

## Quick Start

Original Instructions

# Tuningless Feature Configuration

Kinetix 5300, Kinetix 5500, and Kinetix 5700 Servo Drives

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## Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

<b>Topic</b>	<b>Page</b>
Added references to Kinetix® 5300 servo drives	throughout
Updated screen captures to reflect latest version of the Studio 5000 Logix Designer® application	throughout

## Introduction

Closed-loop servo systems require settings for the control loop gains and filter values to make sure that the load accurately follows the desired input-command signal. The process of adjusting and refining the gain and filter configuration is called tuning.

Appropriate tuning settings depend heavily upon the system characteristics. Each machine behaves differently due to variables such as compliance, backlash, changing inertias, manufacturing tolerances, and machine degradation, so the tuning configuration can vary greatly from one machine to the next.

With the tuning features of the Kinetix® 5300, Kinetix 5500, and Kinetix 5700 servo drives, tuningless operation can now be achieved without compromising on performance. By using both the load observer and the tracking notch filters in the servo drives, most applications no longer require tuning procedures and tests during the commissioning process to achieve an effective level of machine performance.

## Load Observer

The load observer feature operates in real time while the machine is running. During machine operation, the load observer estimates the mechanical load inertia on the motor and compensates for it. The result is that the drive controls the motor as if it is unloaded, which provides a relatively high level of drive performance. In addition, the drive automatically compensates for mechanical variations in the system such as changing loads, compliance, and machine wear over time.

## Configuration

The following steps describe how to configure an axis with the recommended load observer settings for most applications. With the Logix Designer application version 33 and later, the load observer feature is enabled by default for the following drives, so these configuration steps are not required for tuningless operation:

- Kinetix 5300 drives
- Kinetix 5700 ERS3 Series B drives, with firmware revision 13 and later
- Kinetix 5700 ERS4 drives, with firmware revision 13 and later

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**IMPORTANT** Use the load observer with the tracking notch filters to achieve effective tuningless operation.

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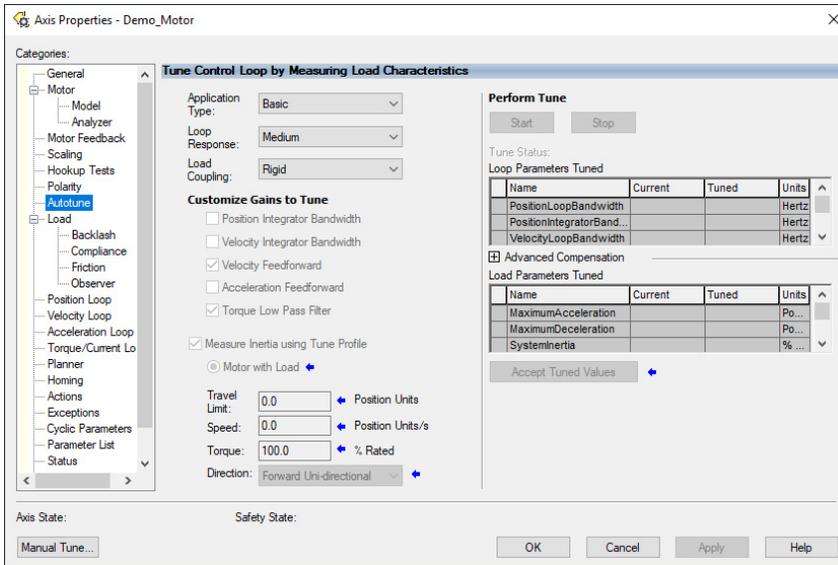
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**IMPORTANT** To ensure stable operation, it is recommended that you do not perform the autotune test when applying the load observer feature.

