh(x)	exp(x)
floor(x)	ln(x)	log(x)
max(x, y)	min(x, y)	mod(x, y)
pow(x, exponent)	round(x, sigfigs)	sign(x)
sin(x)	sinh(x)	sqrt(x)
tan(x)	tanh(x)	

Type Conversion Functions

Function
complex(real, imag)

Conditional Functions

Function	Function
<code>if(check, true, false)</code>	<code>assert(conditional expression)</code> or <code>assert(conditional expression, phrase)</code>

Unit Conversion Functions

Function
<code>stripunit(x)</code> or <code>su(x)</code>

Complex Number Functions

You can use the following complex number functions, where "z" is a complex number.

Function	Function	Function	Function
<code>arg(z)</code>	<code>imag(z)</code>	<code>mag(z)</code>	<code>real(z)</code>

Saving

Click the **Application** button and choose **Save**, press **Ctrl+S**, or choose **Save** from the Quick Access Toolbar at the top of the application. Your geometry is exported to NI AWRDE and you can exit the 3D Editor.