Instructions for Tuning a Bosch-Rexroth Servo Drive using IndraWorks DS – CSB02.1 Control Sections (EtherCat)

Indraworks DS Tuning Procedure (EtherCat)

Table of Contents

Introduction

Summary

This document is designed to serve as a guideline to assist technical personnel in the tuning of a Bosch-Rexroth servo drive. The setup document applies only to servo drives that are used in conjunction with an AMS Controls XL200 Series Controller.

Bosch-Rexroth drives can be tuned in-house or in the field. The following procedures are written for a technician tuning a drive, in-house. Where an asterisk (*****) appears, field-tuning procedures deviate from what is written. **Customers attempting to tune a drive unit in the field should use the information following the asterisk.**

Prerequisites

The document is designed using Indraworks DS version 15v16. Some earlier versions of Indraworks DS will not work with Gen 2 control sections, so it is best to download this version from the Bosch-Rexroth website before moving forward. Otherwise, your screens may not match this documentation.

In addition, for this documentation the Control Section of the drive is a CSB02.1B-ET-EC-EP-NN-EM-NN-FW loaded with Firmware FWA-INDRV*-MPB-20V32-D5-1-NNN-NN. If your drive has a different part number or is loaded with a different firmware this documentation may not match and you may be required to adjust additional settings that are not called out specifically in this documentation, however, this will get the basics accomplished.

The Control Section used in this document may not be what is needed for your application; however, some options are required for this to work. They are as follows:

- ET (Multi-Ethernet)

- EC (Encoder Evaluation)

- EP (Engineering Port) This is required to commission the drive since the standard 2 ports will be utilized by EtherCat

Pre-Tuning Checks

Safety Precautions

DANGER: Safety precautions must be followed at all times! Bosch-Rexroth drives have large capacitors inside them that can deliver a high amperage shock to anyone touching the terminals on the drive. These capacitors can remain charged for up to 10 minutes after having power removed. Remove power and lock out incoming line power before touching any of the terminals on the drive. Eye protection should also be worn while working with these units.

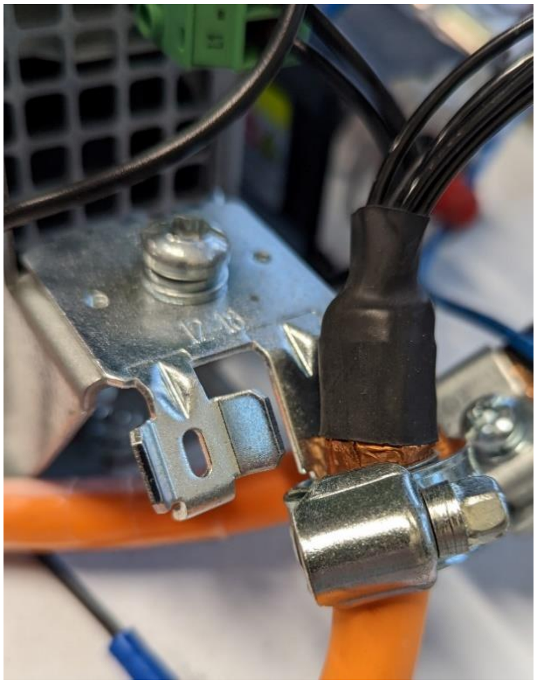
Power Cable Connections

The power cable that connects the drive to the motor **must not** be "spliced," terminated, or otherwise modified. There are important grounding and shielding connections between the motor and the drive that **must** be maintained for proper operation. Improper connection of this cable **will** cause catastrophic failures in the motor and the drive. The motor cable must be connected directly from the motor to the drive. Failure to do so **will** result in damaged equipment.

Power and Resolver Cable Connections

Various motors from Bosch come with either 2 separate connectors for Power and Resolver or the two are built into a single cable. For this reason, we will refer to the motor connection side as Power/Resolver Cables. With power removed and locked out, connect the motor power/resolver cable to the drive and motor. It is important to attach the three main power wires to the appropriate terminals. These wires are labeled 1, 2, and 3, respectively, and **must** be connected to the corresponding terminals, A1, A2, and A3. These drives are self-phasing and cannot correctly phase themselves if the power leads are not properly connected.

The drive comes with “hose clamps” that can be used to clamp the motor cable to the drive. At the end of the motor cable the cable’s internal shields emerge and are wrapped under copper foil. The motor cable must be clamped to the case of the drive with the copper foil shield making contact to the case of the drive (see the Functional Description section of the drive manual for more details).



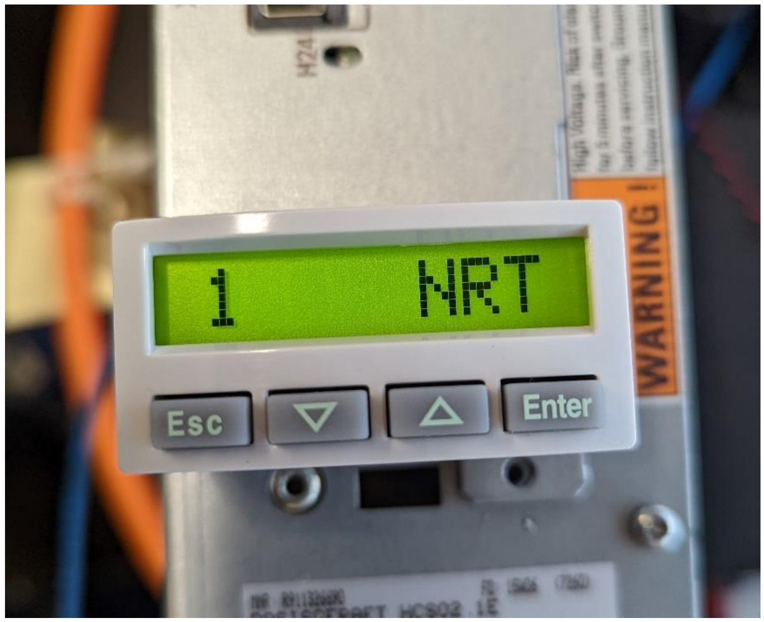
Looking at the motor side of the cable, there is a shield wire terminated with a ring connector. This connector must be connected to the case of the motor via the terminals inside the head of the connector plug. There are two terminals in the head, one for the motor cable, and one for the resolver feedback cable. Some motor/cable combinations have screw on connections at the motor. No additional shield terminations need to be made in these cases.

The motor cable has four wires for the thermal switch and motor brake that must be connected to the drive and motor. See the Functional Description section of the drive manual for terminal connections.

The resolver feedback cable must be connected to the drive and motor. On the drive side, the connector is a DB15 connector. On the motor side, there is a screw-on connector. Note: Some MS2N Series Motors will be a single cable.

Apply Power

Once all the terminal connections have been made and verified, apply 24VDC power to the drive. The screen on the drive will most likely power up to the following display. This is OK and will be cleared as we progress.



Getting Connected

XL200 Series Controller Connections

Connect the Ethernet Cable to the X25/X25 port

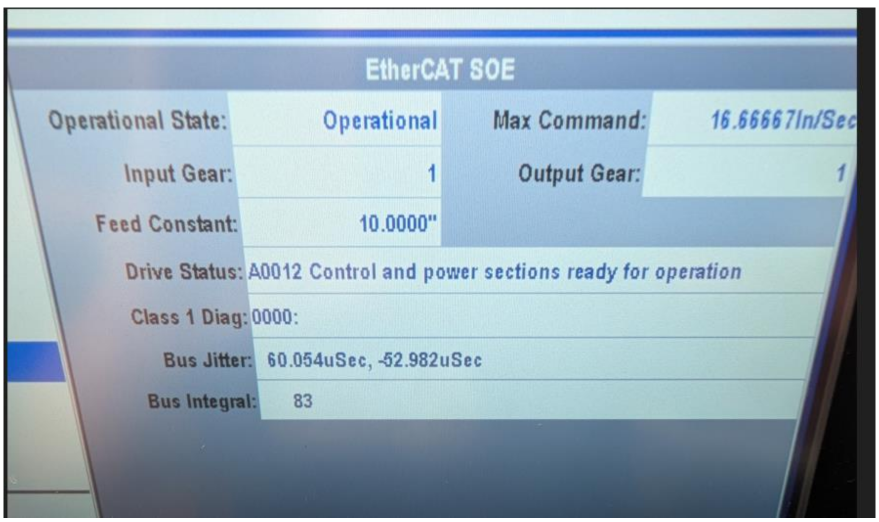
An Ethernet cable connection is required from the XL200's ethernet port to the Servo Drive's X24 or X25 port. A Patch or Crossover cable can be used, and the cable must support 100mb communication rates.

