



**ADVANCED**  
MOTION CONTROLS

AMC  
CONFIGURATION  
ENVIRONMENT

# AMC Configuration Environment

Quick Reference

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# Preface

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*ADVANCED* Motion Controls constantly strives to improve all of its products. We review the information in this document regularly and we welcome any suggestions for improvement. We reserve the right to modify equipment and documentation without prior notice.

For the latest revision of this document, visit the company's website at [www.a-m-c.com](http://www.a-m-c.com). Otherwise, contact the company directly at:

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## General Safety



Notice

You must install and operate *ADVANCED* Motion Controls motion control equipment so that you meet all applicable safety requirements. Ensure that you identify the relevant standards and comply with them. Failure to do so may result in damage to equipment and personal injury.

Read this entire manual prior to attempting to install or operate the drive. Become familiar with practices and procedures that allow you to operate these drives safely and effectively. You are responsible for determining the suitability of this product for the intended application. *ADVANCED* Motion Controls is neither responsible nor liable for indirect or consequential damages resulting from the inappropriate use of this product.



Caution

High-performance motion control equipment can move rapidly with very high forces. Unexpected motion may occur especially during product commissioning. Keep clear of any operational machinery and never touch them while they are working.



High voltage

Keep clear of enclosed units, motor terminals, and transformer terminals when power is applied to the equipment. Follow these safety guidelines:

- Always turn off the main power and allow sufficient time for complete discharge before making any connections to the drive.
- Make sure that the minimum inductance requirements are met. Pulse Width Modulated (PWM) amplifiers deliver a pulsed output that requires a minimum amount of load inductance for proper operation.
- Do not rotate the motor shaft without power. The motor acts as a generator and will charge up the power supply capacitors through the amplifier. Excessive speeds may cause over-voltage breakdown in the power output stage. Note that an amplifier having an internal power converter that operates from the high voltage supply will become operative.
- Do not short the motor leads at high motor speeds. When the motor is shorted, its own generated voltage may produce a current flow as high as 10 times the amplifier current. The short itself may not damage the amplifier but may damage the motor.
- Do not make any connections to any internal circuitry. Only connections to designated connectors are allowed.

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#### Related Documentation

- Product datasheet specific for your drive, available for download at [www.a-m-c.com](http://www.a-m-c.com)
- ACE™ Software Manual, available for download at [www.a-m-c.com](http://www.a-m-c.com)

Document ID	Revision	Date	Changes
MNDGACQR-01	BETA Releases	6/2019	First Release

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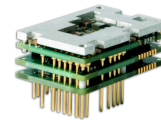
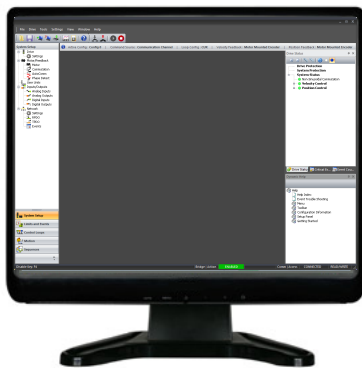
# ACE™ Setup Software

AMC Configuration Environment (ACE™) is a powerful tool used for the commissioning of *ADVANCED* Motion Controls' FlexPro™ servo drives. An easy-to-use interface combined with cutting edge motion control technology make ACE extremely versatile and accessible to users with little previous experience in motion control.

This document presents an overview of the recommended procedure to commission an *ADVANCED* Motion Controls' servo drive in ACE. These step-by-step instructions should be used as a general guide in conjunction with the information in the ACE Software Manual. The ACE Software Manual, along with the Help File included with the software, contain more detailed information on how to configure a drive. Each step presented in this document corresponds to an in-depth discussion in the ACE Software Manual. This document lays out the order in which a user should proceed through ACE during the drive commissioning process, along with explanations of the basic functionality of the steps. Both ACE and the ACE Software Manual are available for download at [www.a-m-c.com](http://www.a-m-c.com).

