SIX PRINCIPLES OF EASY-TO-USE PCB DESIGN CREATION

BY: ERIN GOWDY, MENTOR GRAPHICS CORPORATION

INTRODUCTION

As noted in our recent white paper, Three Challenges Impacting the Efficiency of PCB Engineering Teams, dramatic demographic changes have led to a shift in the scope of work being done by electrical engineers. In particular, engineers have been forced to take on tasks that traditionally have been performed by dedicated experts.

Recapping, this fundamental change in the way electronics systems are developed is being caused by three challenges:

1. First is design complexity, which continues to grow at an accelerated rate. This complexity needs to be addressed while still meeting the business drivers of time-to-market, reduced cost, and increased quality.

2. Second is the declining pool of PCB designers and design engineers. As a consequence, the remaining individuals are expected to achieve higher productivity with fewer resources.

3. Lastly, organizations are taking a more "systems-aware" approach to their development projects. Projects are no longer viewed as single-PCB centric designs, but as entire systems spanning a number of disciplines.

Our view is that these three challenges are forcing a major change in the approach of systems development and the tools that are needed to ensure the highest levels of success.

Increasingly, vendors of leading design creation tools are focusing on enhancing software usability to help organizations respond to these challenges. Irrespective of the design discipline, software should be designed to meet a user's expectations; in essence, it should be easy to use.

This white paper examines the value of ease-of-use in EDA software and proposes a set of principles that are vital to realizing this goal. We then provide a set of examples that shows how Mentor Graphics has implemented functionality in its Xpedition® design creation tools to meet these ease-of-use principles.

THE SIX PRINCIPLES OF EASE-OF-USE

Typically, design engineers spend only a fraction of their time with EDA tools, so we've come up with a list of six principles that tools should adhere to in order to help these engineers make the most out of every minute spent in the design creation process.

1. LEGIBILITY

Legibility refers to more than the text in an application; the entire interface, from text to images to layout, must be "readable." If the functionality is self-evident, it minimizes the need to seek external resources, such as training or additional documentation.

2. PREDICTABLE BEHAVIOR

Tool behavior should be aligned with the expectations of the user. Functions should be located where expected and should behave in a natural way.

3. SIMPLICITY

The principle of simplicity is best captured by the popular adage, "less is more." A tool is confusing and harder to remember if there are multiple ways to achieve a single goal.

4. HIGH LEVEL OF AUTOMATION

By automating simple tasks, tools that are easier to use speed up the design entry process and help the designer avoid errors.

5. FLOW GUIDANCE

Tools should lead the user through an implied workflow without impeding them in any way. Each step in the process should be clearly delineated, but the tool should not restrict the workflow.

6. EFFICIENCY

By embracing the above principles, design tools can achieve greater efficiency and provide higher quality for the user.

By designing tools to match your expectations and behavior, the bar is lowered for new and casual users, allowing for greater concentration on the engineering task rather than on the tool used to perform the task. This improves efficiency and quality while reducing the cost of ownership, since less training will be required and individuals who use the software less frequently will not have to spend a lot of time re-learning their tools.

PRINCIPLES IN PRACTICE: XPEDITION DESIGN CREATION

To become the de-facto standard for design creation, a toolset needs to provide a set of characteristics.

On the one hand, it should be easy to use, easy to deploy, and ready out of the box so the user can get started straight away. On the other hand, the solution should also be scalable, addressing different levels of design complexity and design team size. As design complexity rises, the tool should support greater functionality to enable efficient team design while remaining easy to use.

Mentor Graphics has combined these seemingly contradictory needs into our powerful Xpedition design creation tools. Built with the six guiding principles in mind, Xpedition includes features that empower professional design engineers to not only complete their designs, but to do so as efficiently as possible—without sacrificing functionality and scalability.

RECEIVE HELP ON DEMAND WITH ADVANCED TOOLTIPS

Enhanced tooltips enable the user to learn how a command works without leaving the tool. Unlike traditional help systems, tooltips provide enriched content that include detailed descriptions and videos of functionality.

