

LISTEN.
THINK.
SOLVE.SM

Motion Sizing and Selecting



MotionAnalyzer
Design Motion Control Systems

1. What is Motion Analyzer?

2. What is New?

3. Using Motion Selector

4. What is coming in V4.5 and beyond?

1. What is Motion Analyzer?

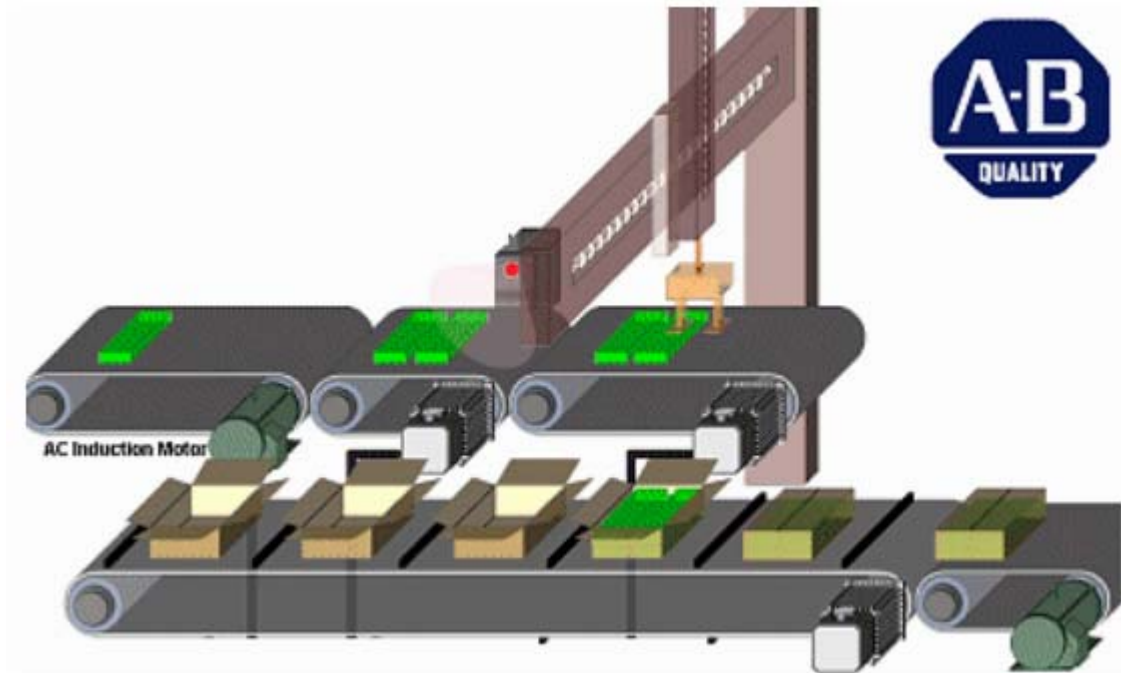
2. What is New?

3. Using Motion Selector

4. What is coming in V4.5 and beyond?

What is Motion Analyzer?

Servo motor and drive sizing software!



Machine Info



MotionAnalyzer
Design Motion Control Systems



Motor and
Drive
Selection

What is Motion Analyzer?

Enter the cycle profile for each axis...

Indexing Cycle Profile

Type of Motion Curve: Trapezoidal

Motion Parameters

Move Distance: 10 in

* Move Time: 1 sec
(Excludes Settling Time)

Dwell Time: 1 sec
(Includes Settling Time)

Computed Parameters

Accel Time: 0.33333 sec

Decel Time: 0.33333 sec

Max Velocity: 15 in/sec

Accel Rate: 45 in/sec²

Decel Rate: 45 in/sec²

Multi Segment Profile

Enter the parameters for this segment. Enter any two of the motion parameters and the others are automatically calculated.

Segment No.	1	2	3	4
Curve Type	S	S	S	S
Initial Vel.	0	-1100	0	1000
Final Vel.	-1100	0	1000	0
Distance	-18.33	-27.5	16.67	25
Time	2	3	2	3
Acc / Dec	-550	366.7	500	-333.3
Thrust	0	0	0	0
Added Inertia	0	0	0	0

Edit Segment No. 1 Auto Compile

Linear S-Curve

0 rpm

-1100 rpm Entered Value Calculated Value

-18.3333 rev Calculated Value

2 sec Entered Value Calculated Value

-550 rpm/sec Calculated Value

0 N-m

0 kg-m²

Buttons: Compile, Insert, Delete, Clear All, Import, Export

Help OK Cancel

From simple...

To complex

What is Motion Analyzer?

Use the actuator models to enter your machine details

✓ Axis Setup
✓ Cycle Profile
✓ Mechanism
✓ Transmission Stages
Selection

Load Data - Applied to the whole profile

Mass : lb Inclination : 0°

Force (Applied +/-) : lbf 90°

Coeff of Friction : Others rad

(Applies to Load and Table Mass)

Actuator Type: Belt Drive

Drive Roll Inertia : lb-in-s²

*Drive Roll Diameter : in

Idler Roll 2 Inertia : lb-in-s²

*Idler Roll 2 Diameter : in

Idler Roll 3 Inertia : lb-in-s²

*Idler Roll 3 Diameter : in

Idler Roll 4 Inertia : lb-in-s²

*Idler Roll 4 Diameter : in

Table Mass : lb

Belt Mass : lb

Losses : lb-in

Losses (Rotary) = Roll + Other losses (except Table Friction)

Typical Co-efficients

- Lubricated Metal Ways = 0.20 (0.1 - 0.25)
- Ball Slides = 0.01 (0.001 - 0.01)
- Teflon / PTFE = 0.05 (0.03 - 0.05)

What is Motion Analyzer?