Check for Controller Communication

If your connections and setting are correct, your drive should power up to a "AB" state or some errored state. We can verify communications by going to the XL200 and doing the following:

- Press "Diagnostics"
- Touch "EtherCAT

If the controller is communicating the drive status will be showing information as well as the Bus Jitter.

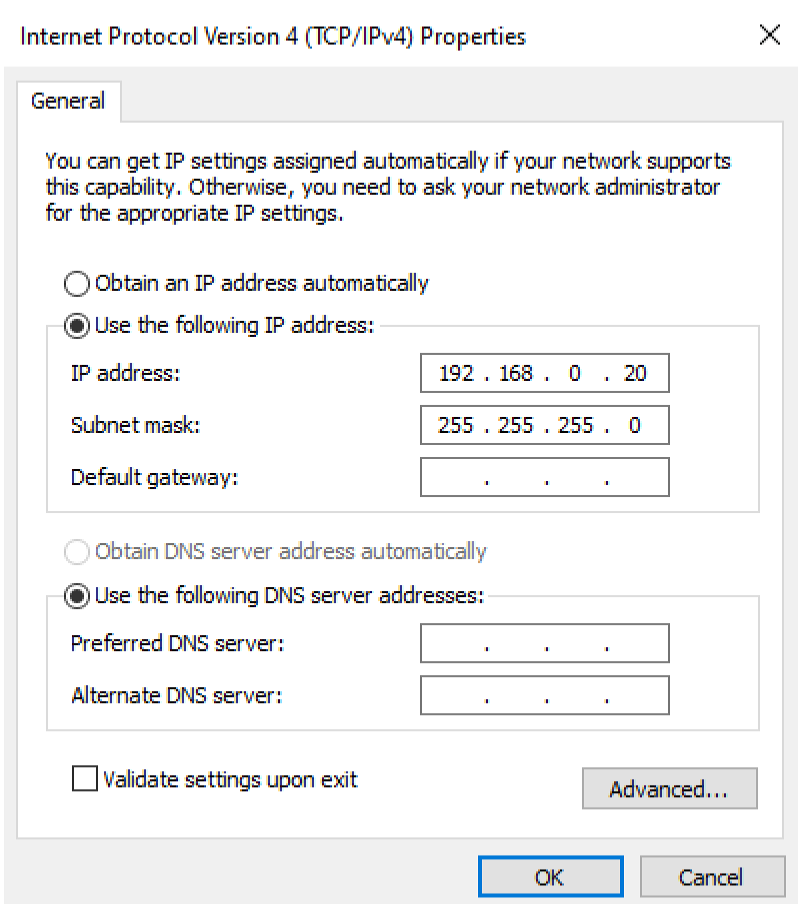


Connecting your PC to the Servo Drive

Connect the Ethernet Cable to the X26 port (Engineering Port)

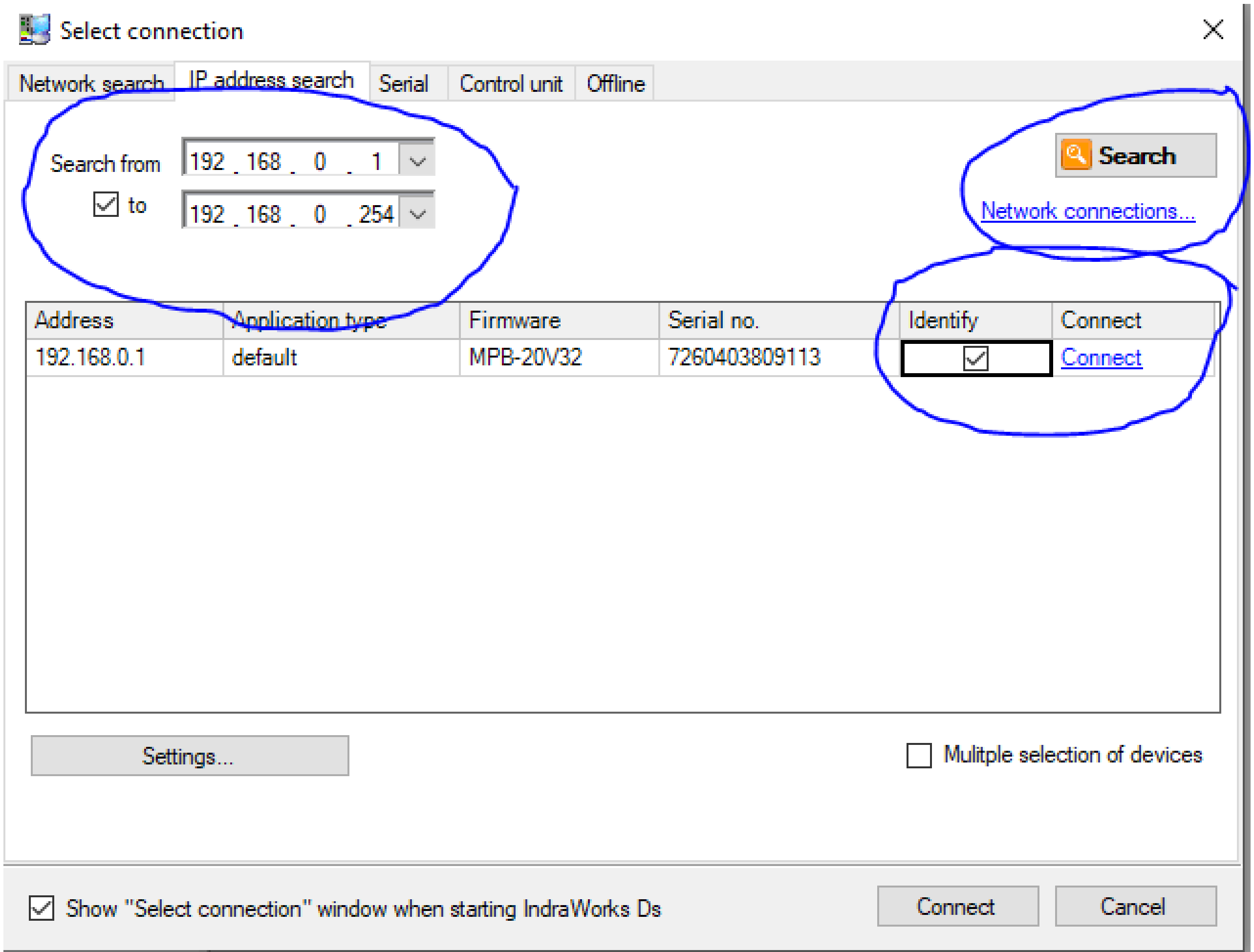
To connect the PC to the Servo Drive on port X26 Only. This is the Engineering Port and will be used for commissioning the drive. A standard patch or crossover ethernet cable can be used. You will need an empty ethernet port on your PC or an ethernet adapter can be used.

Note: To communicate with the drive your PC's Internet Protocol Version 4 (TCP/IPv4) Settings must be set to the same IP scheme as the drive's current settings. If this is a new Drive out of the box the IP address of the drive will be 192.168.0.1, however, if the drive has been previously configured you will need to look at the front display of the drive. The Engineering Port IP Settings can be obtained by pressing the Esc button and navigating the X26 Settings and press enter. See below for an example of IP Settings that may work:



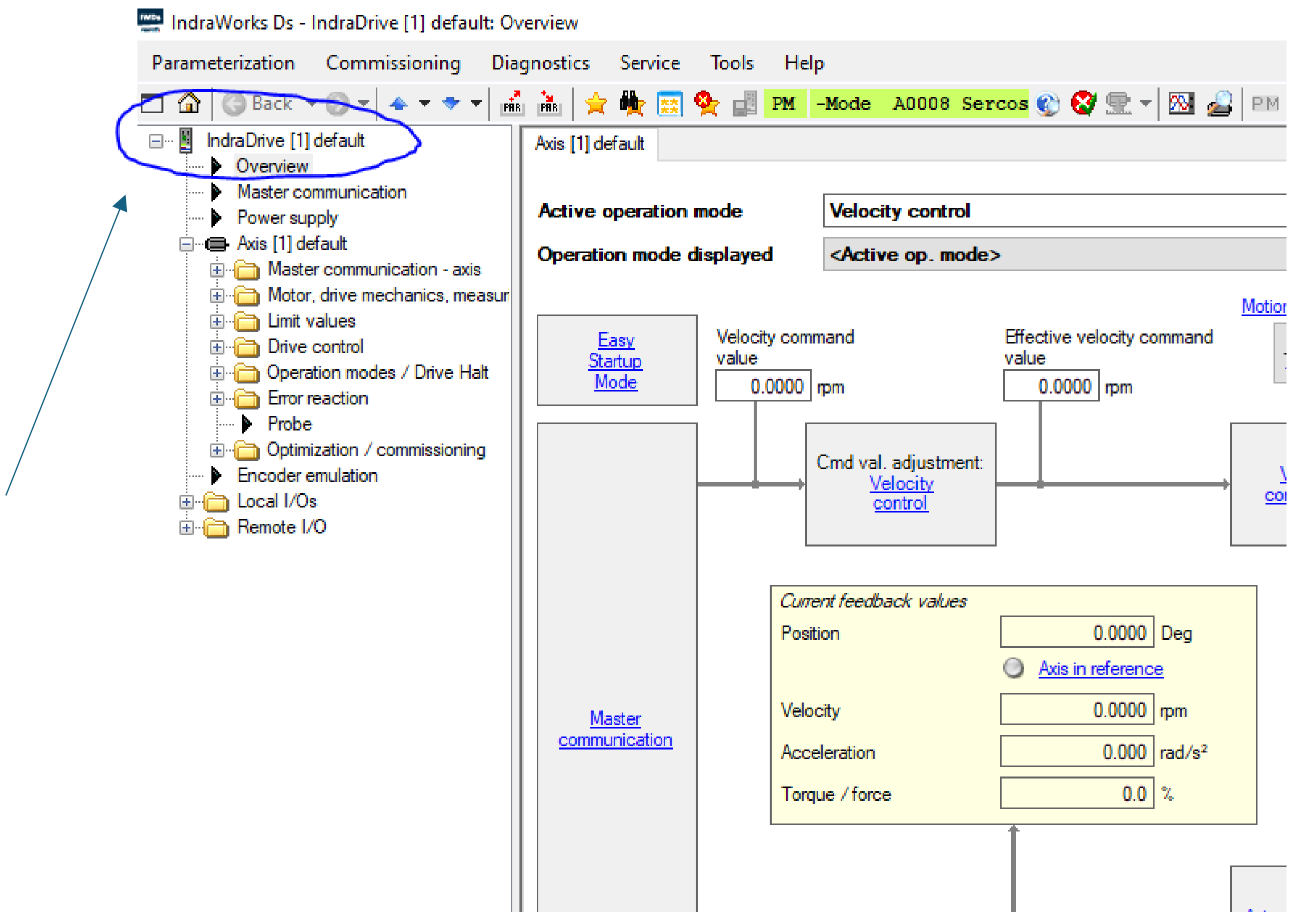
Initializing Communication from IndraWorks

Start up the IndraWorks DS software and select Tools/Start New Indraworks DS Instance. The box below will appear. Make sure the IP address shown starts with the IP address of the drive and then click “Search”. If you are properly connected to the drive the drive will appear in the window, and you can click “Connect.”



Verifying Communication from IndraWorks

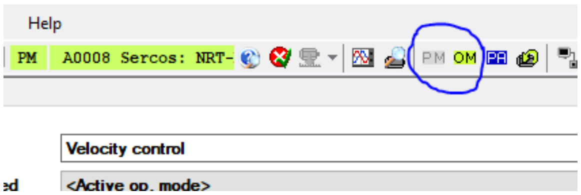
Verify that you now see your project in the “project tree” located in the upper left-hand side of the screen. You are now online with the drive. We are now able to configure the drive.



Commissioning the Servo Drive

Set Parameterization Mode

Before adjusting drive parameters, we must put the drive into a parameterization mode (PM). If this is a new drive it will start up in this mode, however, if not you can easily do this by clicking the PM Button at the top of the screen.



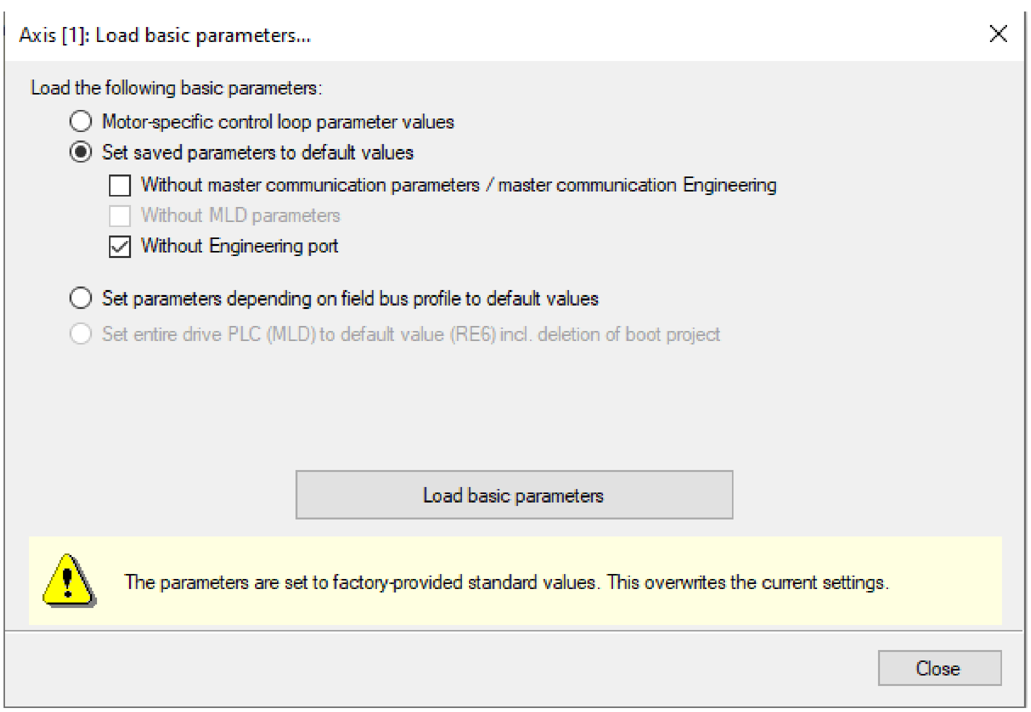
Parameter Adjustment

Various levels of parameters will now be adjusted. These are shown below:

Load Basic Parameters

To start the process of setting the parameters, it is important to start from a default set of parameters. To do this we will "Load Basic Parameters" from the Indraworks software. To do this:

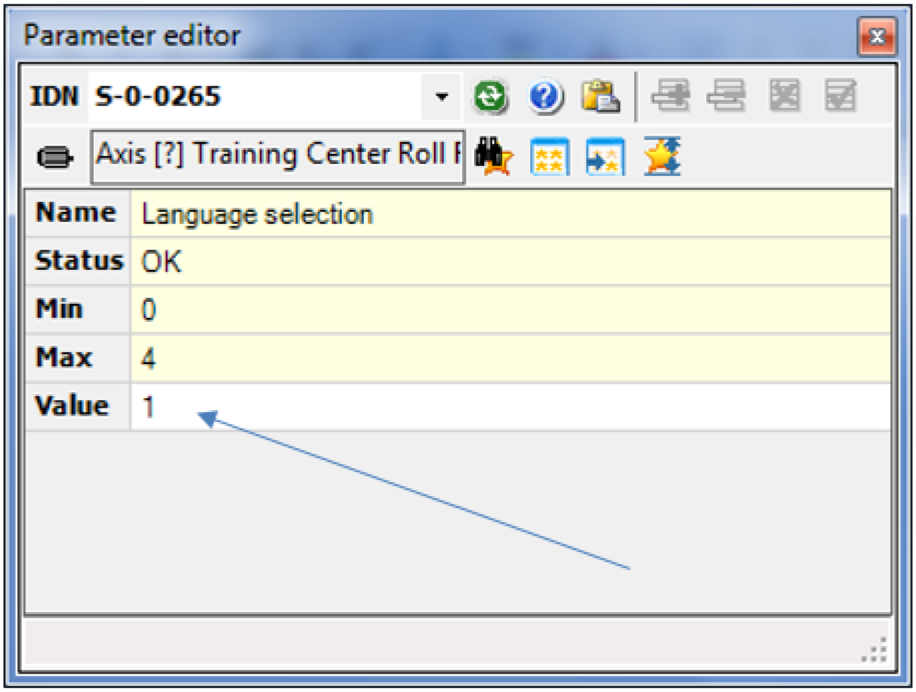
- Click "Commissioning"
- Click "Load Basic Parameters"
- Click "Set saved parameters to default values"
- Click "Without Engineering Port"
- Click "Load Basic Parameters"



Set Drive Language

By default, the drive will use German as the language in which it displays errors. This makes it difficult to determine the cause of problems from Indraworks. This is not to be confused with the language setting on the Indraworks software. They are completely different. To set the language do the following:

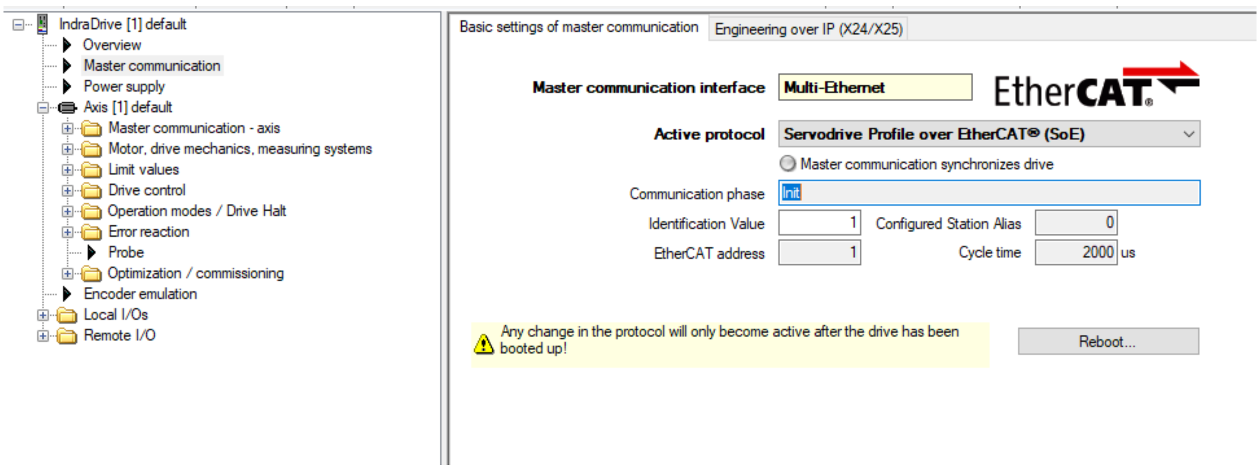
- Click “Parameterization”
- Click “Parameters”
- Click “Parameter Editor”
- Click the “IDN” box and enter S-0-0265
- Under “Value”, enter “1” as shown below:



Set Master Communication

The Master Communication of the drive sets the protocol used in the drive for control and we can set a new IP address if we choose.

- Click “Master Communication” in the project tree
- Click the tab in the settings screen to “Basic settings of master communication”
- In the Active protocol window set “Servodrive Profile over EtherCAT (SoE)” as the option and choose yes for any pop-up windows.
- Click “Reboot”



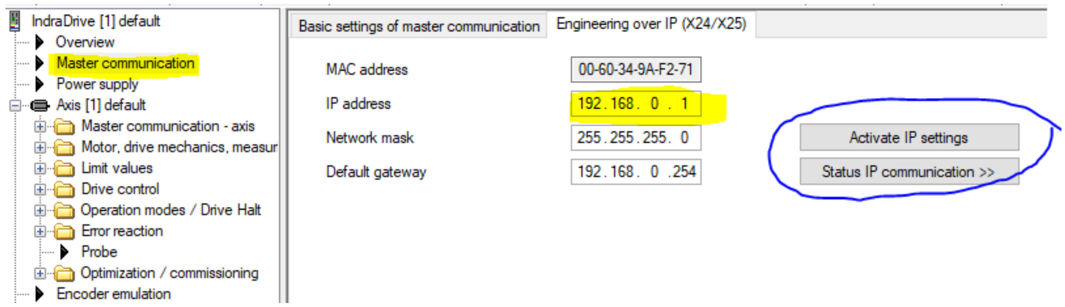
Note: When the drive reboots, it will power back up in the “INI” State on the front panel. You will need to reconnect to the drive from Indraworks to continue.

Set Drive IP address

If we want to set the drive up with an alternate IP address, we can do this by changing the setting as follows:

- Click “Master Communication” in the project tree
- Click the tab in the settings screen to “Engineering over IP (X24/X25)”
- In the IP address window, you can assign a different setting
- Click “Activate IP Setting” when completed

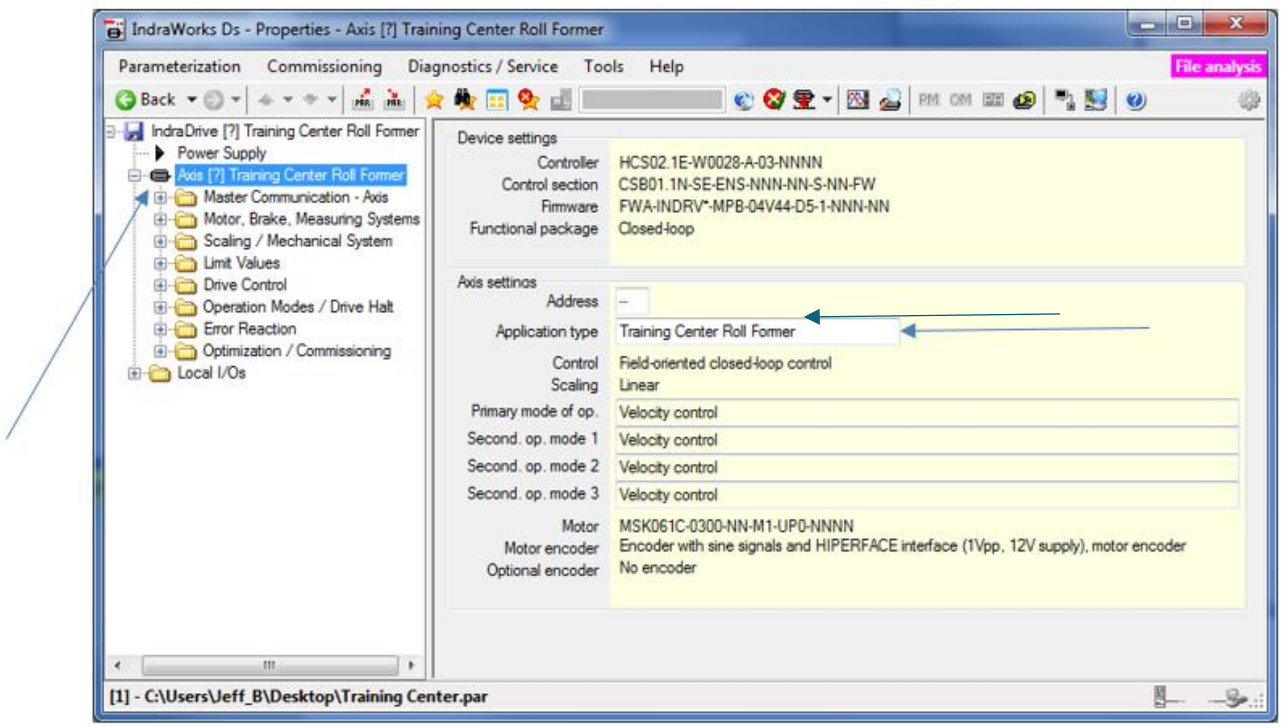
Important: Once you change this setting in the drive you will need to go back to your PC Internet Protocol settings from earlier in this document to re-establish communications.



Name the Axis

We want to give each Axis a name. This helps us identify the Axis. To name the Axis do the following:

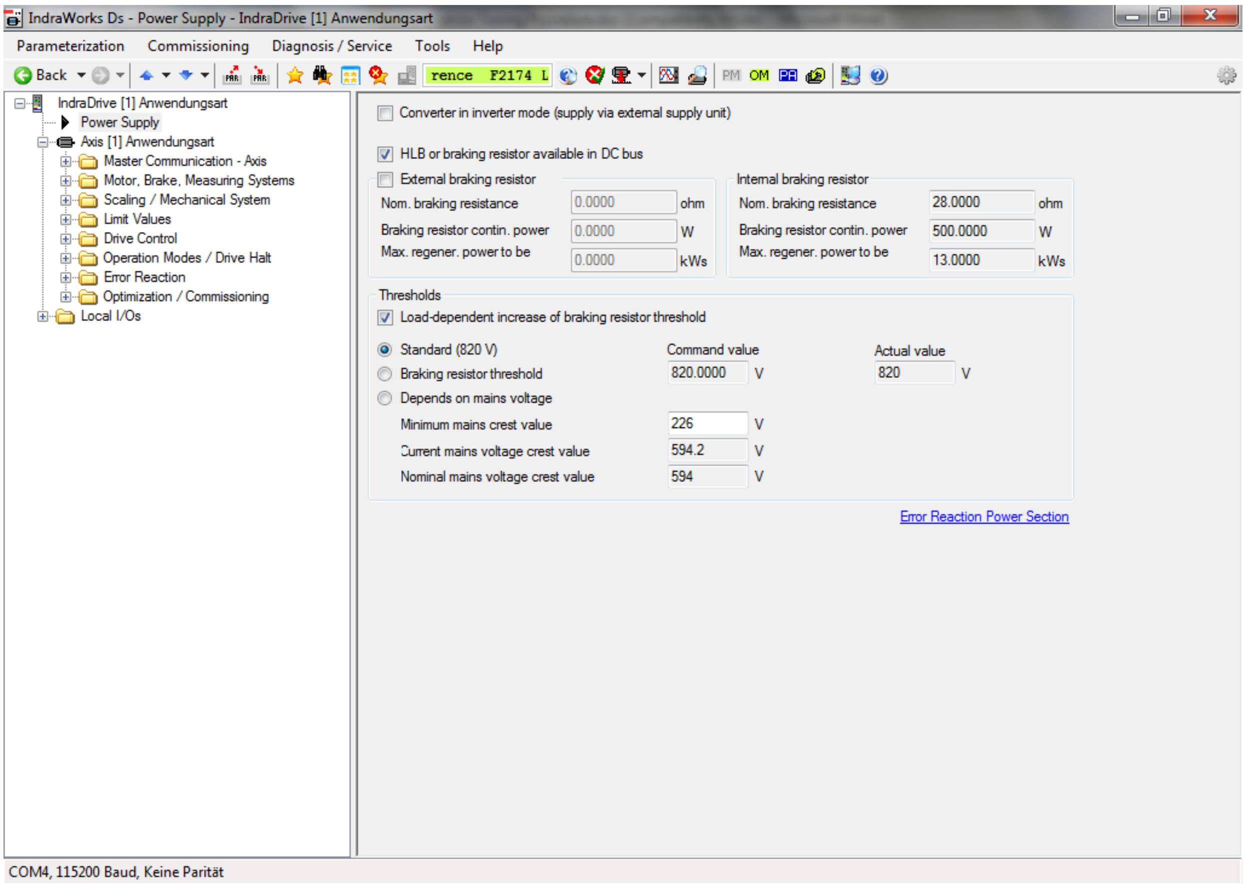
- Right Click the "Axis" in the Project Tree.
- Choose "Properties."
- Name the Axis under "Application Type."