- Xpedition tooltips are progressive, meaning they are exposed only when the user hovers on the toolbar button for an extended period of time, so they don't interrupt the workflow of experienced users.
- Tooltips minimize the learning curve and eliminate the need for extensive training.
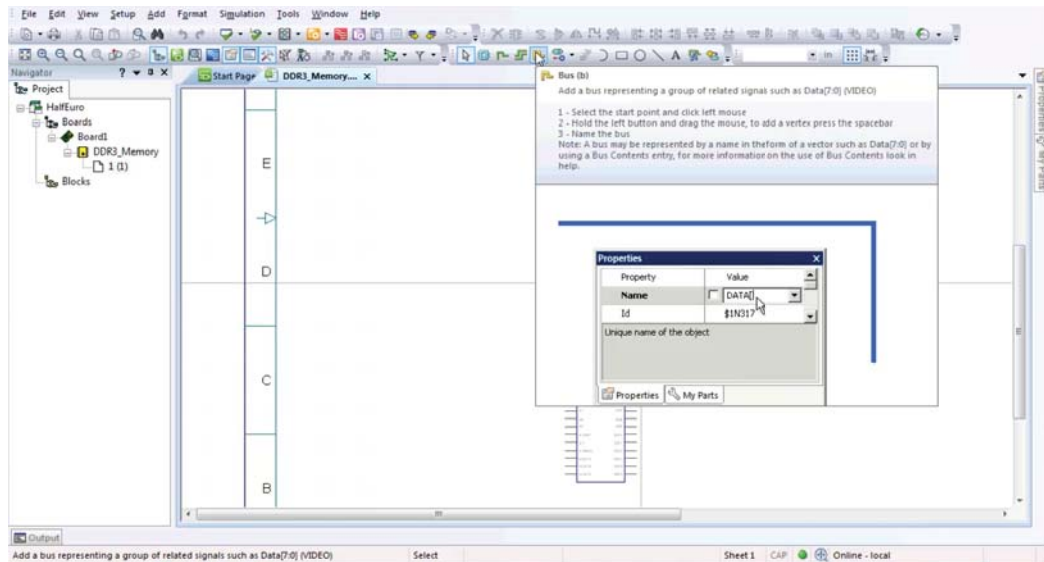
Figure 1: Tooltips allow the designer to quickly get information about a command.

CONTEXT-AWARE INTERFACE SHOWS INFORMATION ONLY WHEN MEANINGFUL

The Xpedition user interface has been optimized to reduce as much clutter as possible. By making the tool context-aware, the user is presented with information only when necessary.

- Tooltips for hierarchical blocks allow the user to preview the content and navigate to the required sheet by double-clicking on the thumbnail.

- When a multi-pin component is inserted into a group of named nets, the net names are highlighted and selected to allow one-click reassignment to the other net, if necessary.
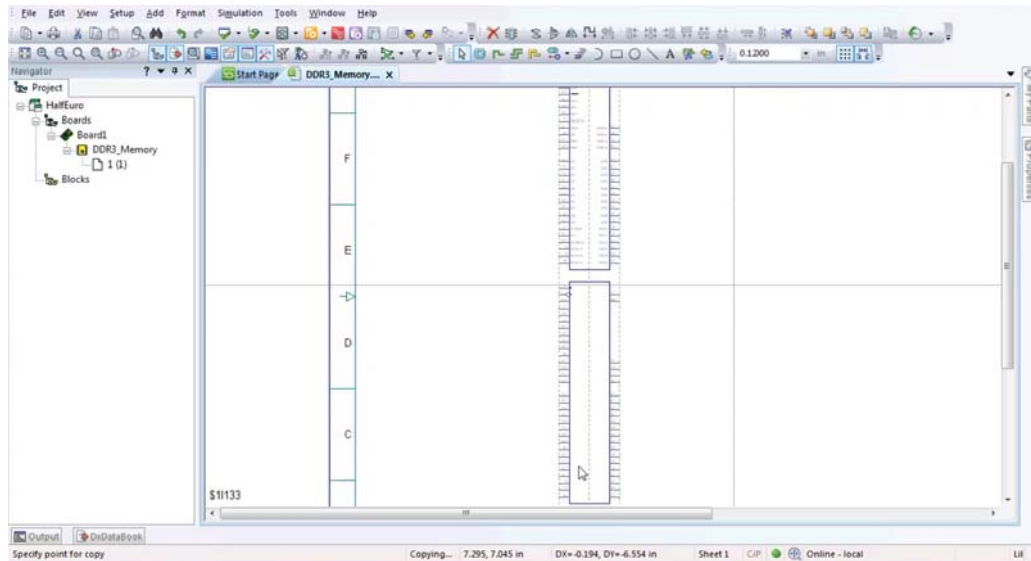
Figure 2: Place parts with ease with context-aware part placement assistance.