Choose from:

Actuator : Belt Drive

Losses (Rotary) = Roll + Other losses (except Table Friction)

Typical Co-efficients ▶

- Lubricated Metal Ways =
- Ball Slides =
- Teflon / PTFE =

Belt actuator

Actuator : Lead Screw

Lead = distance moved per turn
 Inertia = Inertia of leadscrew + bearings + nut
 Pre-load = torque to rotate screw at zero speed due to

Typical Co-efficients ▶

- Lubricated Metal Ways =
- Ball Slides =
- Teflon / PTFE =

Lead screw

Actuator : Chain & Sprocket

Losses (Rotary) = Sprocket + Other losses (except Table Friction)

Typical Co-efficients ▶

- Lubricated Metal Ways =
- Ball Slides =
- Teflon / PTFE =

Chain & Sprocket

Actuator : Rack & Pinion

Losses = Losses in rack + pinion etc.
 PCD = Pitch circle diameter (less than OD)

Typical Co-efficients ▶

- Lubricated Metal Ways = 0.20 (0.1 - 0.25)
- Ball Slides = 0.01 (0.001 - 0.01)
- Teflon / PTFE = 0.05 (0.03 - 0.05)

Or Rack & Pinion

What is Motion Analyzer?

Search for a motor and drive solution

The screenshot displays the 'Axis Data - Vertical Lead Screw' software interface. The top navigation bar includes tabs for 'Axis Setup', 'Cycle Profile', 'Mechanism', 'Transmission Stages', 'Selection', 'Solutions', and 'Axis Stop'. The 'Selection' tab is active. The main window shows 'Motor Type' with radio buttons for 'Motor' (selected), 'Motor with Gearbox', and 'Allen Bradley Integrated Gearmotor'. Below this are 'Gear Parameters' and 'Motor Parameters' sections. A 'Search In Progress' dialog box is overlaid in the center, containing a progress bar and an 'Abort' button. The dialog text reads: 'Motion Analyzer is searching the suitable solution for this axis. Click 'Abort' to abort the search.' At the bottom of the interface, there is a table for selecting components, a 'View Load Graph' button, and a 'Search' button circled in red.

Axis Data - Vertical Lead Screw Product Family : KINETIX 6000

Axis Setup Cycle Profile Mechanism Transmission Stages Selection Solutions Axis Stop

Motor Type : Motor Motor with Gearbox Allen Bradley Integrated Gearmotor

Gear Parameters Motor Parameters

Manufacturer : Alpha +

Configuration : ALL

Series : SP

Frames : All (080,01

Solutions within the Max. Inertia Ratio

Change

Change

User Marked

Please choose the mode of selection

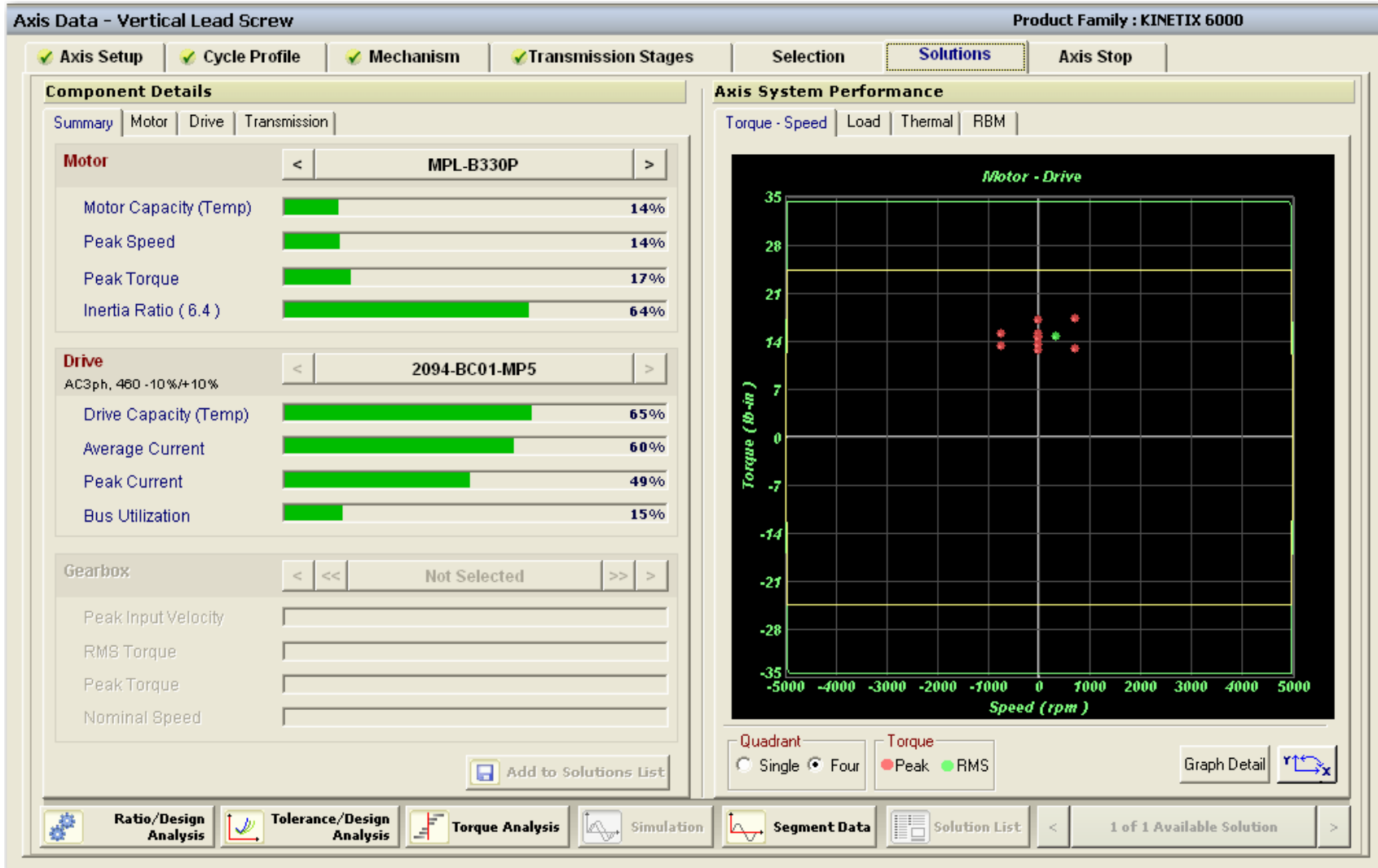
	Manual	Automatic		
Motor	<input type="radio"/>	<input checked="" type="radio"/>	Select	Current Selection : MPL-B330P
Drive	<input type="radio"/>	<input checked="" type="radio"/>	Select	Current Selection : 2094-BC01-MP5