ACE™

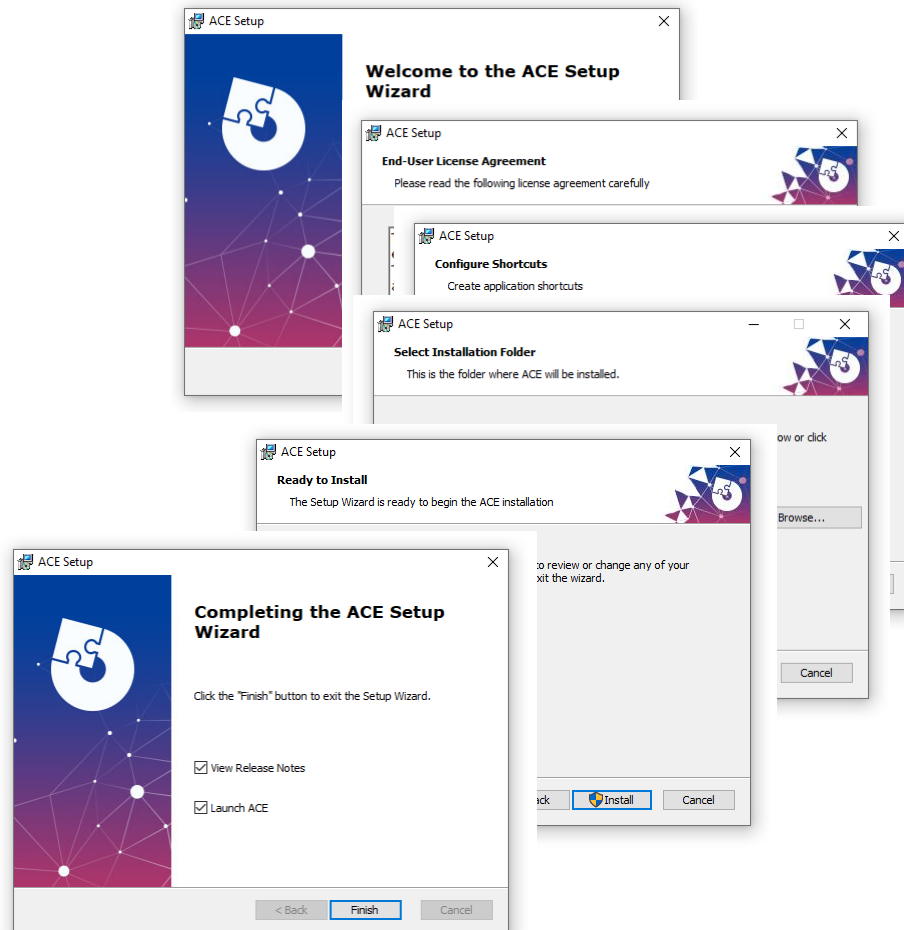
FlexPro™ Servo Drives



## Install ACE

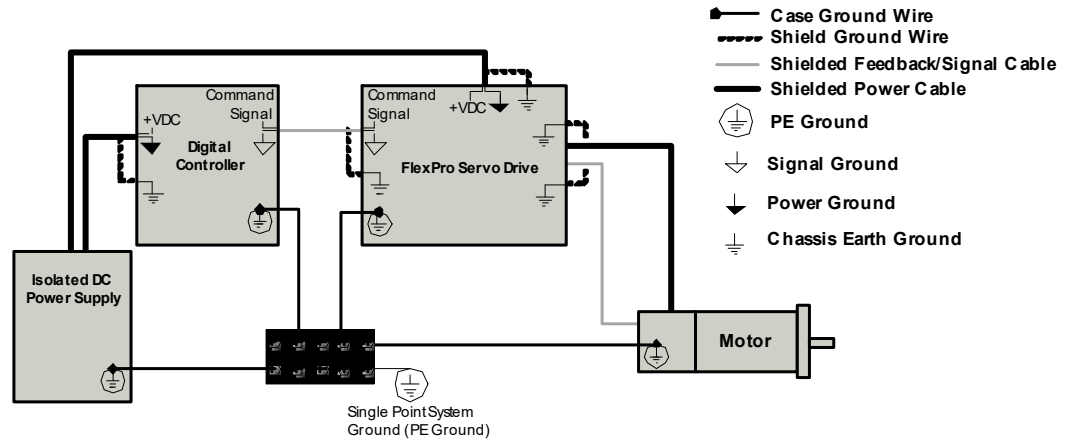
To install ACE on a PC, follow these simple steps.

1. Download the software from [www.a-m-c.com](http://www.a-m-c.com).
2. Save or open the compressed folder, and extract all files to a local directory.
3. Run **ACE\_[version].msi**. Follow the onscreen instructions to complete the installation.



## System Connections

Before a drive can be commissioned in ACE, it is important to make certain that all system connections have been wired safely and properly. Follow a "central point grounding" procedure as shown below to eliminate and reduce ground loops and noise in the system. For reference on proper wiring and system connections, consult the appropriate datasheet and Hardware Installation Manual for the specific drive in use.



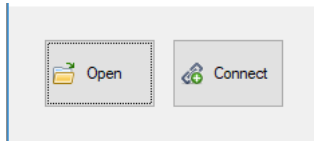
Notice

A digital controller is not necessary for initial drive setup in ACE, as *ADVANCED* Motion Controls FlexPro series servo drives are capable of providing an internal signal used for loop tuning.

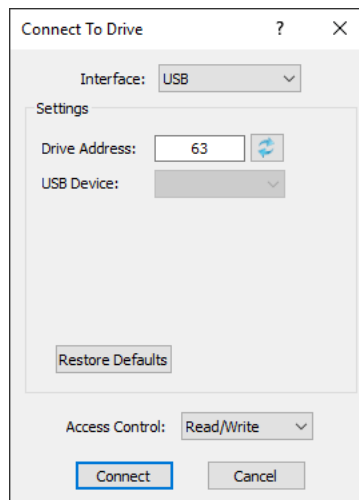
The servo drive must also be connected to a computer with ACE installed. FlexPro drives provide a USB interface for connecting to a PC.

## Step 1 - Establish Communication Connection

Once the drive has been correctly wired into the system and connected to a PC, power may be applied to the drive. Open ACE on the PC, and select the "Connect" option from the opening screen.



The "Connect to Drive" window provides communication configuration settings used to connect to ACE to setup and configure the drive. Depending on the drive in use, this connection may be the same or different from the communication connection used to send motion commands to the drive.



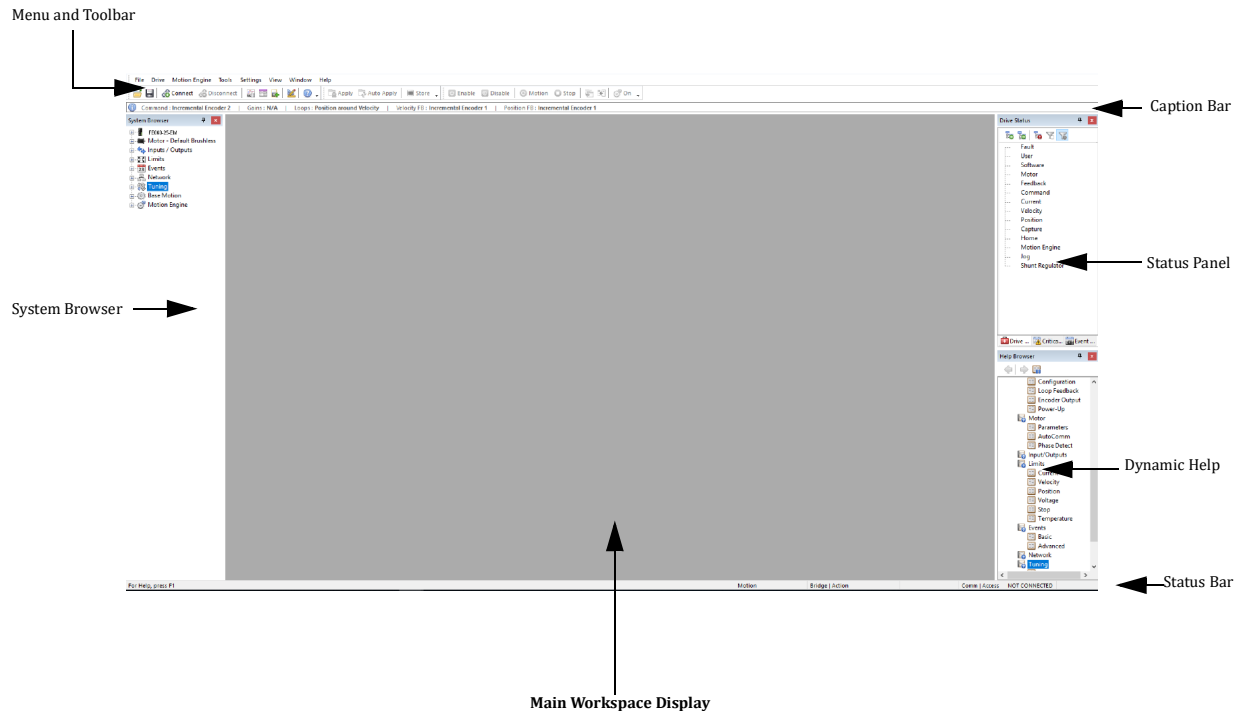
Select the type of communication interface being used to connect with the drive to display the corresponding interface settings. The first time the drive connects to ACE the default settings must be used. The default settings for common communication types are shown in the table below.