Braking Resistor

Inform the system if there is a Braking Resistor available. Double click the "Power Supply" text on the left-hand side of the screen. The window below will appear. If there is a braking resistor on the system check the box marked "HLB or Braking resistor available on the DC Bus."

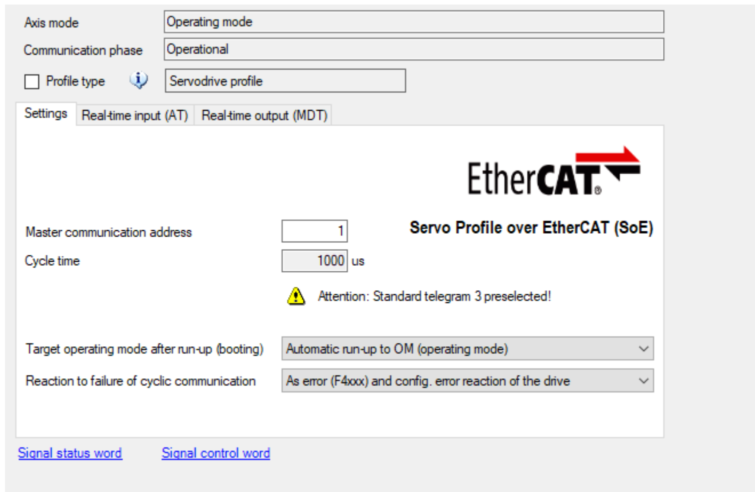
Note: Some drives do not support the addition of a Braking Resistor. For these drives you will not see the option to add an HLB or Braking Resistor.



Set Profile Type

We need to ensure the drive is setup with the profile type of “Analog”. We can do this by:

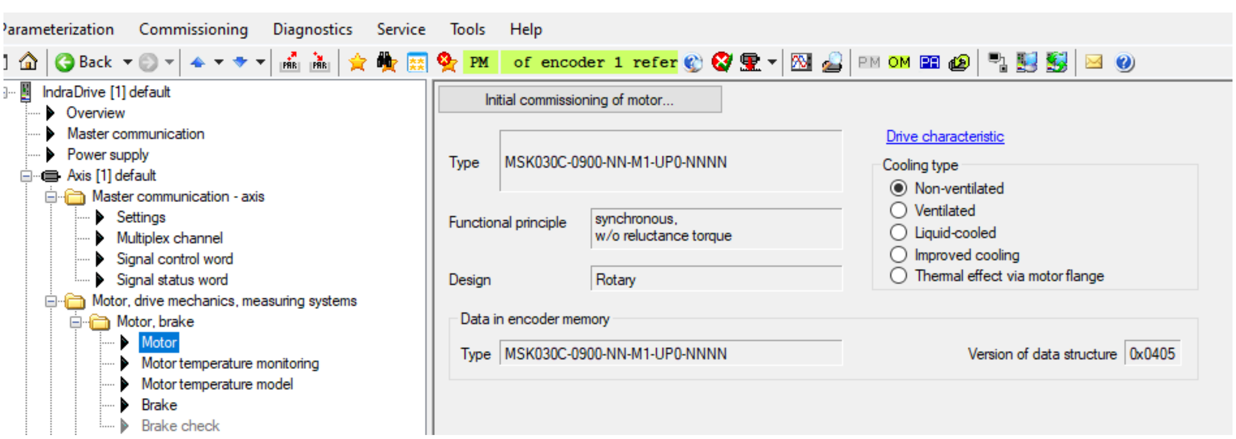
- Click “Master communication – axis”
- Click “Settings”
- Verify the Profile type is set to Servodrive profile. If not, set it as such and then click “Activate Profile Type”



Set Cooling Type

If the servo motor has a cooling fan attached, we must inform the dive. To do this:

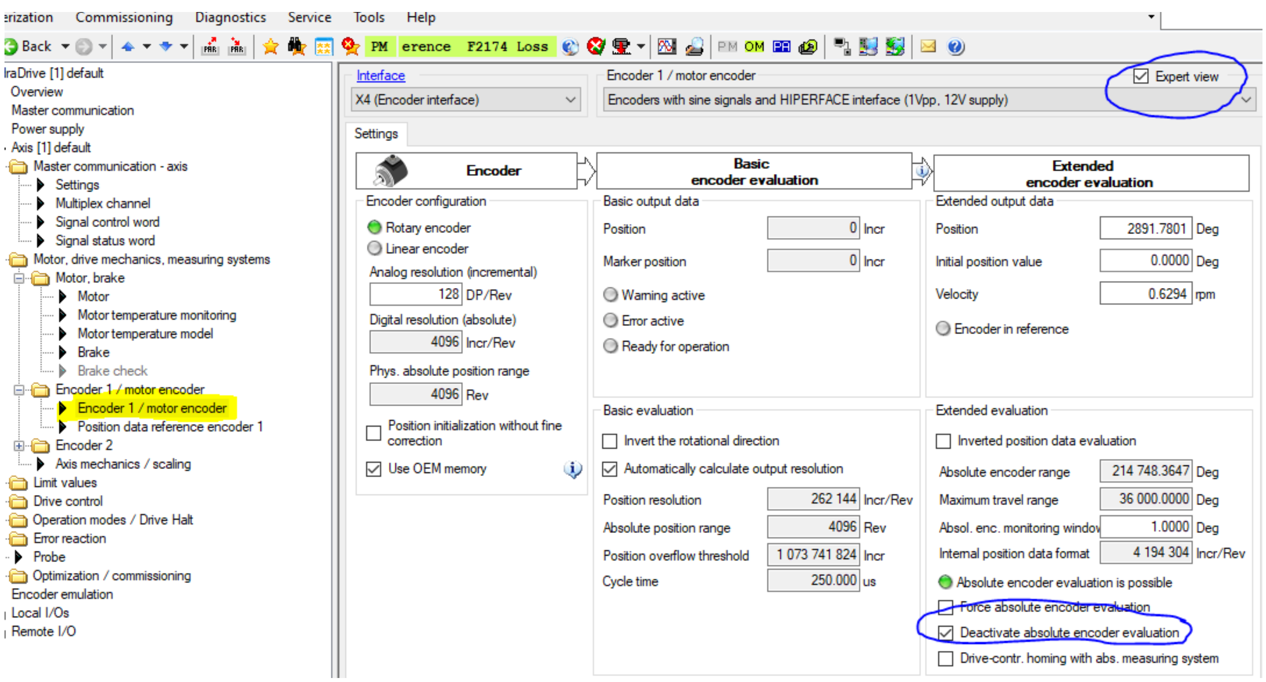
- Click “Motor, drive mechanics, measuring systems”
- Expand “Motor, brake”
- Click “Motor”
- Set “Ventilated” if there is a fan – or “Non-Ventilated” if there is not a fan.



