



Controls Toolkit



Helping you build a better machine, *faster.*

Controls Toolkit

Machine Diagnostics Software



Key Features

- BodeTool™ a powerful software based controls analysis GUI tool that works with Danaher Motion SynqNet controllers
- Advanced sine-sweep and white noise excitation for single or two axis excitation
- Simulate the effects of filter additions without retesting system
- Characterize filters and test quickly before actual implementation
- FilterDesigner™ assists in implementing powerful multistage biquad (notch, low-pass, etc.) filters to your motion code
- Up to six biquad stages per axis (12th order filter) are supported.
- Stability values generated in simulation mode to quantify how stable your servo system is
- Works with all XMP / ZMP type motion controllers including XMP / ZMP-SynqNet controllers
- Network settings allows testing over TCP/IP

Controls Toolkit Includes:  BodeTool  Filter Designer

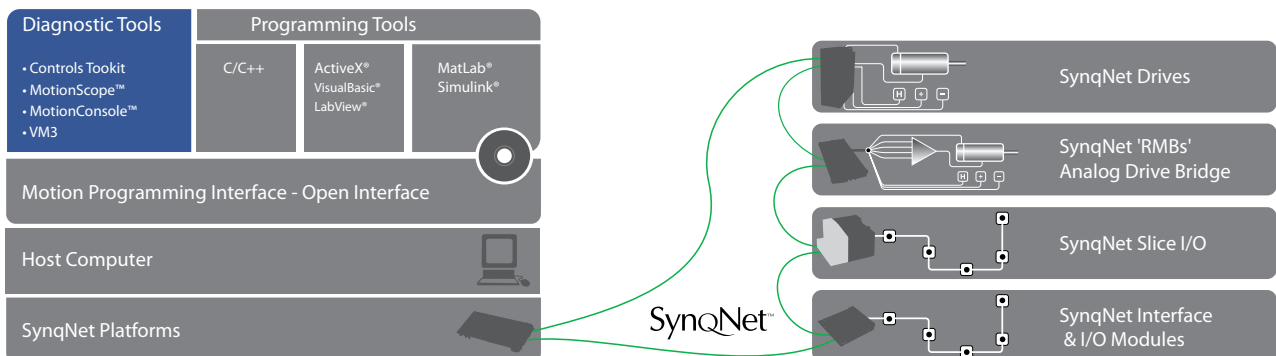
In an ideal world, all mechanical systems can be designed theoretically and then come together elegantly to form the perfect machine. However, even the best laid machine plans can be fraught with unforeseen nuances. So machine builders often must compensate for mechanical anomalies and resonances in motion systems at any given phase of the design cycle. This is where Danaher Motion's Controls Toolkit plays a critical role in machine design.

The Controls Toolkit software package from Danaher Motion includes two integrated Windows® based utilities, BodeTool™ and FilterTool™ designed to work in conjunction with Danaher Motion SynqNet controllers.

Never before has such powerful mechanical characterization software been packaged to work seamlessly with a motion API. The Controls Toolkit exploits the power of Danaher Motion SynqNet controllers to take machine tuning and optimization to a new level.

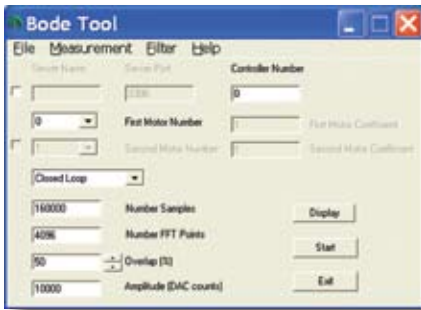
Danaher Motion SynqNet Product Key

The Controls Toolkit works in conjunction with all XMP and ZMP SynqNet controllers. The Controls Toolkit is a key modern software utility that gives the machine designer quantitative visibility into mechanical stability and provides a predictive method for optimizing motion control.



CONTROLS TOOLKIT - BodeTool & FilterDesigner

BodeTool Overview



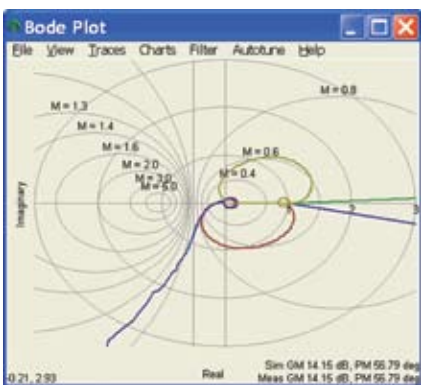
The BodeTool is designed to help the machine builder analyze and compensate for machine resonances. The BodeTool utilizes a Danaher Motion controller to use a sine-sweep or white noise excitation of a single axis, or two axes across a range of frequencies, and record the resulting feedback in several system response formats. Testing can be performed with correlated excitation across two axes and the response of both axes can be tested simultaneously. This data can then be used to compensate for mechanical anomalies by adjusting gains in the control feedback loop. BodeTool parameters can also be input via a command line for automated BodeTool operation.

BodeTool Charts



Bode plot

The red traces indicate the closed loop response while the blue traces simulate the open-loop response.



Nyquist plot

A visual representation of the stability measurement is shown in the Nyquist plot when the "Stability" trace is shown. The stability measurement is shown as a black arrow. The length of the arrow is equal to the stability measurement value in the lower right of the plotting window.