Default Communication Settings		
USB	Drive Address	63
Ethernet	Drive Address	1

Communication settings can be changed after the initial connection to the drive.

## Step 2 - Workspace Navigation

The ACE interface provides many functions, tools and status information to help set up the drive.




It is helpful to become familiar with the ACE interface before proceeding through the drive commissioning process.

- **Menu and Toolbar:** Contains pull-down menus and toolbar icons for quick access to many tools and functions.
- **System Browser:** Used to navigate between the software windows for drive configuration and features.
- **Caption Bar:** Displays quick details about the current drive configuration.
- **Status Panel:** Provides real-time information on drive events and actions.
- **Dynamic Help Browser:** Dynamic Help file that automatically tracks movements through the software and navigates accordingly to the appropriate Help topics.
- **Status Bar:** Provides information on the drive configuration, bridge state, connection status, and accessibility.



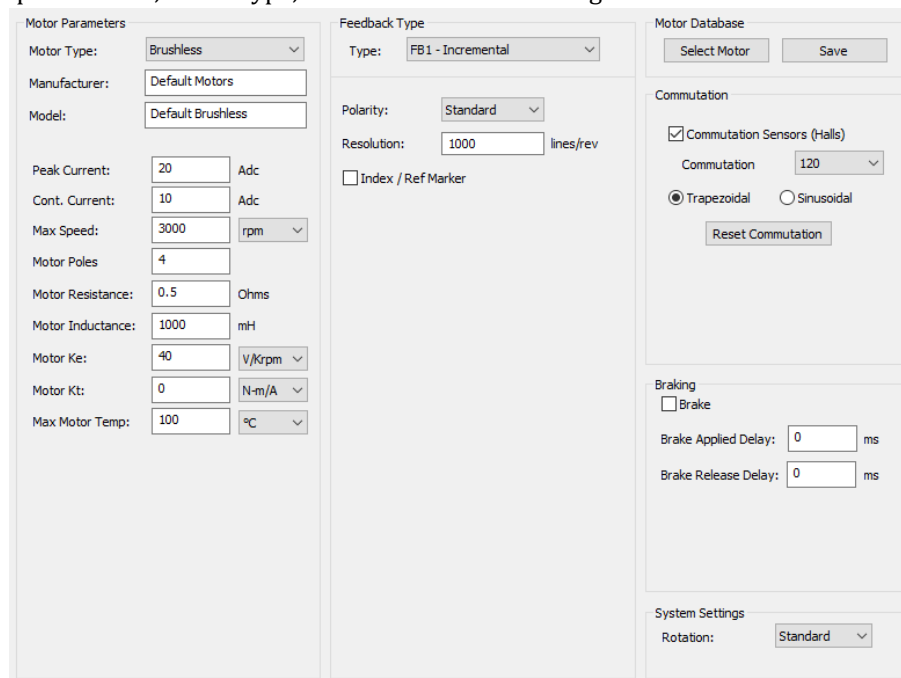
## Step 3 - Input Motor and Feedback Data

 Select *Motor > Parameters* from the System Browser to open the Motor window. The Motor window is where you will input the motor ratings, motor-specific data, and primary feedback information.

ACE uses the motor and feedback values for a variety of functions:


- Calculate Current Loop Gains
- Set Hardware Current, Velocity, and Position Limits
- AutoCommutation/Phase Detect Routines

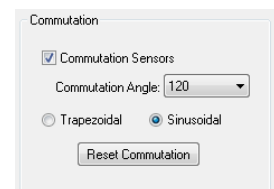
The field options seen in the Motor window will automatically change to correspond with the specific drive, motor type, and feedback device being used.



The screenshot shows the Motor Parameters window with the following settings:

- Motor Parameters:** Motor Type: Brushless; Manufacturer: Default Motors; Model: Default Brushless; Peak Current: 20 Adc; Cont. Current: 10 Adc; Max Speed: 3000 rpm; Motor Poles: 4; Motor Resistance: 0.5 Ohms; Motor Inductance: 1000 mH; Motor Ke: 40 V/Krpm; Motor Kt: 0 N-m/A; Max Motor Temp: 100 °C.
- Feedback Type:** Type: FB1 - Incremental; Polarity: Standard; Resolution: 1000 lines/rev; Index / Ref Marker: .
- Motor Database:** Select Motor, Save.
- Commutation:**  Commutation Sensors (Halls); Commutation: 120;  Trapezoidal;  Sinusoidal; Reset Commutation.
- Braking:**  Brake; Brake Applied Delay: 0 ms; Brake Release Delay: 0 ms.
- System Settings:** Rotation: Standard.

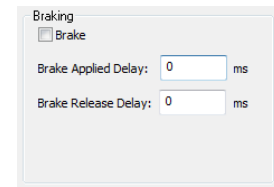
1. Begin by selecting the Motor Type from the drop-down button at the top of the window. The Motor Parameters should change to reflect the chosen Motor Type.
2. Input the Motor model, manufacturer, and ratings information in the Motor Parameters fields. Typically this information can be found on the motor datasheet.
3. Configure the necessary feedback information in the Feedback Type fields.
4. If using Hall Sensors for commutation, select the *Commutation Sensors* checkbox, and select the Commutation Angle and type (Trapezoidal or Sinusoidal).
5. Once the motor and feedback information has been correctly input, click the **Apply** toolbar icon  to save the values.
6. Exit the Motor window.



The close-up shows the Commutation section with the following settings:

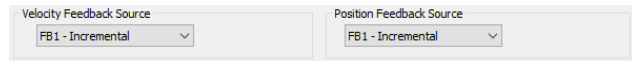
- Commutation Sensors
- Commutation Angle: 120
- Trapezoidal;  Sinusoidal
- Reset Commutation

**Braking (Optional)** Selecting the *Brake* checkbox allows a brake to be assigned with an event action. The brake can be assigned to a digital output in the Inputs/Outputs window. In addition, the brake output can be configured to use delays between external braking and enabling/inhibiting the drive.