FUNCTIONALITY AT YOUR FINGERTIPS

Many of the functions required to capture the design are available without leaving the drawing area, making the design process more efficient.

- Inline text editing allows users to easily insert or replace text, or to perform editing functions such as changing font or color.

- In situ bus/net wiring allows for convenient access to important wiring functions from the mouse's context menu.

- Keyboard accelerators enable you to quickly change selection mode, from fence to overlap or even smart selection of specific elements, all without the need to change global settings.
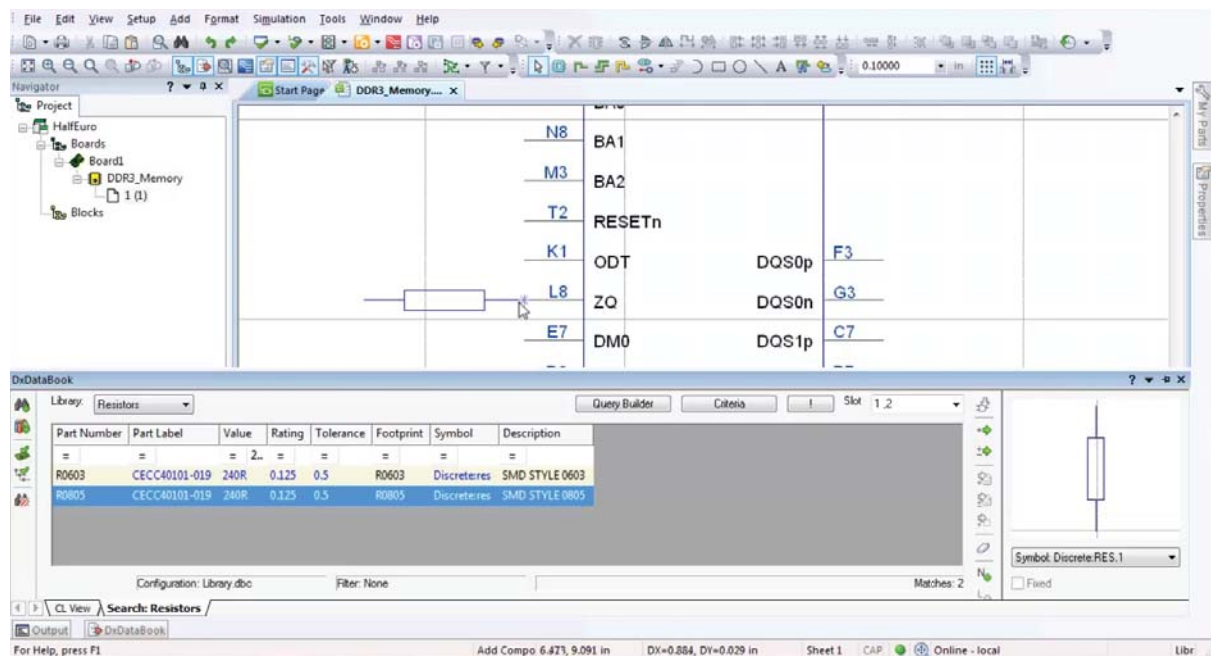
Figure 3: Connections by abutment allow the designer to easily add a net to a design.