The sine sweep is a series of sine signals that are momentarily constant in frequency and are stepped in frequency between adjacent frequencies. BodeTool frequency parameters can range from below 1 Hz (fractional) up to half the sample rate of the given axis. The entire sine sweep signal is continuous in time (i.e. no discontinuities in time).

The noise test is a faster test than the sine sweep that also has higher resolution at higher frequencies. The sine sweep has better resolution at lower frequencies. Between the two tests, you can get outstanding measurements of your system performance.

The bode plot view is a classic frequency response chart that shows log amplitude and phase vs. log scale frequency. Closed loop, open loop, controller and sensitivity for measured and simulated response can be displayed as different colors on the graph for easy viewing.

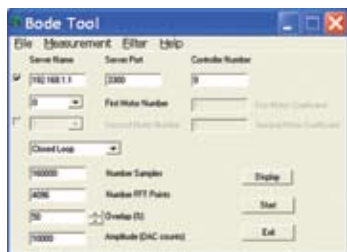
The BodeTool also has the capability to display data in a Nyquist chart format. The Nyquist chart (polar) is often used to determine the stability of a system. The imaginary linear amplitude response is plotted against the real linear amplitude response to give an understanding of potential stability. A quantitative stability measurement is made when a bode test is run. The measurement is displayed quantitatively in the bottom right hand of the plotting window in the Nyquist view option. The real / imaginary vs. frequency response is often used to verify a resonance when the real response is at a local min. or max, while the imaginary response is at a point of inflection at the same frequency.

The Amplitude vs. Phase chart simply plots the log amplitude response vs. the phase response. This plot is often used in conjunction with a Nichols chart.

With a variety of chart view options, the BodeTool is a powerful tool for machine designers to quickly visualize system response. In addition, the data export feature allows further data analysis in 3rd party software programs.



Network Functionality



The BodeTool allows network testing by simply entering the IP address or server name and the port number into the network settings dialog box. Testing over a network can be helpful when the target machine resides far from the developer. Network functionality and data shared among team members helps speed development times.

FilterDesigner



FilterDesigner GUI

The above graph shows the FilterDesigner GUI. This straightforward approach allows a wide range of filter variables to be simulated on a given system quickly.



Filter Simulated

Once the filter is applied, the system response is charted, in this case, the open-loop unfiltered vs. filtered open-loop is plotted.



System Retest

System retested with the actual filter applied.

The Filter Tool works in conjunction with the BodeTool to improve move times and system stability. The Filter Tool provides a graphical interface for specifying multistage biquad filters. Standard biquad filters include notch, low-pass, lead/lag, resonator, etc. All filter parameters are specified in standard engineering units (dB and Hertz).

Different filters can be designed for each axis. Once a sine-sweep is complete through the BodeTool, from this closed-loop response the Filter Tool allows the user to implement the effects of various filter addition to the system. The Bode Tool can simulate the response of a system when a post filter is applied without having to enable or retest the system with the newly applied filter. This allows for multiple filter types and frequency variables to be simulated and fine-tuned in a short amount of time without risk to the actual mechanical system.

Once the appropriate filter is in place the Filter Tool automatically calculates digital coefficients to be downloaded to the cascading biquad filter. Up to six biquad stages per axis (12th order filter) are supported on XMP type controllers. The system can be retested at this point, and a new bode plot can then be analyzed to verify the actual performance of the filter.

Visit our support site at <http://support.motioneng.com> to find out more about the Controls Toolkit and other technology advancements from Danaher Motion. More information about this and other Danaher Motion software is also available at www.danahermotion.com.





*Helping you build a better machine, **faster.***

Danaher Motion -

Helping you build a better machine, faster

Danaher Corporation combined over 30 industry-leading brands such as MEI, Kollmorgen, Thomson, Dover, Pacific Scientific, Portescap, Neff, Seidel and Bautz to establish a customer-focused motion control manufacturing company called Danaher Motion. We offer this powerful set of integrated motion control technologies under the Danaher Motion and Thomson brand names. We are a \$1B+ global motion control leader, unique in our ability to marshal decades of application experience and technical innovation to help you build better machines, faster.

Danaher Motion defines high standards of quality, innovation and technology. We enable improved machine performance and reliability while controlling costs. Our global manufacturing footprint, rapid customization and prototyping capabilities drive quick lead times. Unmatched application experience and design expertise empowers you to commission machines faster.

Consider your options in today's market for a motion control partner. Select Danaher Motion and join a team with 6100 employees, over 60 years of application experience and 2000+ distributor locations around the globe. Danaher Motion serves industries as diverse as semiconductor, aerospace and defense, electric vehicle systems, packaging, printing, medical and robotics. We offer an unparalleled depth and breadth of motion control product solutions through a worldwide service and support infrastructure, field service engineers and support teams available when and where you need them.

The Danaher Business System -

Building sustainable competitive advantage into your business

The Danaher Business System (DBS) was established to increase the value we bring to customers. It is a mature and successful set of tools we use daily to continually improve manufacturing operations and product development processes. DBS is based on the principles of Kaizen which continuously and aggressively eliminate waste in every aspect of our business. DBS focuses the entire organization on achieving breakthrough results that create competitive advantages in quality, delivery and performance – advantages that are passed on to you. Through these advantages Danaher Motion is able to provide you faster times to market as well as unsurpassed product selection, service, reliability and productivity.

Local Support Around the Globe