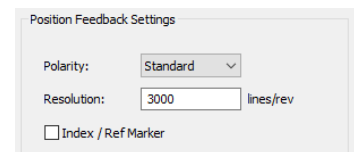


### Feedback Assignment (Optional)

Depending on the system setup, the primary feedback device being used for commutation may not be the same device being used for velocity or position feedback. In this case, the `[DriveName] > Loop Feedback` window in the System Browser allows the specification of which feedback device is used for the velocity and position loops. If necessary, open the Feedback window and configure the velocity and position feedback devices.




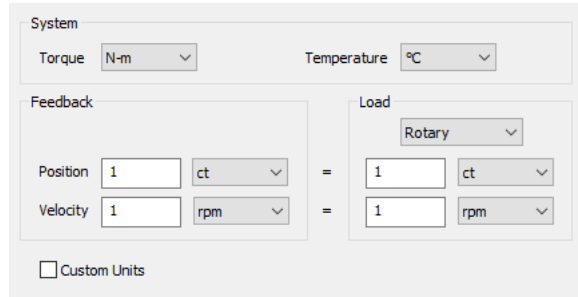
**Auxiliary Feedback (Optional)** In a dual loop application, ACE allows for an auxiliary encoder to be used to close the position loop. The *Position Feedback Settings* selection below *Position Feedback Source* provides an interface to input the auxiliary encoder information to ensure proper operation and to allow for an auxiliary index to be used for homing.



**Motor Database** The Motor Database allows motor information to be saved and stored. Motor information can be entered directly into the *Motor Parameters* window, or imported via an .XML file. Motor information from the database can be exported as an .XML file, as well.

## Step 4 - Set User Units (Optional)

ACE uses "counts" as the default base measurement unit for position, "counts/sec" for velocity, and "counts/sec<sup>2</sup>" for acceleration. However, ACE allows the option to setup the drive using units that are more desirable or relevant to the machine and/or axis the drive is being configured for. To do so, click the **User Units** toolbar icon  to open the User Units window.









The User Units window allows user customization of the measurement units in ACE. Each measurement parameter - Position, Velocity, Torque, Temperature - has several different measurement types available, some of which are dependent on the motor type (Rotary or Linear). Note that the units in the Motor Parameters window are not affected by changes made in the User Units window.

1. Choose the desired Units from the pull-down menus. If no selection is made, ACE will use the default units.
2. Selecting the Custom Labels checkbox will allow the definition of custom units and labels. A scaling ratio between standard and custom units can also be defined.

## Step 5 - Limits

The Limits windows are used to set general drive limits and parameters. These can be accessed under the *Limits* heading in the System Browser.

-  **Current:** Use this window to set the drive output current limits within the hardware capability of the drive.
-  **Velocity:** Use this window to set user or system defined velocity limits and values. Can be configured regardless of whether the velocity loop is enabled.
-  **Position:** Use this window to set user or system defined position limits and values. Can be configured regardless of whether the position loop is enabled.
-  **Stop:** Use this window to set drive deceleration limits.
-  **Voltage:** Use this window to set the software under and over voltage limits. These limits are restricted to fall within the hardware capability of the drive.
-  **Temperature:** Use this window to configure an external temperature sensor.

**Current Limits**

Peak Current:  ≤ 50 Adc  
 Peak Current Time:  ≤ 65 s  
 Continuous Current:  ≤ 25 Adc  
 Foldback Time:  ≤ 65 s

Current Limiting Algorithm  
 Time-Based Limiting  
 RMS Charge-Based Limiting

Scaling Source:

**Velocity Limits**

Motor Over Speed:  rpm  
 Zero Velocity Window:  rpm  
 At Velocity Window:  rpm  
 Velocity Following Error:  rpm  
 Positive Velocity Limit:  rpm ≤ Motor Over Speed  
 Negative Velocity Limit:  rpm ≤ Motor Over Speed

**Position Windows**

In-Home Position Window:  ct  
 In-Position Window:  ct  
 Position Following Error Window:  ct

Disable Position Limits

Max Measured Position Limit:  ct  
 Min Measured Position Limit:  ct  
 Max Target Position Limit:  ct  
 Min Target Position Limit:  ct

The Limits settings will change the conditions at which an event occurs. The actions the drive takes during an event can be configured in the [Events](#) window.

**Stop Deceleration Limit**

Position Mode:  rpm/s  
 Velocity Mode:  rpm/s

**Voltage Limits**

Under Voltage: 8 V ≤  V <  V <= 58 V  
 Over Voltage:  V <= 58 V  
 Nominal DC Bus Voltage:  VDC

**Motor Over Temperature**

Action Active At:  °C ≤ 100 °C  
 Action Inactive:  °C ≤ 60 °C

**Temperature Input**


Source Type:

Select Available Input:  
 Analog Input 1 --- Motor Temperature


Scale:  °C / V  
 Offset:  V

## Step 6 - Events

The Events windows let you configure the action the drive will take when an event occurs. You can select actions for drive protection, system protection, and drive system events. These can be accessed under the *Events* heading in the System Browser.

 **Basic Events** The Basic Events window allows for simple configuration of common drive events. Select the desired action for the drive events from the selection boxes. If **Latch** is checked for a specific event, the selected action will remain in effect until power is cycled or the Drive Status is reset.

Event	Action	Latch
Drive Over Temp	Disable Power Bridge	<input type="checkbox"/>
Under Voltage	Disable Power Bridge	<input type="checkbox"/>
Over Voltage	Disable Power Bridge	<input type="checkbox"/>
Short Circuit	Disable Power Bridge	<input checked="" type="checkbox"/>
Hall State Error	Disable Power Bridge	<input type="checkbox"/>
User Positive Limit	Positive Stop	<input type="checkbox"/>
User Negative Limit	Negative Stop	<input type="checkbox"/>
Motor Over Speed	Disable Power Bridge	<input type="checkbox"/>
Motor Over Temp	Disable Power Bridge	<input type="checkbox"/>
Comm Channel Error	Stop	<input type="checkbox"/>
PWM/DIR Broken Wire	Disable Power Bridge	<input type="checkbox"/>
Velocity Following Error	No Action	<input type="checkbox"/>
Position Following Error	No Action	<input type="checkbox"/>

 **Advanced Events** The Advanced window allows in-depth customization of the way the drive responds to certain events.


Events are grouped into categories to facilitate event selection. Expand the group headings by clicking on the arrow next to the Group Name to view the event listings.