DESIGN THE WAY YOU THINK

An add-in dialog provides quick access to favorite parts, special components, and recently used parts, aiding the designer in quickly capturing the design. Combined with dynamic alignment markers that aid in symbol placement, the user is able to create clearly documented schematics with minimal amounts of rework or clean up.
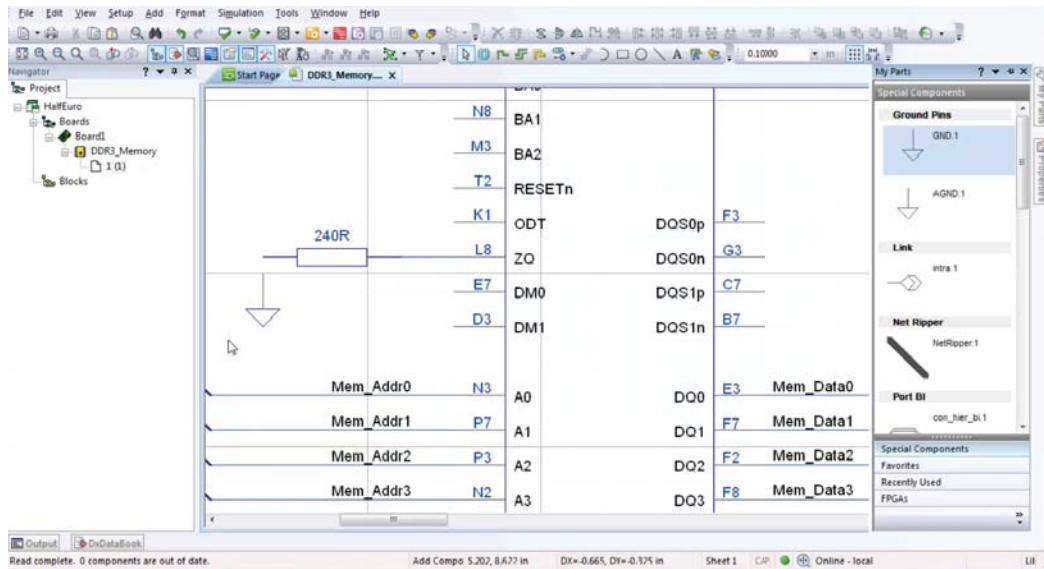
Figure 4: An add-in dialog allows you to quickly access the parts that are most frequently used.

IMPROVED EFFICIENCY THROUGH DESIGN AUTOMATION

Powerful design automation minimizes the effort and number of mouse clicks needed to connect multi-pin symbols.

- Pin selection by individual pin or pin groups provides the flexibility of automated pin-to-pin connections while still allowing you to maintain control over net routing.

- Quickly insert multiple serial components into existing nets, or multi-pin parts into existing wiring, with automatic net splitting and easy user reassignment of net names.
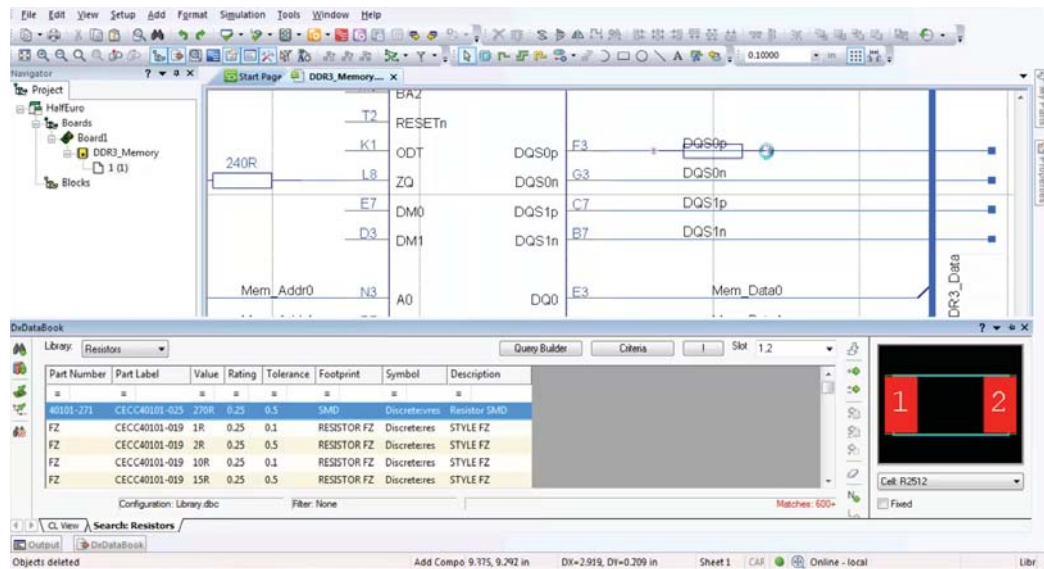
Figure 5: Automatic net splitting saves the designer time and effort.