Select Manual to choose your Components.
Select Automatic to have Motion Analyzer select for you.

View Load Graph Search

What is Motion Analyzer?

Observe the results...



What is Motion Analyzer?

Or look for a better solution with the Analysis Tools

The screenshot displays the Motion Analyzer software interface. At the top, there are five main tool buttons: Ratio/Design Analysis, Tolerance/Design Analysis, Torque Analysis, Simulation, and Segment Data. The 'Torque Analysis' button is currently active, opening a dialog box.

The background shows a graph titled 'Gearboxes' with a y-axis ranging from 0 to 120 and an x-axis from 0 to 1. A red vertical line is positioned at 0.6944 on the x-axis. Several curves are plotted, with a red curve being the most prominent.

The 'Torque Analysis' dialog box has two tabs: 'Peak Torque Analysis' and 'RMS Torque Analysis'. The 'Peak Torque Analysis' tab is selected. It shows 'Segment Number 1 of 6' and 'Critical Segment'. Below this is a table of torque components:

Component	Percentage	Progress Bar
Gravitational	84%	[Progress bar showing 84%]
Friction Torque	17%	[Progress bar showing 17%]
Leadscrew Losses	12%	[Progress bar showing 12%]
Slide Mass	3%	[Progress bar showing 3%]
Motor Losses	2%	[Progress bar showing 2%]
Motor Inertia	1%	[Progress bar showing 1%]

At the bottom of the dialog box, there is a 'Help' button, a text note: 'Any discrepancy in the sum of percentages is due to rounding off to the absolute value. Percentages shown are displayed against the Application Peak Torque', and a 'Return' button.

The main interface also has a 'Selected Curves' section with 'Ratio' and 'Peak' options, and 'Help' and 'Apply Selection' buttons at the bottom.