Each event has several programmable attributes that can be edited by clicking on an event row:

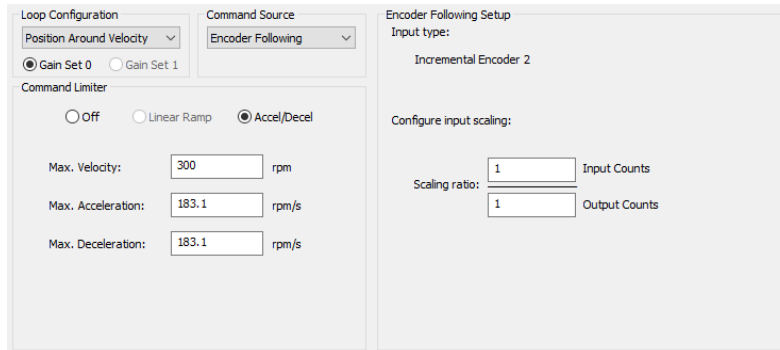
- **Delay:** The time delay between the actual occurrence of the event and the event action.
- **Action:** The action to be taken by the drive after the response time has elapsed. For safety reasons some actions are not available with some events.
- **Recovery:** The time after which the selected event action will be removed when the cause of the event is no longer present.
- **No Repeat:** The time, after the recovery time and subsequent removal of the event action, during which the drive will NOT consider an occurrence of the event as a new occurrence. The Event Action will still be applied in case an event does occur within this window. However, that occurrence will not be counted as a new occurrence with regard to the Maximum Recoveries attribute.
- **Recoveries:** The number of occurrences of the event prior to a permanent event action. The number of recoveries can be set to a specific value, or to Latch or Unlimited.

Group	Event	Delay [ms]	Action	Recovery [ms]	No Repeat [ms]	Recoveries
/ Fault						
/ User						
/ Software						
/ Motor						
/ Feedback						
/ Command						
/ Current						
/ Velocity						
/ Position						
Shunt	Shunt Regulator Active	0	No Action	0	100	Unlimited

## Step 7 - Configurations

 ACE allows two separate sets of drive parameters to be saved under  $[DriveName]$  > *Configuration 0* and *Configuration 1*. This is useful when more than one set of drive parameters may be required as the system mechanics may change. For initial drive commissioning purposes, only *Configuration 0* needs to be used. Note that *Configuration 1* will not be available for selection unless the *Enable Second Configuration* checkbox is selected in the  $[DriveName]$  > *Settings* window.

Select  $[DriveName]$  > *Configuration 0* from the System Browser. The Configuration window contains settings for the following parameters:



The screenshot shows a configuration window with the following sections:





- Loop Configuration:** A dropdown menu set to "Position Around Velocity". Below it are two radio buttons: "Gain Set 0" (selected) and "Gain Set 1".
- Command Source:** A dropdown menu set to "Encoder Following".
- Command Limiter:** Three radio buttons: "Off", "Linear Ramp", and "Accel/Decel" (selected). Below are three input fields: "Max. Velocity: 300 rpm", "Max. Acceleration: 183.1 rpm/s", and "Max. Deceleration: 183.1 rpm/s".
- Encoder Following Setup:** "Input type:" set to "Incremental Encoder 2". "Configure input scaling:" with two input fields: "Scaling ratio: 1" for "Input Counts" and "Scaling ratio: 1" for "Output Counts".

- **Loop Configuration:** Enables the different control loops for the specific drive modes: Current, Velocity, Position Around Current, and Position Around Velocity. This should be set to the final application of the drive system. For instance, if the desired configuration is Position Around Velocity, it is not necessary to change the loop configuration from Current to Velocity to Position Around Velocity while tuning each control loop.
- **Gain Set:** ACE also allows two separate sets of loop gain values to be configured and assigned to either Configuration 0 or Configuration 1. The values are entered either in the *Tuning > Gain Set 0* or *Gain Set 1* windows. For now, leave Gain Set 0 assigned to Configuration 0. The values for Gain Set 0 will be entered later during loop tuning.
- **Command Source:** The Command Source field assigns the command input type to the selected Configuration. Selecting one of the available options will bring up the parameters for the specific command type. For initial drive commissioning purposes, select *No Command* as the input source, as the command signal will be internally generated by the Waveform Generator.
- **Command Limiter:** The Command Limiter is used to limit the change in the input command signal as seen by the drive, with the resulting effect being dependant on the operating mode. Typically for initial loop tuning purposes the Command Limiter can be left OFF.

## Step 8 - Check Drive Status



The Drive Status tab in the Status Panel displays active and history event items that provide a real-time indication of drive operation. Data is grouped into categories to conveniently identify event statuses.



Check the drive events to determine if any inhibiting events are preventing the drive from proper operation. Some events are related to hardware issues such as faulty wiring or power supply problems, while others are related to the software limits set in the [Limits](#) window. The event state for each drive event is indicated according to the table below.

Icon	Name	Description
	Active	An event that is active but not assigned to an action. This includes events assigned to No Action in the Events window and pure status events that cannot be assigned an action.
	Disabling Action	An event that is active and assigned to an action. An action either inhibits motion partially or disables motion completely according to the action assigned in the Events window.
	History	An event which is not presently active, but was active at some point after the last time the drive was powered on or the last time the Reset Events button was used.
	Inactive	An event that is not presently active, and has not been active since after the last time the drive was powered on or the last time the Reset Events button was used.

Note that the event *Software Disable* is directly controlled by the Command Toolbar at the top of the DriveWare screen. Do not worry about clearing this event until ready to begin [Tuning and Commutation](#).

### Command Toolbar Motion Controls

	Icon	Action
Enable/Disable		Enable Drive
		Disable Drive

	Icon	Action
Stop		Motion
		Stop

## Drive Status and Tuning

When tuning the Current, Velocity, and Position loops, the Drive Status panel is an invaluable tool for determining drive behavior. It is recommended to keep the Drive Status panel open and available while loop tuning to observe any events that may be inhibiting the drive or are indicators of improper configuration.

The Status Bar along the bottom of the ACE workspace is also useful in quickly determining the drive state. The **Bridge | Action** and **Comm | Access** fields provide information on the state of the power bridge and drive communication status. If no inhibiting events are currently active, the **Bridge** state should read *Enabled* after clicking on the Enable icon on the command toolbar. If the bridge state remains *Disabled* after clicking on the Enable icon, hover the mouse over the **Action** portion of the Status Bar to display the inhibiting event.