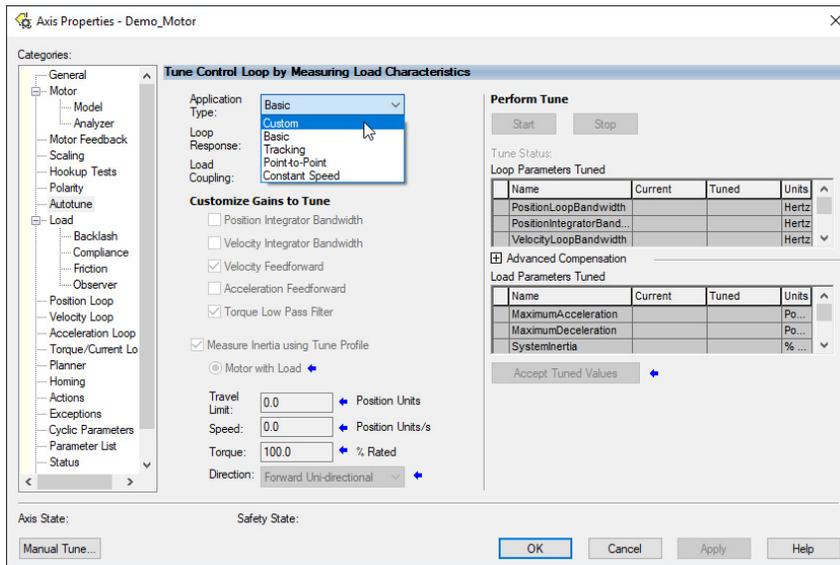
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1. In the Controller Organizer, right-click an axis and choose Properties.

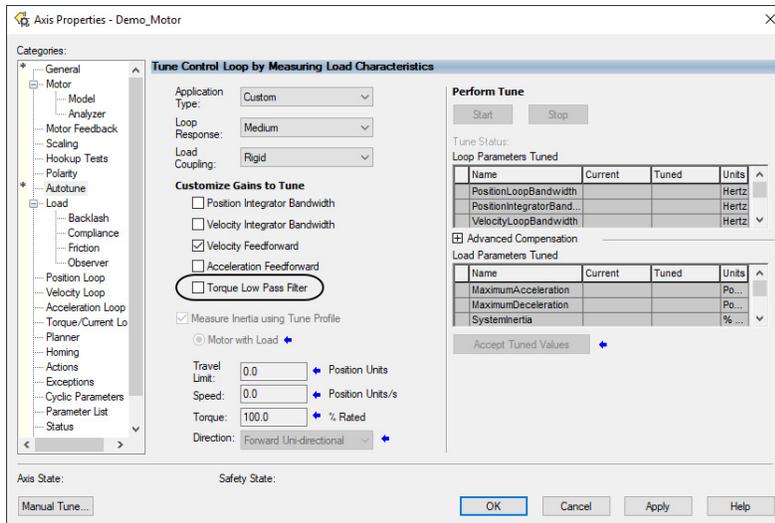
2. Select the Autotune category.



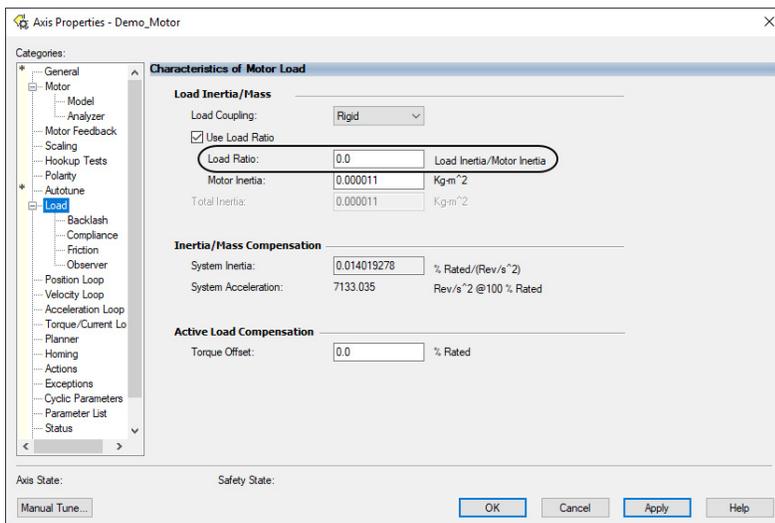
3. From the Application Type pull-down menu, choose Custom.