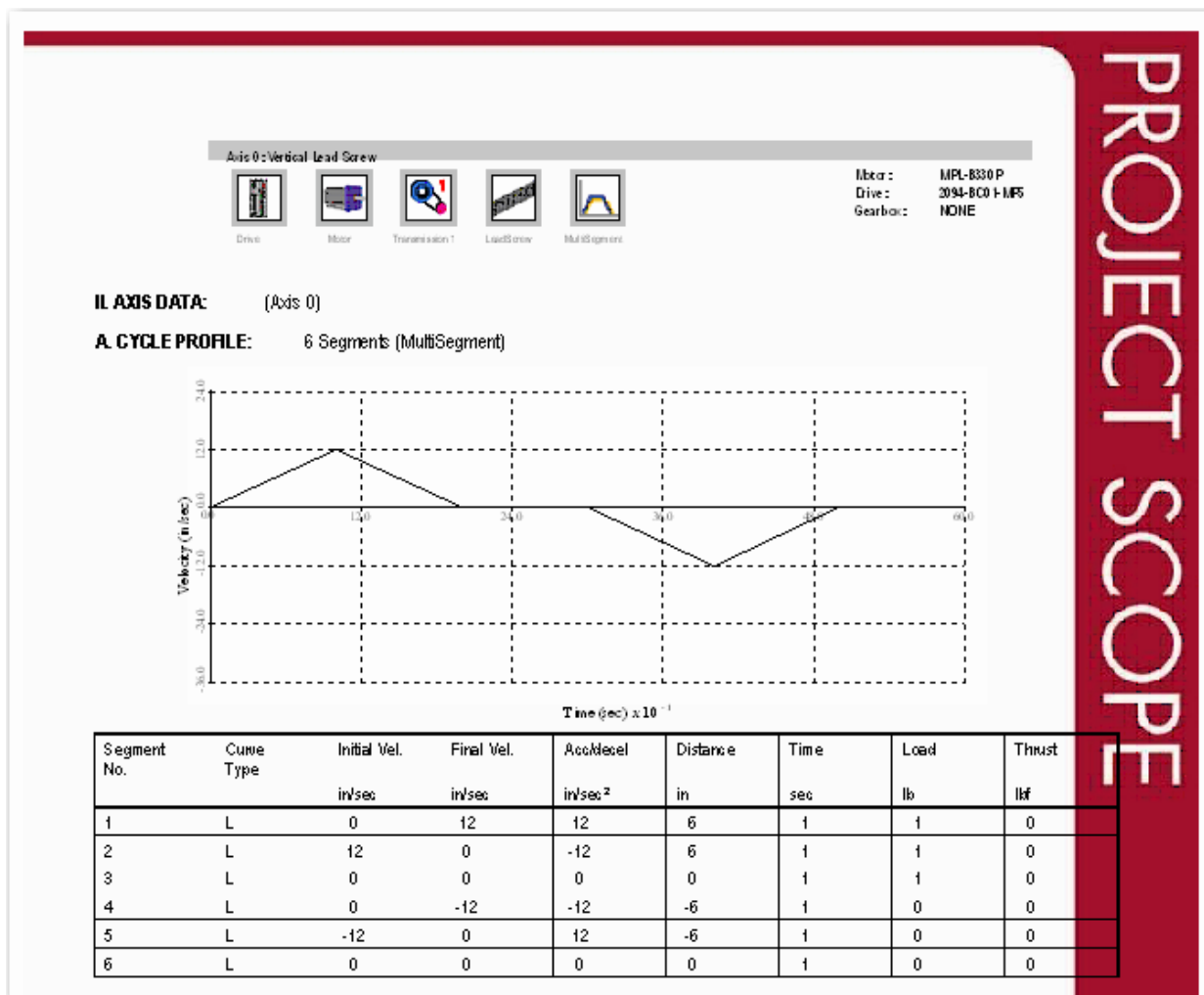
View the finished system

The screenshot displays the 'System View' window of the Motion Analyzer software. The window title bar includes 'System View', 'Number of Power Rail Slots Required by Application= 3', and 'Product Family: KINETIX 6000'. On the left, a tree view shows a root node '2094-BC01-MP5 Shunt: INTERNAL' connected to three axis nodes. Each axis node is expanded to show its configuration details.

Axis No.	Configuration	Motor	Drive	Gearbox
0	Vertical Lead Screw	MPL-B330P	2094-BC01-MP...	NONE
1	Horizontal Lead Screw	MPL-B320P	2094-BMP5	NONE
2	Belt Indexer	MPL-B230P	2094-BMP5	SP060S-MF2-16...

What is Motion Analyzer?

Print a system report



PROJECT SCOPE

Where can I get Motion Analyzer?

You can obtain your *free* copy of Motion Analyzer software:

- By visiting <http://www.ab.com/motion> and downloading Motion Analyzer today
- By a copy of Kinetix Accelerator Toolkit **PUB # IASIMP-SP004-ENC**



1. What is Motion Analyzer?

2. What is New?

3. Using Motion Selector

4. What is coming in V4.5 and beyond?

What is New?

- Kinetix 2000!
- Actuators!
- Larger screen format
- System Notes – always visible and direct editing
- Axis Setup tab with improved graphics to aid data input



What is New?

- Cycle Profile Tab
 - Wider graph display
 - Variable Jerk (% time) to match the new MAM instruction in Logix V16.
 - Accel/Decel rates reported (Indexing Profile) could be used to populate a MAM instruction.

Indexing Cycle Profile

Type of Motion Curve : Trapezoidal S-Curve 30 % Jerk

Motion Parameters

Move Distance : 200 mm

* Move Time : 1 sec
(Excludes Settling Time)

Dwell Time : 0.1 sec
(Includes Settling Time)