For a complete list of drive events and suggested methods of troubleshooting, consult the Event Troubleshooting Appendix in the ACE Software Manual.

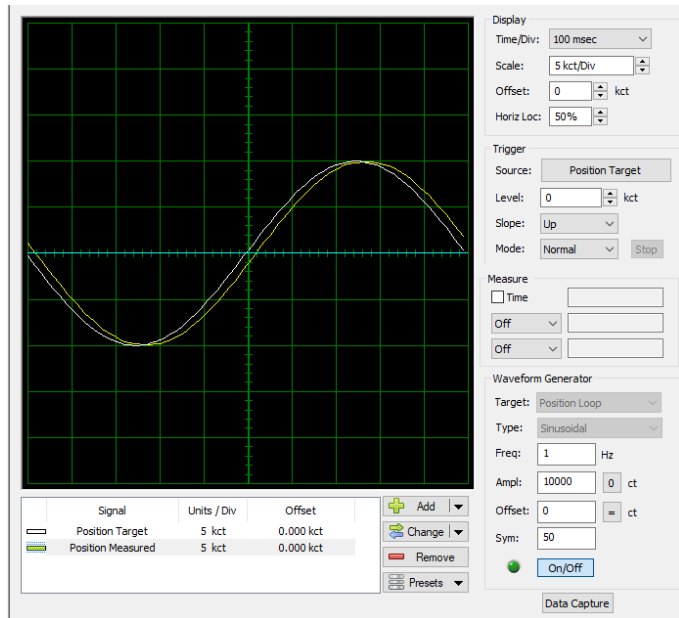
## Step 9 - Tuning and Commutation



Open the Scope/Tuning window by clicking on the Scope/Tuning icon on the toolbar.

The Scope/Tuning Window provides an all-in-one resource for commanding an internal signal to the drive, monitoring over 40 different drive parameters while testing or troubleshooting, and real-time gains adjustments during tuning and drive setup.

Drive tuning is a multi-step process that involves proper tuning of up to three different servo loops. Before tuning, the drive should have the appropriate parameters and limits configured in the the Motor, Feedback, Limits, and Events windows.



The tuning and commutation process is dependent on the mode the drive is going to be operating in, as well as the end result of the system application. For instance, the drive may be tuned for a more "robust" application (high accuracy) or for a more "responsive" application (high speed).

It is not necessary to tune all three servo loops for every application. The Position loop can be closed around both the Velocity and Current loops, or around the Current loop alone.

- **Position Around Velocity** - The position loop algorithm output becomes the new velocity set point. This mode is most common in "contouring" applications, where a position trajectory must be tracked very closely. It is important to start with a stable yet responsive velocity loop. Typically, it is sufficient to just use the position loop proportional gain. Feedforward gain can be added to improve tracking performance. It is best to use a small step command as a reference signal during tuning.
- **Position Around Current** - The position loop algorithm output becomes the new current (torque) set point. This mode is most common in "point-to-point" applications, where actual motion between the start and end point is not critical. In this case, velocity loop tuning can be avoided. In this case, the position loop proportional gain and derivative gain are increased simultaneously. Once a stable response is achieved, integral gain can be added to improve stiffness. It is best to use a triangular waveform or a step command during tuning.

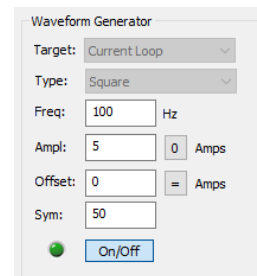


## Current Loop Tuning

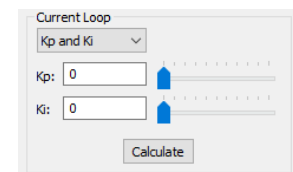
The Current loop is the innermost loop and forms the basis of all motion. Current loop tuning is done with the motor de-coupled from the load, and free to move. It is recommended to disable the drive prior to beginning the tuning process.

The current loop tuning process follows these basic steps:

1. Set up the Waveform Generator in the Scope/Tuning window to send a 100 Hz square wave into the current loop. Set the current amplitude within the drive and motor current limits.
2. With the Scope/Tuning window still open, select *Tuning > Current Loop Gains*. Select *Window > New Vertical Tab Group* from the menu bar to display both the Current Loop Gains and the Scope/Tuning window at the same time.



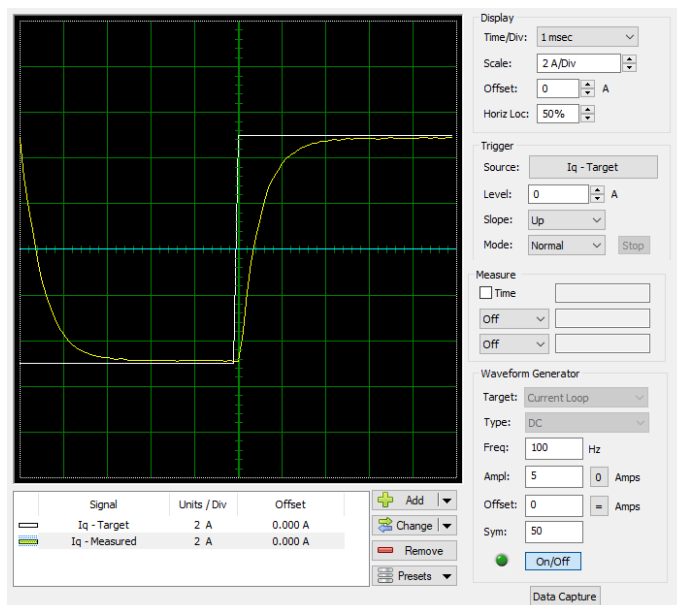
3. Choose *Calculate* from the Current Loop Gains tab as a starting point for signal tuning (*Calculate* uses the data entered in the Motor window to derive a starting point for current loop tuning. If unsure about the accuracy of the motor information, begin with both Proportional and Integral Gain at zero).



4. Choose the **Current** Scope Preset from the Scope Settings tab to configure the digital oscilloscope. Verify that the "Current Target" square wave is visible on the oscilloscope. Adjust the *Time/Div* or amplitude scale if necessary.