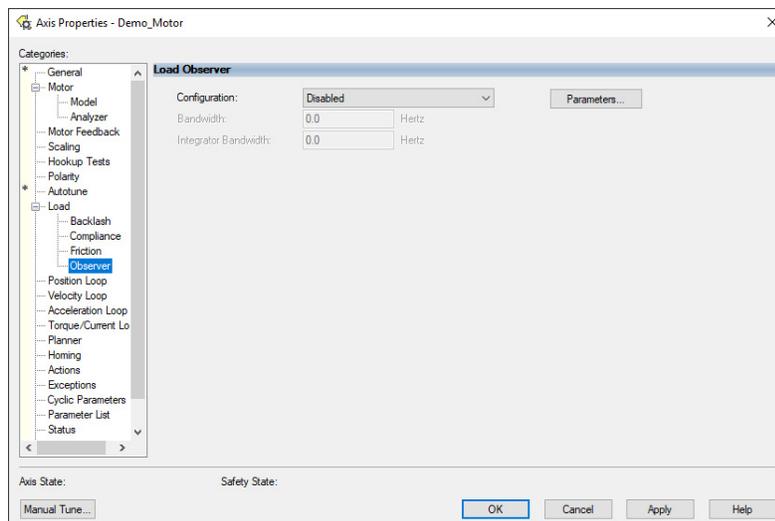
4. Clear the Torque Low Pass Filter checkbox.



5. Select the Load category and verify that the Load Ratio is zero; otherwise, set it to zero.



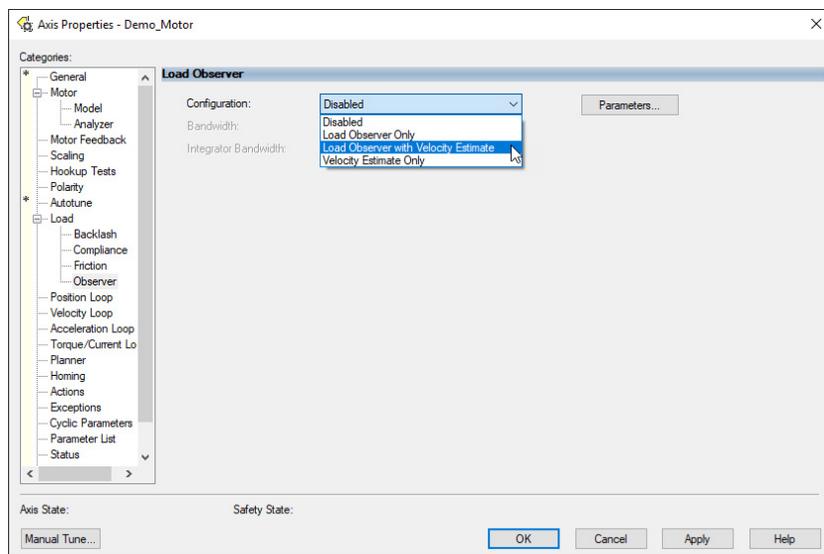
6. Under the Load category, select Observer.



- From the Configuration pull-down menu, choose 'Load Observer with Velocity Estimate' if the axis is configured for Position Loop control or 'Load Observer Only' if the axis is configured for Velocity Loop control. Load Observer is not available for Torque Loop control.



It is recommended that Position Loop control is used for both positioning and velocity applications. In select cases, application requirements may dictate Velocity Loop control.



- Click Apply.

## Adaptive Tuning with the Tracking Notch Filters

The tracking notch filters operate in real time while the machine runs. During machine operation, the drive measures the mechanical resonances in the system and dynamically sets the frequencies of the various notch filters to attenuate the effect of the resonances.