Load Data

Thrust : 0 N

Load : 0 kg

Computed Parameters

Accel Time : 0.50974 sec

Decel Time : 0.17447 sec

Max Velocity : 304 mm/sec

Accel Rate : 701.63078 mm/sec²

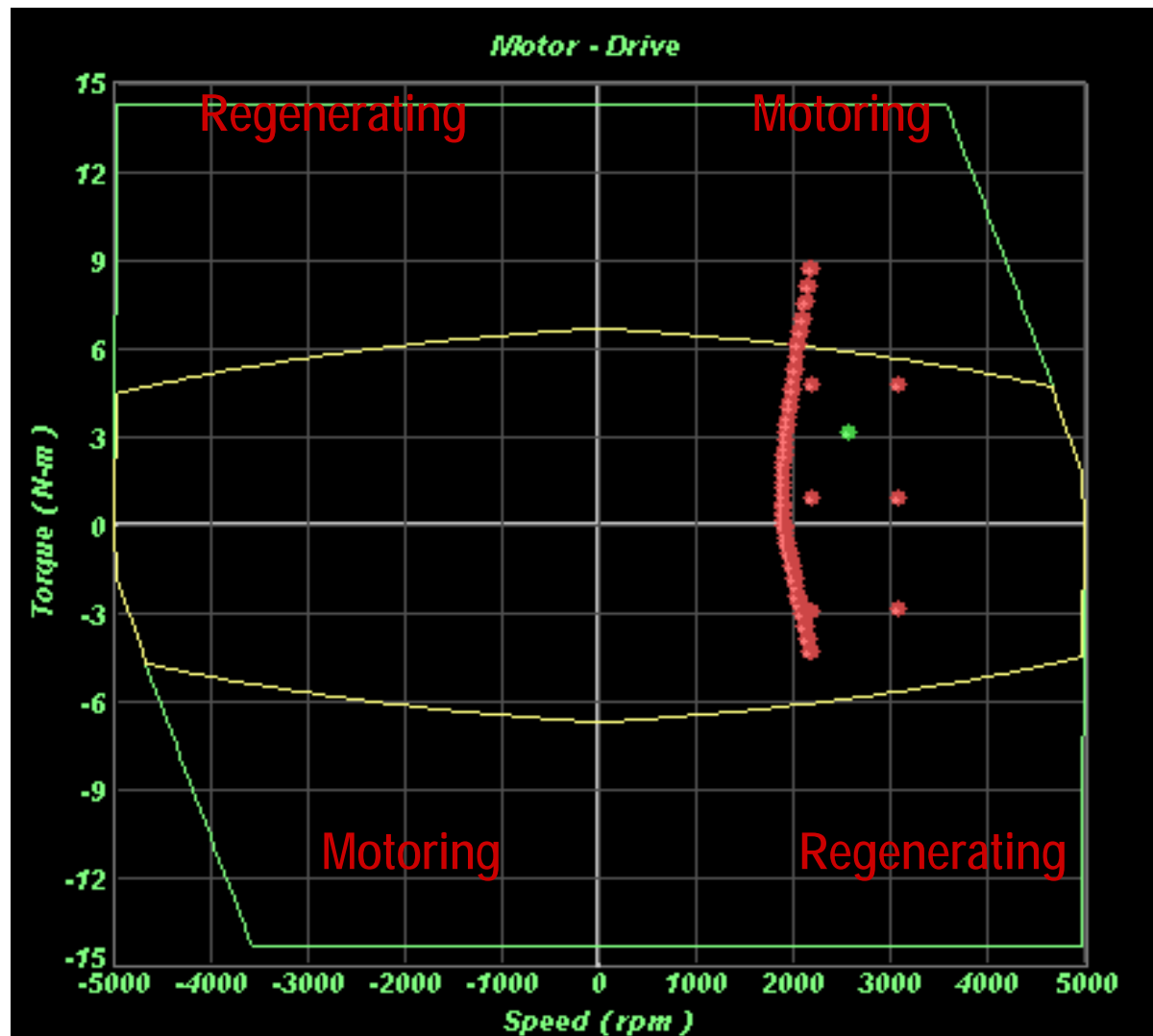
Decel Rate : 2049.86248 mm/sec²

Profile Data Use the sliders to adjust the Motion Profile.
Display is shown for the case of 100% Jerk

Help OK Cancel

What is New?

- Solutions Tab
 - Four Quadrant Torque/Speed display (can be switched back to 2 Quadrant)
 - This shows that the regenerative Torque/Speed curve is actually different from the motoring one that is all we normally see.
 - This is very helpful when complex cam profiles are examined



What is New?

Solutions Tab

- Up/down stepping of motor and drive sizes (< >)
- Up/down stepping of gearbox ratio (< >) and frame size (<< >>)



Component Details

Summary | Motor | Drive | Gearbox

Motor < MPL-A1510V >

Motor Capacity (Temp)		55%
Peak Speed		53%
Peak Torque		77%
Inertia Ratio (18.2)		182%