5. Enable the drive by clicking the Enable icon. Adjust the Proportional Gain until a "knee" is formed, then adjust the Integral Gain as necessary until the measured current closely approximates the target current, as shown below. Click the Disable icon when completed. To

save tuning parameters, click **Apply**  then **Store**  in the toolbar.



## Commutation

Commutation of a permanent magnet servomotor is the process that maintains an optimal angle between the permanent magnet field and the electromagnetic field created by the motor current(s). This process ensures optimal torque or force generation at any motor position.

- For brushed motors, simply select which two motor phases are used for external commutation in the *Motor > Parameters* window.
- For brushless motors, ACE features an AutoCommutation routine that automatically detects the motor and feedback parameters and polarity and configures the drive accordingly.



Notice



AutoCommutation requires the motor to travel a short distance (two revolutions plus one electrical cycle for rotary motors, or three electrical cycles for linear motors). Motors with insufficient travel distance will require Manual Commutation instead. See the ACE Software Guide for Manual Commutation procedure.

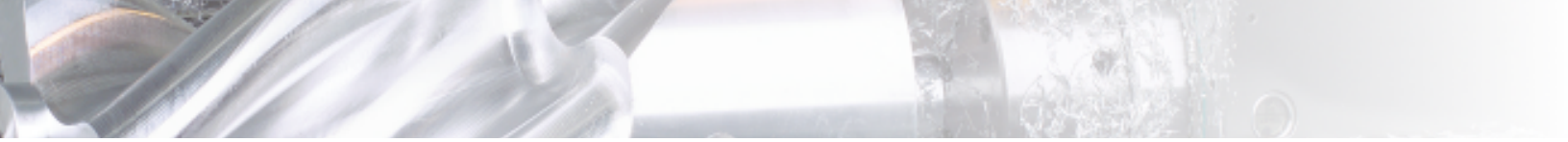



### AutoCommutation

Before running AutoCommutation, be sure the correct motor information is entered in the Motor window and that the motor is de-coupled from the load and free to move. AutoCommutation only needs to be ran once during the initial drive setup, then the information can be stored into the drive nonvolatile memory by clicking the Store icon on the toolbar. The AutoCommutation settings will also be saved with the project file when the project file is saved.

AutoComm Details		Present Values:	AutoComm Values:
<b>Feedback</b>			
Motor Encoder:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Index:	<input type="checkbox"/>	<input type="checkbox"/>	
Resolution:	1000	<input type="text"/>	Lines/rev
Polarity:	Standard	<input type="text"/>	
<b>Halls</b>			
Hall Sensors:	<input type="checkbox"/>	<input type="checkbox"/>	
Commutation		<input type="text"/>	
<b>Commutation</b>			
Type:	Sinusoidal	<input type="text"/>	
Sync:	None	<input type="text"/>	
<input type="button" value="Start AutoCommutation"/>			

1. Ensure *Sinusoidal Commutation* is selected from within the *Motor > Parameters* window.
2. Select *Motor > AutoComm* from the System Browser.
3. If drive is disabled, click the Enable icon to enable the drive.
4. Click *Start AutoCommutation* to begin. During the process, observe the motor distance traveled in each direction.
5. When AutoCommutation is complete, select whether the motor moved the proper distance. If it did not, verify the pole count or pole pitch in the Motor window.
6. Verify the proper commutation and synchronization settings. AutoCommutation will default to a selection based on the feedback devices found during the AutoCommutation routine. It is recommended to use this setting.
7. Click **Apply**  and **Store**  from the toolbar to apply the settings.

- 
8. In some cases, the AutoCommutation results will differ slightly from the Motor data. You may choose between using the values determined by AutoCommutation or the values entered in the Motor window.
  9. If any warnings appear after the AutoCommutation process has completed, consult the section on Commutation in the ACE Software Manual for instructions on how to proceed. Typically any AutoCommutation warnings are indications of incorrect information entered into the Motor window, or faulty or miswired connections.
  10. After running AutoCommutation, it is suggested to test motor commutation with a small DC current. Return to the Scope/Tuning window, and set up the Waveform Generator to send a DC offset into the current loop. Set the *Offset* field for a small value to move the motor at a slow speed (value will be dependent on motor parameters, but a typical starting point will be 0.1 amps). If the motor spins, then AutoCommutation was successful. If the motor does not move as expected, rerun AutoCommutation.

 **Phase Detect** For brushless motors that are not using Hall Sensors or an absolute feedback device, it is necessary to run the Phase Detect routine after AutoCommutation in order to establish the initial motor position for sinusoidal commutation.

Phase Detect must be performed before the motor can be commutated each time the drive power is cycled, or anytime sinusoidal commutation is lost. The routine requires the motor to vibrate for a few seconds, and can be set up to be performed via a digital input, or automatically on power-up. Couple the motor to the load before running Phase Detect. Consult the ACE Software Guide for detailed instructions on how to successfully run Phase Detect.

## Velocity Loop Tuning

Velocity loop tuning is dependent on the mechanical load, and therefore will change with any system changes. Velocity loop tuning should be performed with the motor installed in the system and connected to the load. It is recommended to disable the drive before beginning the tuning process.



The velocity loop tuning process follows these basic steps:

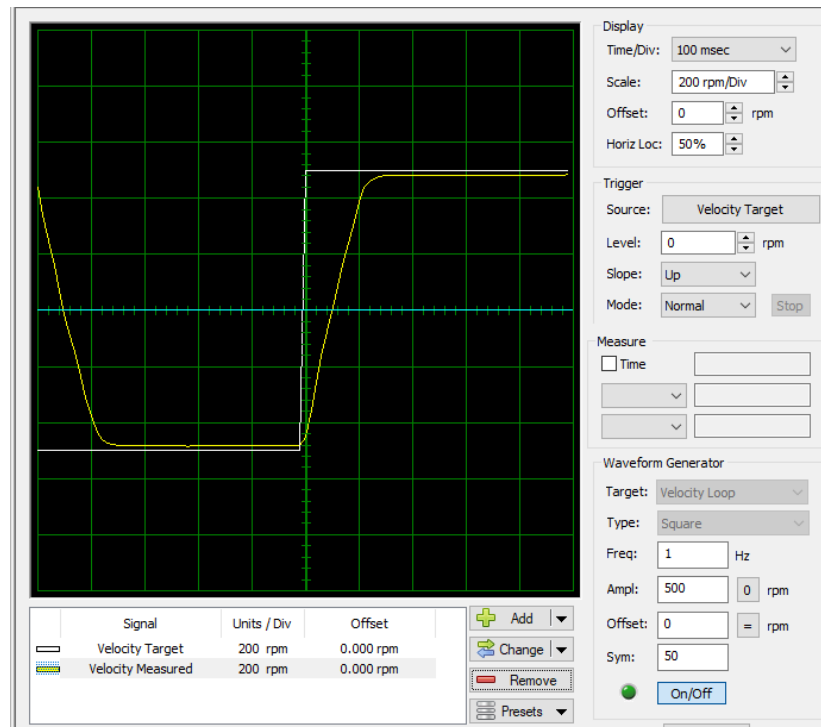
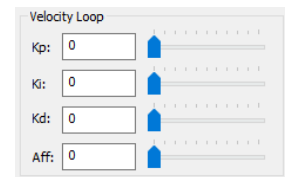
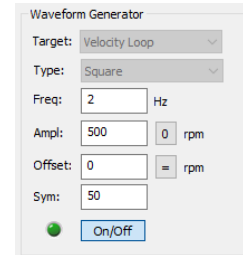
1. Set up the Waveform Generator in the Scope/Tuning window to send a 1-3 Hz square wave into the velocity loop. Set the amplitude to approximately 10% of nominal motor speed.