### Configuration

The following steps describe how to configure an axis with the recommended adaptive tuning settings for most applications. With the Logix Designer application version 33 and later, the tracking notch filters are enabled by default for the following drives, so these configuration steps are not required for tuningless operation

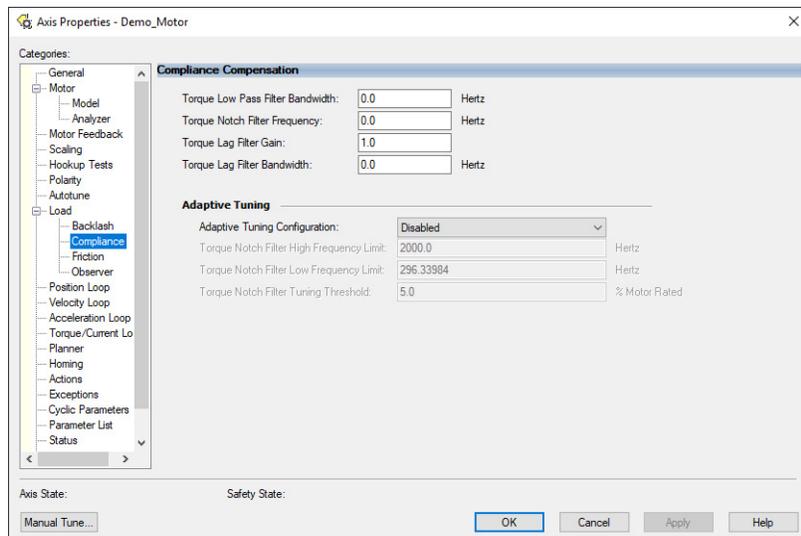
- Kinetix 5300 drives
- Kinetix 5700 ERS3 Series B drives, with firmware revision 13 and later
- Kinetix 5700 ERS4 drives, with firmware revision 13 and later

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**IMPORTANT** Use the load observer with the tracking notch filters to achieve effective tuningless operation.

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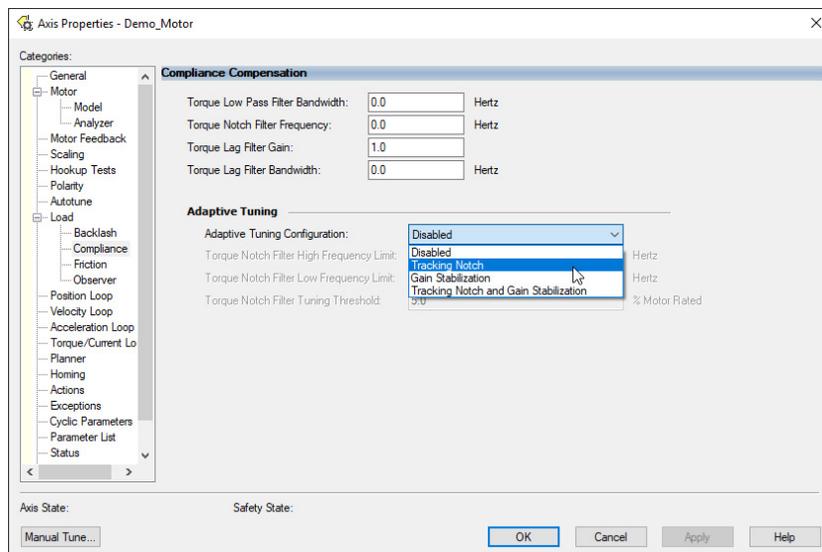
1. In the Controller Organizer, right-click an axis and then choose Properties.
2. Under the Load category, select Compliance.