Drive < 2093-AMP1 >

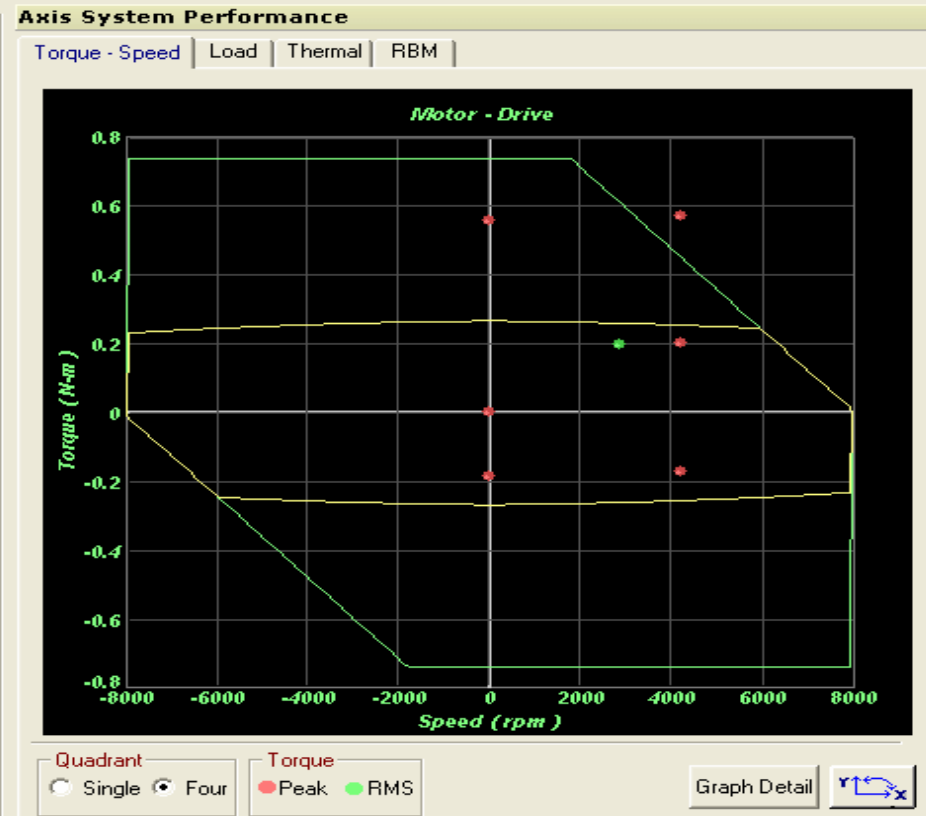
AC1ph, 230 -10%/+10%

Drive Capacity (Temp)		66%
Average Current		35%
Peak Current		52%
Bus Utilization		116%

Gearbox(10:1) << LP050-MO1-10-110 >>

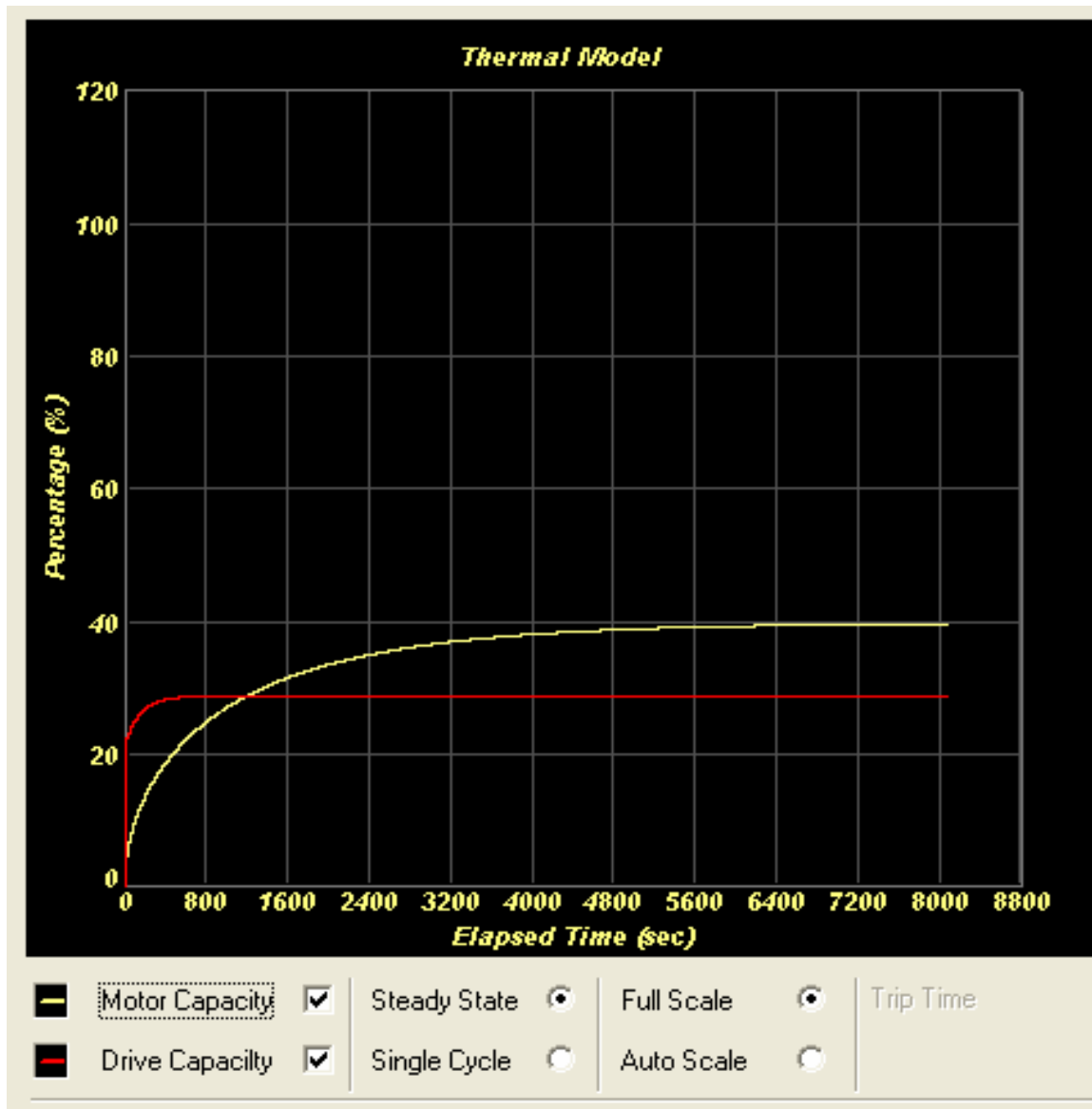
Peak Input Velocity		53%
RMS Torque		29%
Peak Torque		42%
Nominal Speed		72%