Disable Absolute Positioning

Most servo motors provided by AMS Controls will have an absolute encoder on them. However, absolute positioning is not used for a Die Accelerator or Roll Feed application. This feature needs to be turned off. To do this:

- Click “Motor, drive mechanics, measuring systems.”
- Expand “Encoder 1/ motor encoder”
- Click “Encoder 1/ motor encoder”
- In the settings window, Click “Expert View”
- Click “Deactivate absolute encoder evaluation”



Set the Axis Mechanics of the System

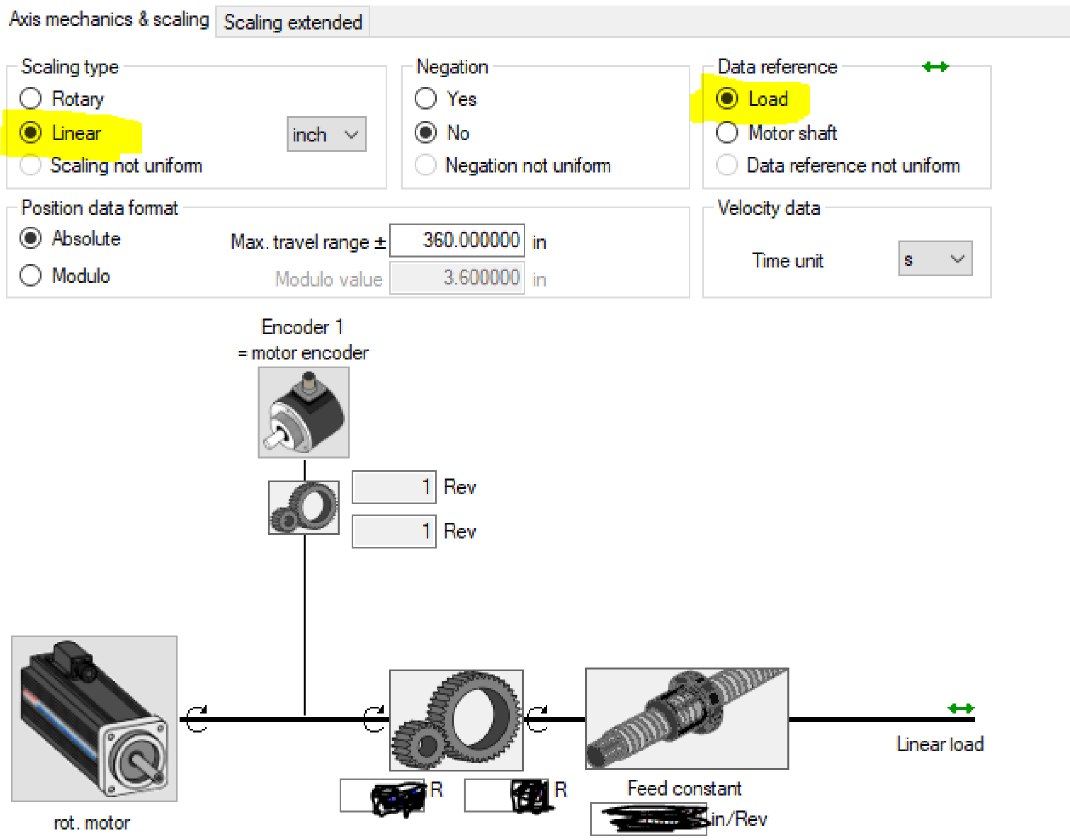
The setting of the axis mechanics and mechanical gearing of the system is extremely important! It is important that we set these to actual values of the attached load. The drive uses these settings to properly determine speed, gains, and feedback values. Incorrectly setting these values WILL result in unexpected faults and drive tuning.

Set the Axis Mechanics & Scaling

This is the location in which we tell the controller what the system is connected to. The screen should look like the following picture, however; the actual gearing and feed constant settings will be determined by attached mechanics. The most common applications used for these are Roll Feeds and Die Accelerators. A couple of examples for how these settings are determined are on following pages of this document.

- Click “Motor, drive mechanics, measuring systems”
- Click “Axis mechanics / scaling”
- On the settings page, click the “Axis mechanics & scaling” tab
- Set the scaling type to “Linear”
- Set the Data reference to “Load”

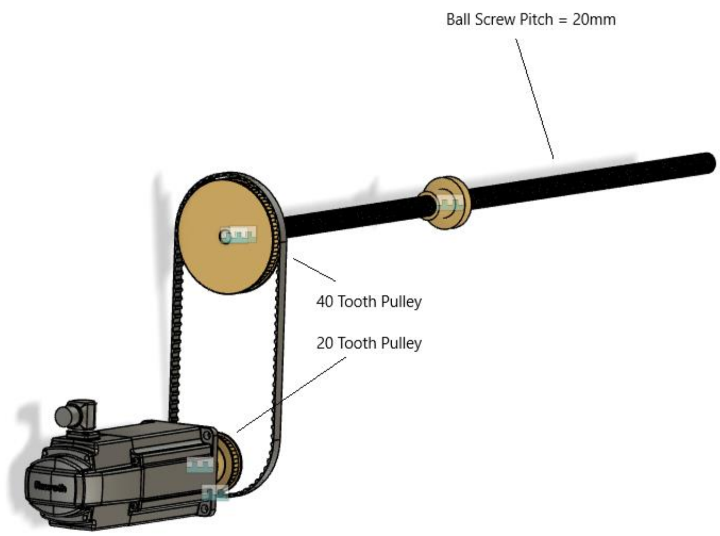
Note: DO NOT adjust the “Maximum Travel Range” parameter. This can drastically affect other parameters in the system. It is meaningless in our application.

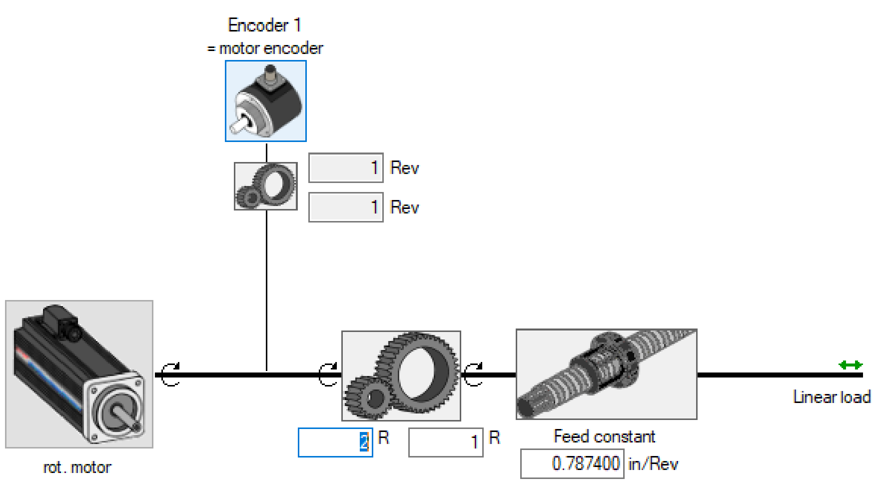

Axis mechanics & scaling
Scaling extended
Scaling type
Rotary
Linear
inch
Scaling not uniform
Negation
Yes
No
Negation not uniform
Data reference
Load
Motor shaft
Data reference not uniform
Position data format
Absolute
Max. travel range ±
360.000000
in
Modulo
Modulo value
3.600000
in
Velocity data
Time unit
s
Encoder 1
= motor encoder
1
Rev
1
Rev
[redacted] R
[redacted] R
Feed constant
[redacted] in/Rev
rot. motor
Linear load

Example Axis Mechanics Settings (Die Accelerator)

Below is an example of the mechanics of a Die Accelerator system using a ball screw and gear reduction. For the examples below the settings would be as follows:

- Feed Constant = 0.7874" (20mm/25.4)
  - The feed constant is the amount of movement of the load per rotation of that device. In this instance the screw pitch or lead is 20mm. We convert that to inches by taking mm and dividing by 25.4.
- Gear Ratio is 2:1 or 40:20