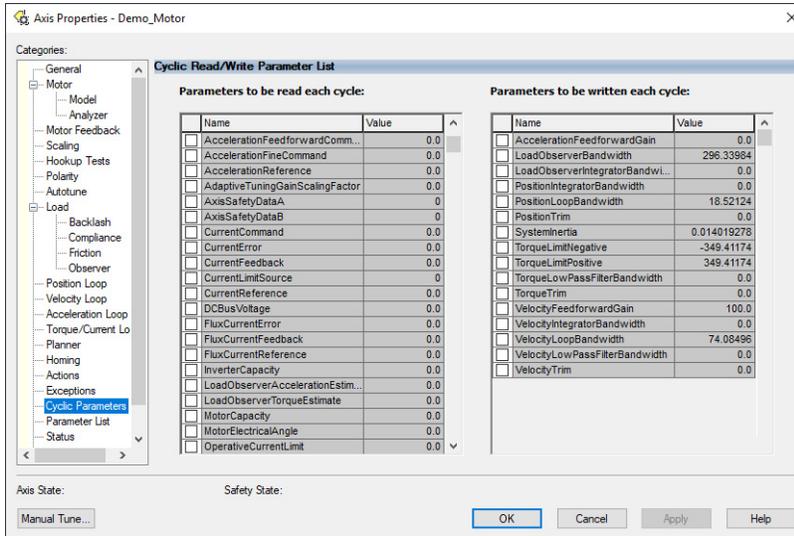
3. From the Adaptive Tuning Configuration pull-down menu, choose Tracking Notch.

With the Logix Designer application version 33 and later, the Compliance category parameters for the following drives will differ since they have four notch filters:

- Kinetix 5300 drives
- Kinetix 5700 ERS3 Series B drives, with firmware revision 13 and later
- Kinetix 5700 ERS4 drives, with firmware revision 13 and later



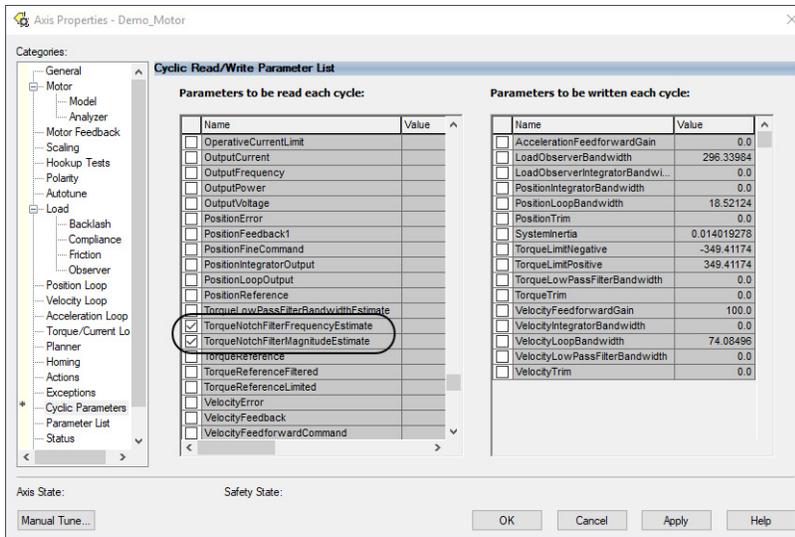
4. Select the Cyclic Parameters Category.



5. Scroll down and check TorqueNotchFilterFrequencyEstimate and TorqueNotchFilterMagnitudeEstimate.



Selecting these parameters is optional. They are available to assist with commissioning and provide diagnostic information.



6. Click Apply.

## Additional Considerations

For more detailed technical information on the operation of the load observer or adaptive tuning features, see Chapter 1 of Motion System Tuning Application Techniques, publication [MOTION-AT005](#).

### Notch Filter Initialization

With the Logix Designer application version 33 and later, the drive will persist adaptive tuning values through a drive power cycle for the following drives:

- Kinetix 5300 drives
- Kinetix 5700 ERS3 Series B drives, with firmware revision 13 and later
- Kinetix 5700 ERS4 drives, with firmware revision 13 and later

For details on how to retain the notch filter settings when power is removed and reapplied to the system, see Knowledgebase Technote [Retaining Notch Filter Frequency through System Power Cycle](#).