Add to Solutions List



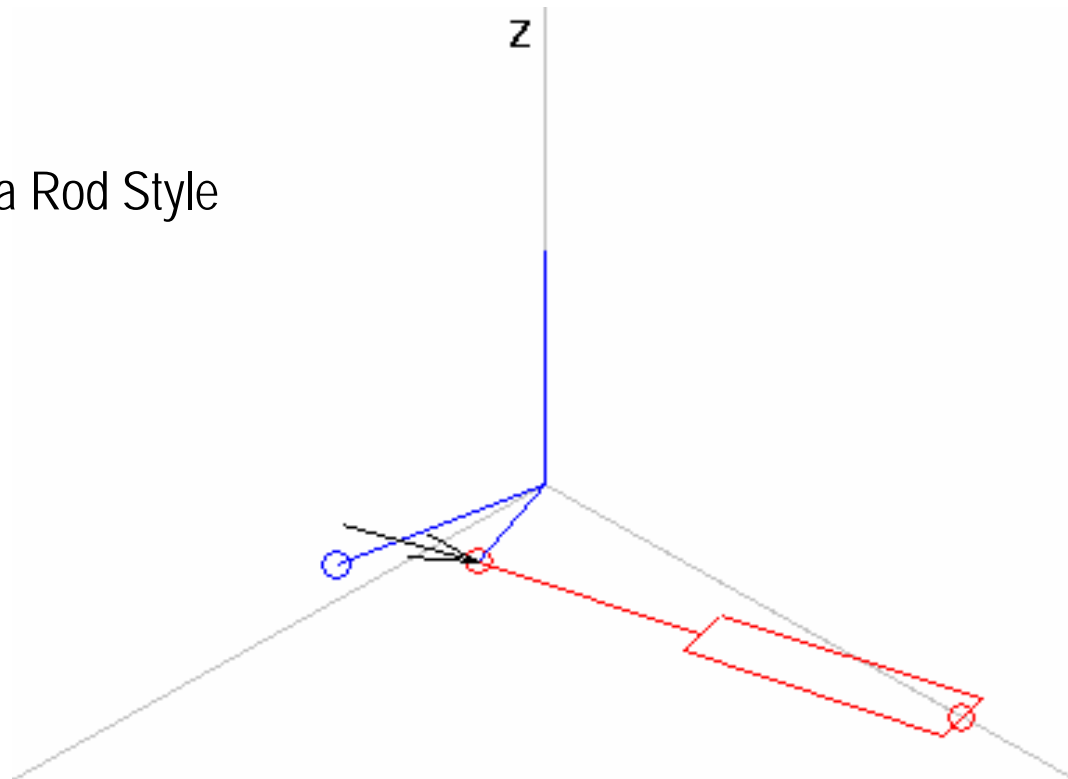
What is New?

- Solutions Tab
 - Analysis of drive thermal overload behaviour
 - Addition of "Drive Capacity" as defined by the thermal overload function.



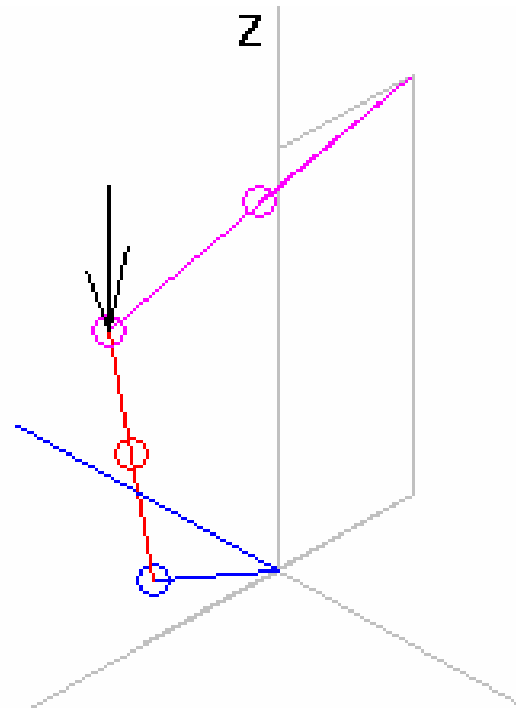
What is New?

- New User Defined Templates
 - Inverse Crank
 - A rotary load driven by a Rod Style Actuator



What is New?

- New User Defined Templates
 - Four Bar Linkage
 - A crank driving an oscillating radius arm




- Sizing support for linear stages!

Axis Setup Cycle Profile Mechanism Selection

Load type : Linear Rotary

Actuator type : User Defined Actuator Allen Bradley Integrated Linear Actuator Allen Bradley Integrated Linear Stage



Voltage Selection

Supply Type : AC 1 phase AC 3 phase DC

Voltage Type : Single Range

*Nominal Voltage: Tolerances % - +

Motor / Drive Parameters : Max. Ambient: °F Altitude: ft

Axis Name :

More Info in the MPAS Topic...

1. What is Motion Analyzer?

2. What is New?

3. Using Motion Selector

4. What is coming in V4.5 and beyond?

Turn your Motion Analyzer file into a *complete* Bill of Material

The screenshot shows the Rockwell Automation Motion Selector web interface. The page has a header with the Rockwell Automation logo and the title "MOTION SELECTOR". A left sidebar contains navigation links: "New Configuration", "Open Existing Configuration", and "Exit Motion Selector". The main content area is titled "Home" and "Welcome to Motion Selector". It features three main sections: "Create a Quick Quote" with a text input field containing "Untitled Quick Quote" and a "continue" button; "Create a new Configuration" with a text input field containing "Untitled Configuration" and a "continue" button; and "Open existing Configuration" with a folder icon, a text input field, and a "browse" button. Below these sections is a table with columns: "Configurations", "Last Updated", "Location/Description", and "Action".