UNIFIED GUI FOR DIFFERENT DISCIPLINES

A common environment for the designer and librarian provides consistent presentation of graphical objects including fonts, layered graphics, and color schemes. The two environments use the same graphical settings and share the same automation layer.
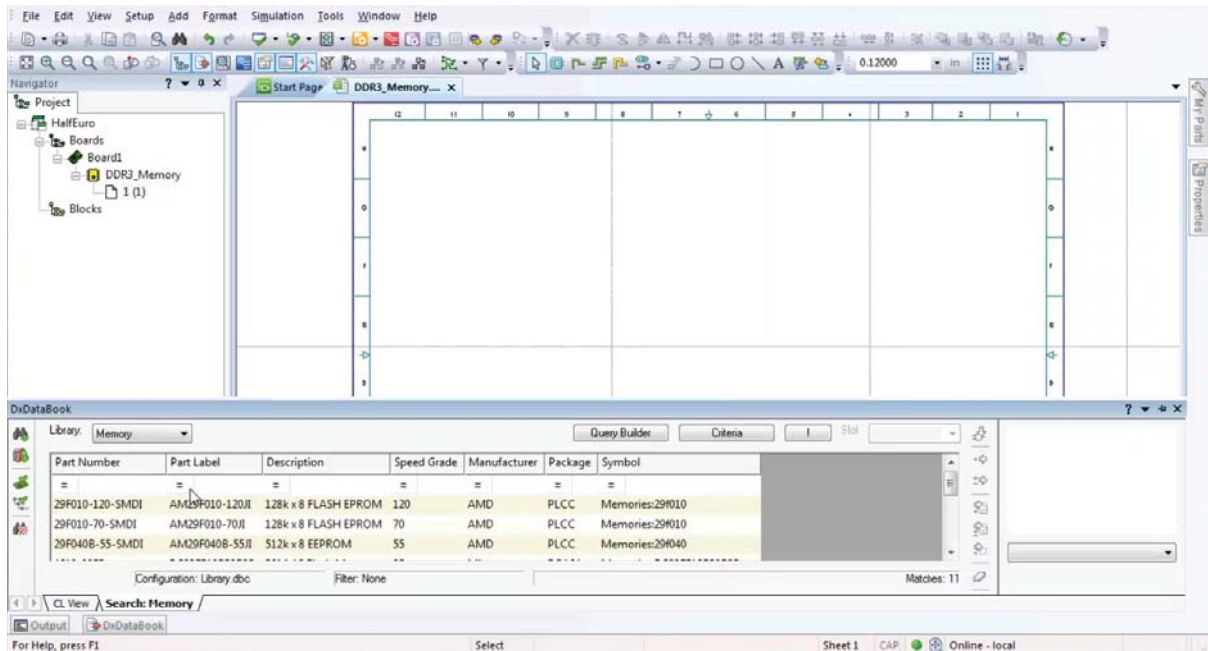
Figure 6: The xDx GUI is customizable, allowing designers to control the look and feel of their workspace.

FLOW GUIDANCE

Each step in the design process prompts the user with options and next steps, extending ease-of-use across the flow, from design creation tasks to integration with PCB layout.

- The optimized user interface helps the user in all steps of the flow, from project management to constraint entry and the integration status of the PCB.

- Tutorials, online help, and other resources are readily available from the start page with quick links to application notes and tech notes.
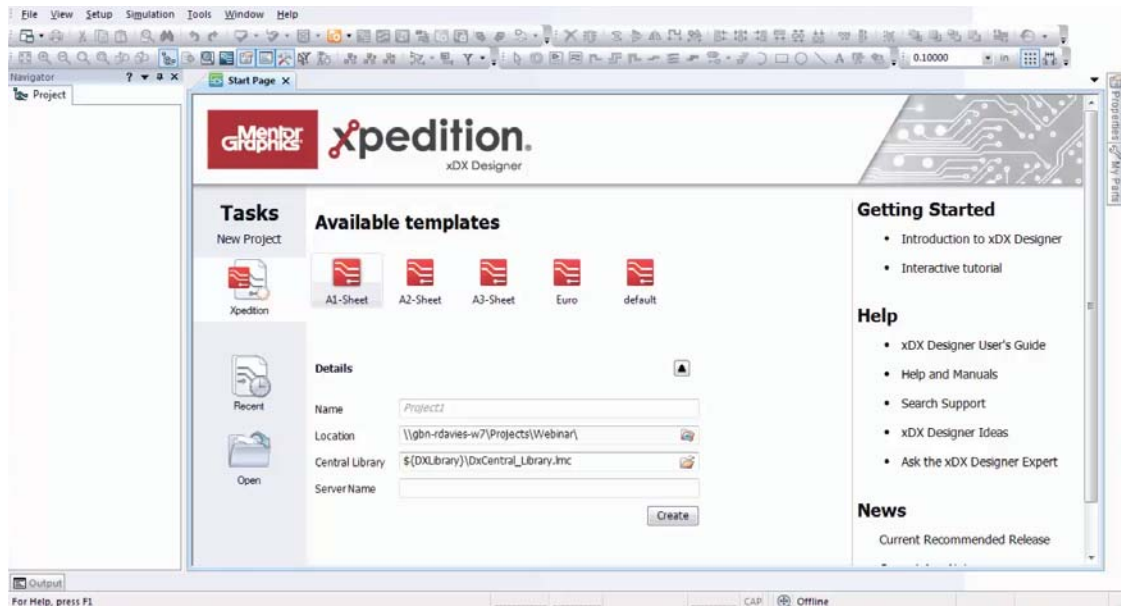
Figure 7: The start page provides quick access to tutorials, documentation, news, and other resources.