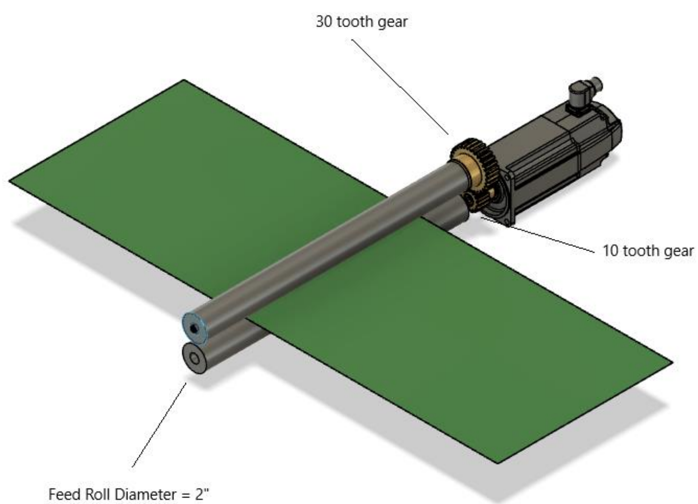


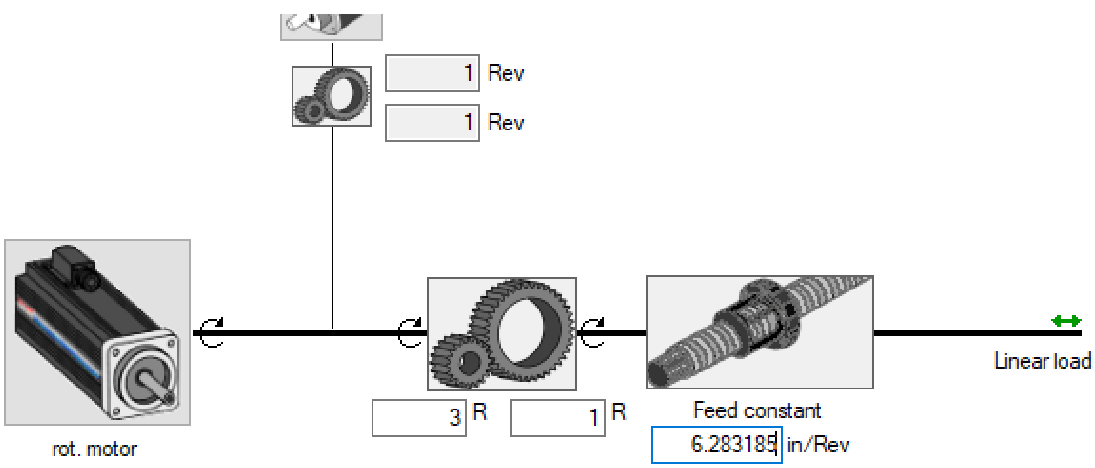


Example Axis Mechanics Settings (Feed Rolls)

Below is an example of the mechanics of a Feed Roll or Servo Feeder system using a set of feed rolls and gear reduction. For the examples below the settings would be as follows:

- Feed Constant = 6.283185" (2" x 3.14159)
    - The feed constant is the amount of movement of the material per rotation of the rolls. In this instance the feed roll diameter is 2". To get the amount of movement per rev of the rolls, we need to know the circumference. We get the circumference by taking the feed roll diameter x pi.
- Gear Ratio is 3:1 or 30:10





Velocity Scaling

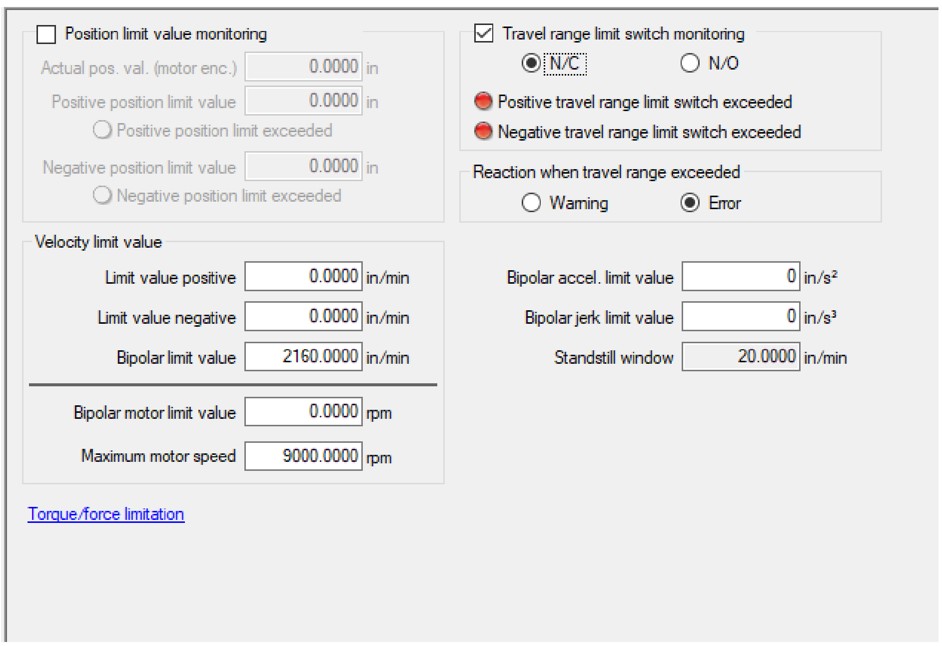
Set the Velocity Scaling of the system. Go there by doing the following:

- Click “Limit Values”
- Click “Motion Limit Values”

To scale the system, we need to know the maximum FPM of the Axis. We will need to convert this value to in/min and add 20% to properly scale the system. For instance, we have a Die Accelerator System that we want to run at a max speed of 150FPM. The following formula would be used:

150FPM x 12 = 1,800in/min x 1.2 = 2,160 in/min

Therefore 2,160 in/min would be entered as shown below:



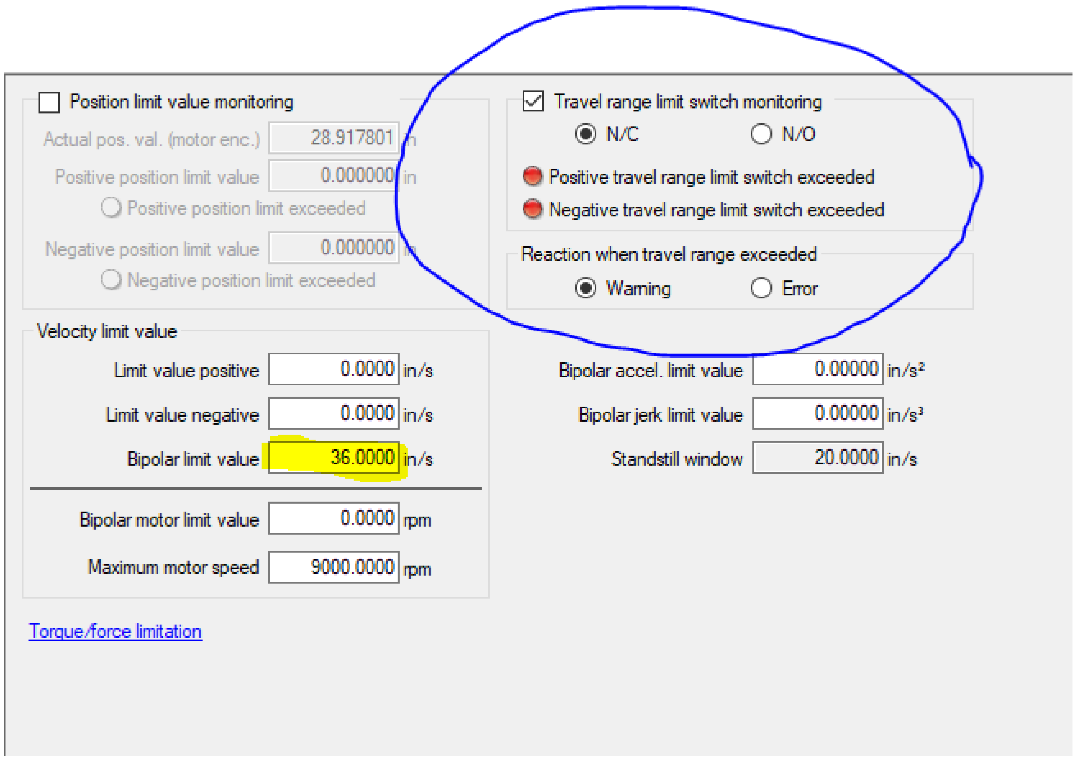
Set Travel Range Limit Switch Monitoring

Set the Travel Range Limit Switch Monitoring of the system. Go there by doing the following:

- Click "Limit Values"
- Click "Motion Limit Values"

At this time we will tell the drive if we have over-travel switches connected and if they are N/O or N/C. The drive should be set to react as a warning as shown.

Important! - If you are setting up a Roll Feed System do NOT check the travel range box above.