2. Select *Tuning > Gain Set 0* to open the velocity loop gain parameters. Set all the velocity loop gains to zero.

3. Choose the **Velocity** Scope Preset in the Scope/Tuning window to configure the digital oscilloscope. Verify that the "Velocity Target" square wave is visible on the oscilloscope. Adjust the *Time/Div* or the amplitude scaling if necessary.

4. Enable the drive by clicking the Enable icon. Adjust the Velocity Loop Proportional Gain until a "knee" is formed, then adjust the Integral Gain until a slight overshoot in the measured velocity is observed, as shown below. Typically the Feedback Filter Cut Off Freq (*Tuning > Filters*) should then be set to between 50-1500Hz to dampen oscillations and noise. The Low Speed Smoothing can also be increased if the motor is vibrating or making excessive

noise. When adjustments are complete, click the Disable icon. Click **Apply**  and **Store**  on the toolbar to save the gain settings.

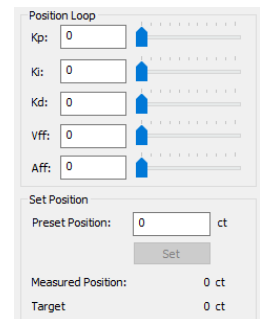
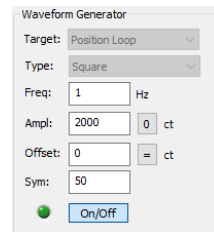




## Position Loop Tuning

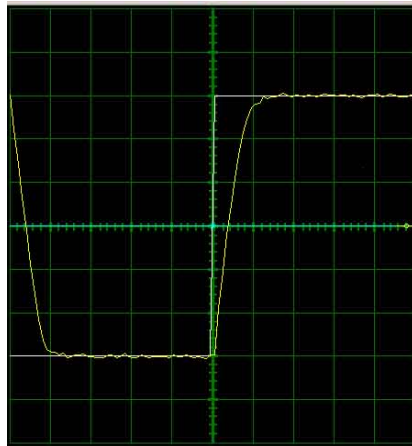
Position loop tuning is dependent on the mechanical load, and therefore will change with any system changes. Position loop tuning should be performed with the motor installed in the system and connected to the load. It is recommended to disable the drive before beginning the tuning process

The position loop tuning process follows these basic steps:

1. Set up the Waveform Generator in the Scope/Tuning window to send a 1-3 Hz square wave into the Position Loop. Set the amplitude to between 1/8 and 1/2 revolution for a rotary motor.
2. Select *Tuning > Gain Set 0* to open the position loop gain parameters. Set all the position loop gains to zero.
3. Enter "0" in the *Set Position* field, and click the *Set* button to set the Measured Position and Target Position equal to 0.
4. Choose the **Position** Scope Preset from the Scope/Tuning tab to configure the digital oscilloscope. Verify that the "Position Target" square wave is visible on the oscilloscope. Adjust the *Time/Div* or the amplitude scaling if necessary.
5. Enable the drive by clicking on the Enable icon. Beginning with the Position Loop Proportional Gain, adjust the gains as necessary until the measured position closely approximates the target position without excessive overshoot. It is not necessary to adjust the Velocity or Acceleration Feedforward gains. When adjustments are complete, disable the drive by clicking the Disable icon. Click **Apply**



 and **Store**  on the toolbar to save the gain settings.



## Step 10 - Additional Features

The features listed below are additional functions in ACE that are used for further drive configuration and motion tasks. Consult the ACE Software Manual or Help Files for more information on properly utilizing the following features:

-  **Emulated Encoder Output** *[Drive Name] > Encoder Output* - Certain drives allow configuration of an Emulated Encoder output. The Emulated Encoder is used to synchronize the command to other axes or to close the position loop.
-  **Inputs/Outputs** *Inputs/Outputs* - ACE allows the configuration of analog and digital inputs and outputs for drive features and diagnostics.
-  **Programmable Limit Switch** *Inputs/Outputs > Programmable Limit Switch* - ACE is configurable to support to independent programmable limit switch (PLS) outputs. These allow the drive to activate digital outputs that are position dependent. The pulse width and repeatability are also configurable.
-  **PDO Configuration** *Network > RPDO/TPDO/Events* - The PDO Configuration options are available for drives compatible with CANopen, EtherCAT, and Ethernet Powerlink network communication, and allows the configuration of PDO mapping assignments.
-  **Homing** *Base Motion > Home* - The Homing routine in ACE defines the absolute position to the drive with respect to the machine. ACE supports many different Homing routines that rely on signals such as limit switches, home switches, and encoder indexes to accurately position the load.
-  **Jog** *Base Motion > Jog* - The Jog feature allows a constant velocity to be commanded for a desired period of time. Velocity, Acceleration, and Deceleration values define the Jog motion.
-  **Indexes** *Motion Engine > Indexes* - An Index task is a profiled move defined by a set of basic parameters. ACE allows up to 16 unique Indexes to be saved and stored. Indexes can be either Absolute or Relative.
-  **Sequences** *Motion Engine > Sequences* - A Sequence is a set of steps that are Motion Tasks and Control Functions linked together and executed in a sequential order. ACE allows up to 16 different Sequences to be saved and stored.

ACE™ Quick Reference  
MNDGACQR-01



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