Configurations	Last Updated	Location/Description	Action
----------------	--------------	----------------------	--------

Add the cables and accessories that you need

Step 5: Motor/Actuator Power Cable

Motor Power Cable Cable Length :

Selected Power Cable: No Power Cable selected

Step 6: Motor/Actuator Feedback Cable

Feedback Cable with molded connectors Cable Length :

Universal Motor Feedback Cable without drive end connectors (Connectors available in Accessories) Cable Length :

Selected Feedback Cable: No Feedback Cable selected

Step 7: Motor/Actuator Brake Cable

Brake Cable Cable Length :

Selected Brake Cable: No Brake Cable selected

Step 8: Resistive Brake Module

None 2090-XB33-32 2090-XB33-16

2090-XB120-06 2090-XB120-03 2090-XB120-01

View the Bill of Material and export to desired format

MOTION SELECTOR

Pick and Place Example

- ▶ System Configuration
- ▶ Additional BOM
- ▶ BOM view
- ▶ Export to Excel (Extract)
- ▶ Export to PDF
- ▶ Export to Word
- ▶ Save
- ▶ Save As
- ▶ Exit Configuration

BOM View

▶ **Export to Excel (Extract)**

▶ **Export to PDF**

▶ **Export to Word**

Item	Part No	Quantity	Description
1	2094-PRS3		
2	2094-B10S		
4	1768-M04SE		
5	2090-K6CK-D15		
6	2090-K6CK-D26		
7	2090-SCEP3-0		
8	2094-BC01-MP5-S	1	Integrated Axis module 460V, 6kW
9	MPL-B330P-MK24AA	1	Motor, 8.36 N-m (74 lb-in.), 3000 rpm motor
10	2090-XXNPMP-16S03	2	CABLE, NON-FLEX, MOTOR POWER, MP, 16 GAUGE, 3M
11	2090-XXNFMP-S03	2	CABLE, NON-FLEX, MOTOR FEEDBACK, MP, 3M
12	2090-UXNBMP-18S03	1	CABLE, NON-FLEX, MOTOR BRAKE, 3M
13	2094-BMP5-S	2	Axis Module 460V, 5.9A
14	MPL-B320P-MK22AA	1	Motor, 5.64 N-m (49.9 lb-in.), 5000 rpm motor
15	MPL-B230P-VJ42AA	1	Motor, 4.74 N-m (42 lb-in.), 5000 rpm motor
16	2090-XXNPMF-16S03	1	CABLE, NON-FLEX, MOTOR POWER, MF, 16 GAUGE, 3M
17	2090-XXNFMF-S03	1	CABLE, NON-FLEX, MOTOR FEEDBACK, MF, 3M

▶ **Additional BOM Items**

Item	Part No	Quantity	Description
1	2090-SCEP0-1	2	Cable, SERCOS fiber optic plastic cables only suitable for use inside an enclosure, 0.1m

27

1. What is Motion Analyzer?

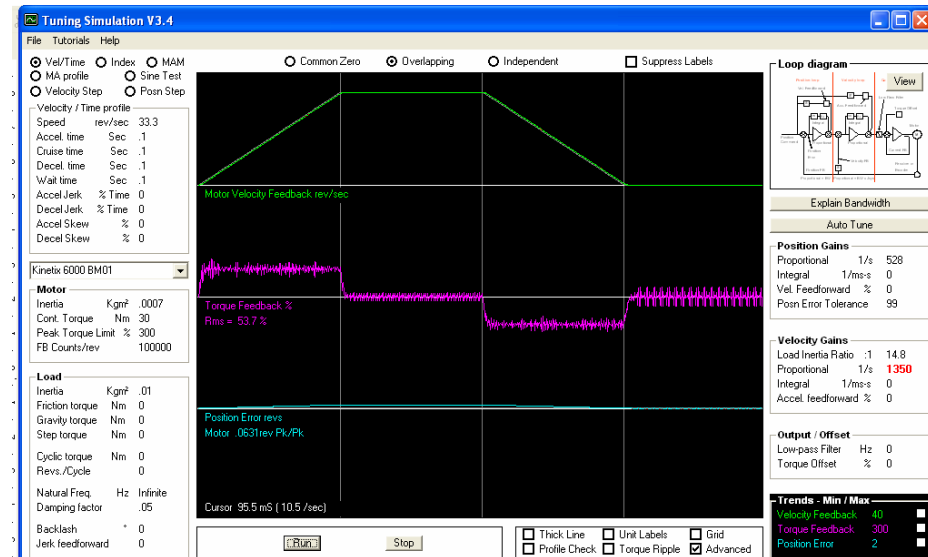
2. What is New?

3. Using Motion Selector

4. What is coming in V4.5 and beyond?

- Version 4.5
 - Move profile editor:
 - More Quick Index tools
 - CAM moves
 - Export moves & to Logix (AOI)
 - SolidWorks (import inertia)
 - Standard drives support
 - *Scheduled May 2008*

- Version 5.0
 - Greatly improved architecture
 - “Fill in the Form” model
 - More profile editor enhancements
 - More SolidWorks interaction
 - *Scheduled Fall 2008*



LISTEN.
THINK.
SOLVE.SM

Motion Sizing and Selecting



MotionAnalyzer
Design Motion Control Systems

Schaedler Yesco
EXPO 2008