### Increased Performance

Manual tuning may be used if higher performance is required after applying the default load observer gain values. It is recommended that you incrementally increase the bandwidth values while maintaining the following relationships:

#### *For Position Loop Control*

- Load Observer Bandwidth = 4 x Velocity Bandwidth = 16 x Position Bandwidth

#### *For Velocity Loop Control*

- Load Observer Bandwidth = Velocity Bandwidth

The bandwidth values can be increased until the desired system performance is achieved.

To reduce following error, it is recommended that Integrator Bandwidth be applied according to the following relationship:

#### *For Position Loop Control*

- Position Integrator Bandwidth = Position Bandwidth/100

#### *For Velocity Loop Control*

- Velocity Integrator Bandwidth = Velocity Bandwidth/10

The integrator bandwidth value can be adjusted until the desired system performance is achieved. It is not recommended to use the position and velocity integrators simultaneously.

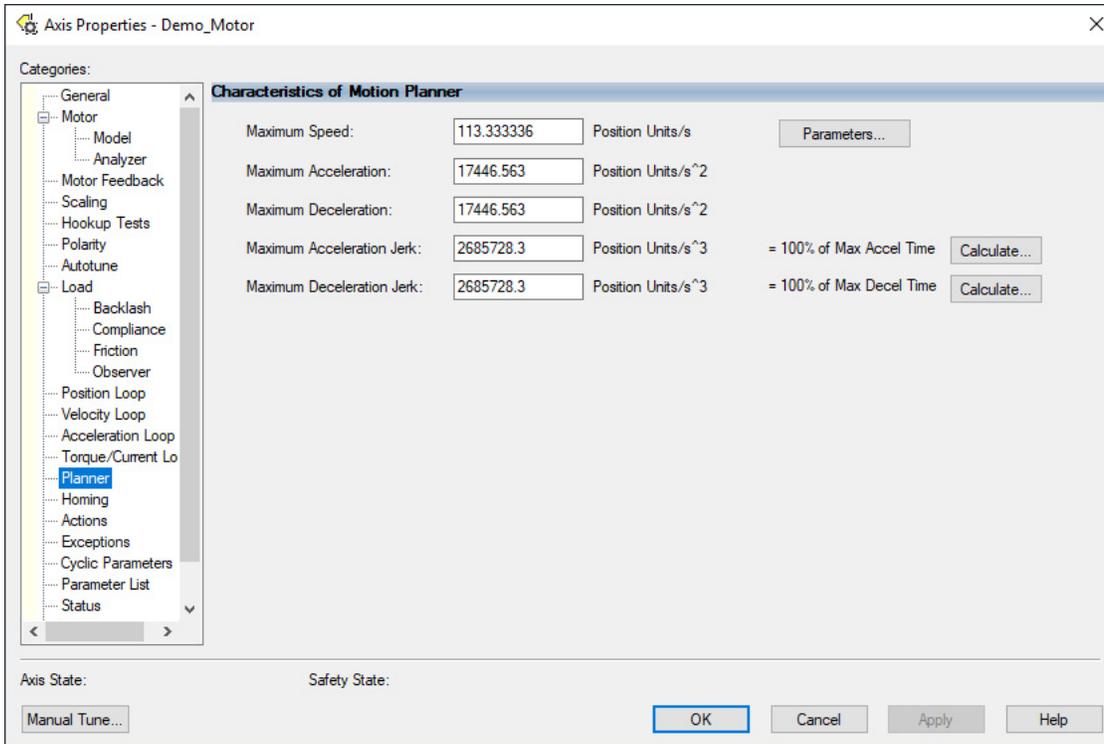


It is recommended that Position Loop control is used for both positioning and velocity applications. In select cases, application requirements may dictate Velocity Loop control.