SEAMLESS INTEGRATION

Constraint management is built into the design-creation toolset, enabling seamless transfer of intent from engineering to layout, and managing bi-directional changes. As soon as a net is added to the schematic, the user can add constraints, with full support for multi-user concurrent entry.

- Changes can be passed forward to the PCB layout on demand, using a traffic light system. Choose to pass design changes and constraint changes together, or just pass the constraint changes, for greater flexibility in the design flow.

Users can also quickly integrate complex FPGAs into the design and optimize the routing based on the board context.

- With a built-in wizard to aid in part and footprint selection and importing the HDL interface, it takes only a few mouse clicks to include FPGAs in a design. A bi-directional interface ensures that any design changes are fed back to the FPGA flow.
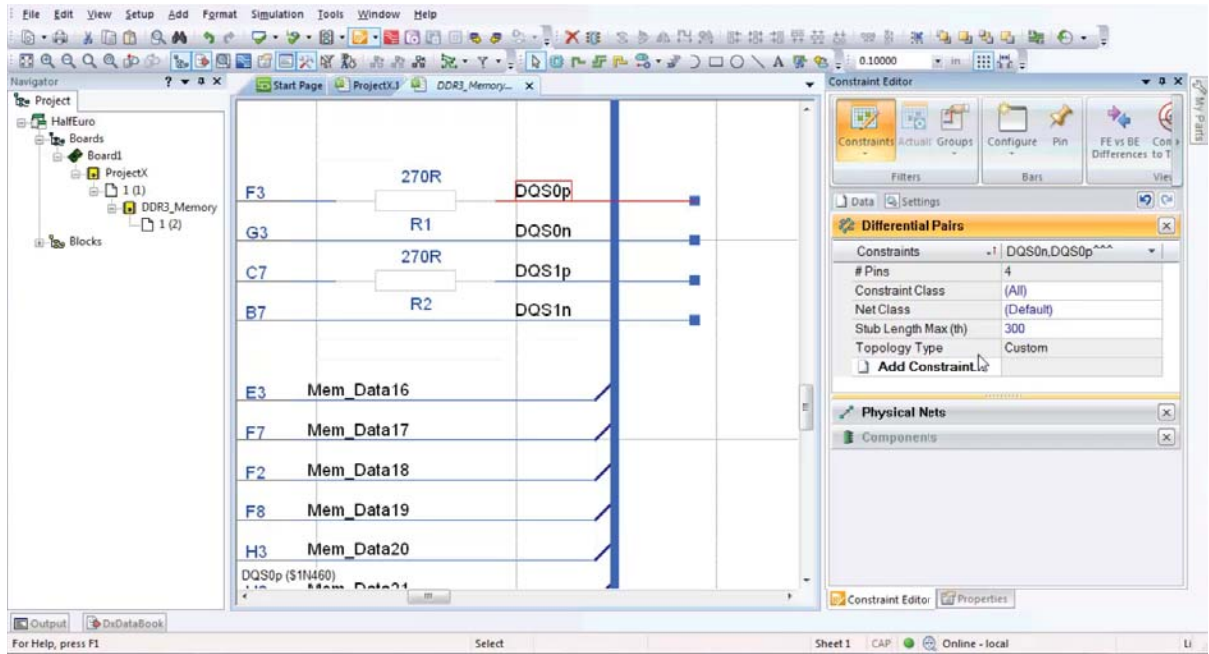
Figure 8: Accessible constraint management allows for enhanced control of the design process.

CONCLUSION

Mentor Graphics has strived to employ the six ease-of-use principles when building the Xpedition design creation tools. With a simple and legible interface that behaves as expected, combined with high levels of automation and flow guidance, Mentor Graphics makes it easy to benefit from a highly productive and efficient design process. With Xpedition, engineers can focus their time and energy on the design task at hand.

For the latest product information, call us or visit: **www.mentor.com**