For more detailed technical information on manual tuning, see chapter 4 of Motion System Tuning Application Techniques, publication [MOTION-AT005](#).

## Maximum Acceleration and Deceleration

When using the load observer feature, it is recommended that the load ratio is set to zero. For applications that use 'percent of maximum' as acceleration units for motion instructions, the Maximum Acceleration and Maximum Deceleration values for the application should be decreased (as appropriate for the load) to stay within drive and motor limits during operation. The Maximum Acceleration and Deceleration attribute values can be found in the Planner category of the Axis Properties dialog box.



## Vertical Load Considerations

The gain stabilization feature is not recommended for vertical loads, as detuning of the control loop gains produced by this feature may cause load drops. For more detailed information on techniques for managing vertical loads, see the Vertical Load and Holding Brake Management Application Technique, publication [MOTION-AT003](#).

## Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication <a href="#">1770-4.1</a>	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, <a href="http://www.rockwellautomation.com/global/certification/overview.page">http://www.rockwellautomation.com/global/certification/overview.page</a>	Provides declarations of conformity, certificates, and other certification details.
Servo Drive Installation Best Practices, publication <a href="#">MOTION-AT004</a>	Provides a quick reference of installation best practices for Rockwell Automation single-axis and multi-axis servo drive systems.
Motion System Tuning Application Techniques, publication <a href="#">MOTION-AT005</a>	Provides information and tips for motion system tuning.
Kinetix 5300 User Manual, publication <a href="#">MOTION-UM005</a>	Provides information on installing, configuring, starting, and troubleshooting your Kinetix 5300 servo drive system.
Kinetix 5500 Servo Drives User Manual, publication <a href="#">2198-UM001</a>	Provides information on installing, configuring, starting, and troubleshooting your Kinetix 5500 servo drive system.
Kinetix 5700 Servo Drives User Manual, publication <a href="#">2198-UM002</a>	Provides information on installing, configuring, starting, and troubleshooting your Kinetix 5700 servo drive system.
Integrated Motion on the EtherNet/IP Network: Configuration and Startup User Manual, publication <a href="#">MOTION-UM003</a>	Information on how to configure and troubleshoot your ControlLogix® and CompactLogix™ EtherNet/IP™ network modules.
Industrial Automation Wiring and Grounding Guidelines, publication <a href="#">1770-4.1</a>	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, <a href="http://www.rockwellautomation.com/global/certification/overview.page">http://www.rockwellautomation.com/global/certification/overview.page</a>	Provides declarations of conformity, certificates, and other certification details.
Servo Drive Installation Best Practices, publication <a href="#">MOTION-AT004</a>	Provides a quick reference of installation best practices for Rockwell Automation single-axis and multi-axis servo drive systems.
Motion System Tuning Application Techniques, publication <a href="#">MOTION-AT005</a>	Provides information and tips for motion system tuning.
Kinetix 5300 User Manual, publication <a href="#">MOTION-UM005</a>	Provides information on installing, configuring, starting, and troubleshooting your Kinetix 5300 servo drive system.

You can view or download publications at [rok.auto/literature](http://rok.auto/literature).

# Rockwell Automation Support

Use these resources to access support information.

<b>Technical Support Center</b>	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	<a href="http://rok.auto/support">rok.auto/support</a>
<b>Knowledgebase</b>	Access Knowledgebase articles.	<a href="http://rok.auto/knowledgebase">rok.auto/knowledgebase</a>
<b>Local Technical Support Phone Numbers</b>	Locate the telephone number for your country.	<a href="http://rok.auto/phonesupport">rok.auto/phonesupport</a>
<b>Literature Library</b>	Find installation instructions, manuals, brochures, and technical data publications.	<a href="http://rok.auto/literature">rok.auto/literature</a>
<b>Product Compatibility and Download Center (PCDC)</b>	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	<a href="http://rok.auto/pcdc">rok.auto/pcdc</a>

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