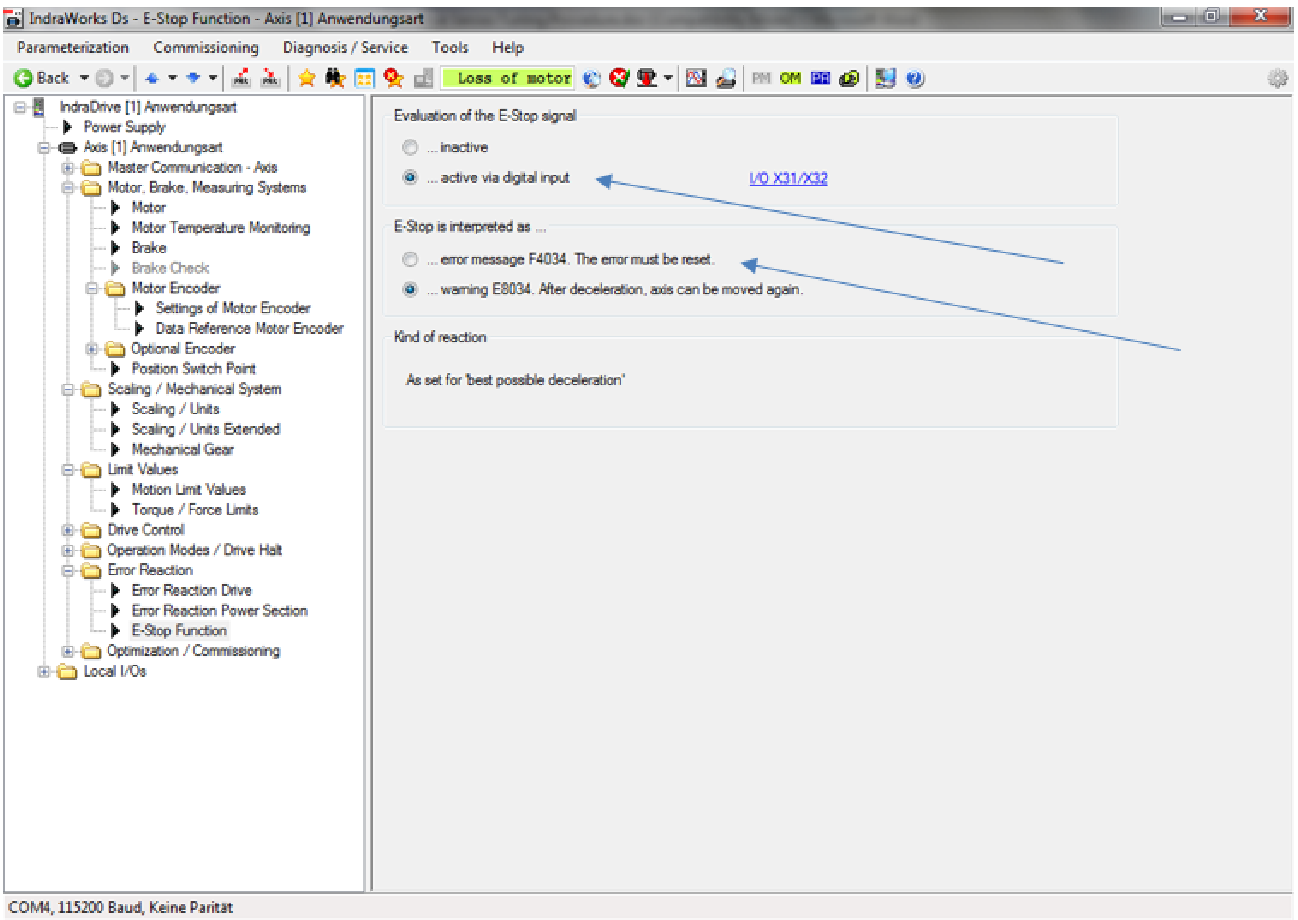


Set E-stop Function

Set the E-stop function. Assuming the E-stop signal is being used and is physically wired the below selections can be made. Go there by doing the following:

- Click “Error Reaction.”
- Click “E-stop Function.”
- Set the “Evaluation of the E-stop Signal” to Active
- Set “E-stop is interpreted as…” to Warning E8034

Note: If the E-stop signal is not being utilized simply check “inactive.”



Set Inputs and Outputs (I/O)

The Input and Output assignments are dictated by the electrical design. The Inputs and Outputs are assignable in the software. Go there by:

- Clicking "Local I/Os."
- Click "I/O X31/X32."

In the example below the following I/O were assigned:

- Input 1 (X31:1) = Probe 1
- Input 2 (X31:2) = Probe 2
- Input 3 (X31:3) = E-stop
- Input 4 (X31:4) = Forward Overtravel
- Input 5 (X31:5) = Reverse Overtravel
- Output 8 (X31:8) = Drive Fault

Digital inputs Status

PIN	Signal	Bit
X31:1	S-0-0401 : Probe 1	0
X31:2	S-0-0402 : Probe 2	0
X31:3	P-0-0223 : E-Stop input	0
X31:4	P-0-0222 : Travel range limit switch inputs	0
X31:5	P-0-0222 : Travel range limit switch inputs	1
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0

Digital outputs

PIN	Signal	Bit
X31:8	P-0-0115 : Device control: Status word	13
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0
--	S-0-0000 : Not assigned	0

Set Operating Mode

Before attempting to move the motor, we must put the drive into an operation mode or “Phase 4.” Placing the drive into Phase 4 must be done from the XL200 Series Controller.

From the XL200 Controller display do the following:

- Touch “Diagnostics”
- Touch “EtherCAT”
- Press F2-Change State
- Set to “Operational”
- Touch “OK”
- Current Phase should then read “Operational”

Note: If the drive fails to go to Operational, see the Troubleshooting section of this manual for help to resolve this issue.

Spinning the Motor

Controller Setup

Now that the initial drive parameters are set, the system is ready for motion.

DANGER: De-couple the motor from all mechanical connections to die. Should the command signal be out of phase on start-up, the motor will quickly spin out of control in one direction, causing physical harm to equipment and personnel.

1. The motor should be disconnected from any mechanical structures, gearing, or couplings before continuing. Place the motor on the floor and secure the motor so it can't roll. Most servo motors have enough torque to roll over or even flip in the air, causing damage to the motor or those standing nearby.
2. The closed-loop AMS Controls controller must now be programmed with the information required to begin testing the servo system. Explanations of these parameters follow.
3. Begin by setting the following parameters to their corresponding "start-up" settings:

Jog Select	Die
Loop Gain	5
Maximum Die Return Velocity	Max. Line Speed + 15fpm
Minimum Die Return Velocity	1*
Acceleration	Line Speed in fpm + 10-15
Return Acceleration	Same as Acceleration
Minimum Die Distance	See Below
Maximum Die Distance	Max. Travel Allowed**
Line Resolution	See Below

Jog Select

The Jog Select parameter allows the operator to switch from jogging the line through the controller to jogging the die. If "Line" is selected, the controller turns on its Forward and Reverse outputs when the corresponding inputs are activated.

When "Die" is selected, the controller does not turn on its directional outputs when the jog buttons are pushed. When the controller is configured to jog the die, and a jog input is received, the controller turns on its Drive Enable output and tries to command the drive with the analog signal.

Loop Gain

In simple terms, Loop Gain reflects the responsiveness of the motor. If this number is too low, the motor will be slow and sluggish to respond. If the Loop Gain is set too high, the motor will become "over-stable" and begin to oscillate.

AMS Controls sets the Loop Gain as high as possible without pushing the motor into an "over-stable" state. This is accomplished by increasing the Loop Gain until the motor begins to oscillate, then backing the number down until oscillation goes away.

For most applications, the Loop Gain for a Bosch-Rexroth motor/drive combination should be set around 10-15.

Maximum Die Return Velocity/Minimum Die Return Velocity

When running parts, the AMS Controls controller can calculate the speed at which it needs to bring the die back to the home position to achieve the next part. It is programmed to always try to come back as slowly as possible to save wear and tear on the servo/actuator system.*

The Maximum Return Velocity of the motor should be set high enough so that the controller can bring the die back to the home position before the next cut point is reached. For most applications, adding 10 to 15 feet per minute to the maximum line speed is sufficient.

If the controller can achieve the first target, but displays a "Missed Shear" error afterward, increase the Maximum Die Return Velocity to overcome this problem.

Minimum Die Return Velocity should be set as low as possible to extend the life of the mechanical parts on the servo/actuator system. However, should the need arise to bring the die back to the home position faster, the Minimum Die Return Velocity parameter can be set as high as is necessary.

**On Hole Detect models, the controller is not programmed with the part length, so it cannot calculate a return speed. In these cases, the controller will always bring the die back to home at the Maximum Die Return Velocity. Careful consideration should therefore be given when setting the drive "Bipolar Velocity Limit Value" on controller models with the Hole Detect option. See the section "Velocity Scaling"*

Acceleration/Return Acceleration

Acceleration is the rate at which the controller brings the die up to line velocity. Enter the value calculated for the sizing of the application.

Return Acceleration should be set high enough for the controller to bring the die up to speed to get back to the home position, but Return Acceleration can usually be set lower to increase the life of the mechanical equipment in the servo/actuator system.

Minimum Die Distance

Minimum Die Distance is the minimum amount of distance the die must travel at the controller's programmed Acceleration to reach line velocity. This distance can be calculated by using the following formula:

S_0 = Line Speed in Feet per Minute
S_1 = Line Speed in Inches per Second
D = Total Dwell Time of Press
A = Acceleration

$S_0 / 5 = S_1$

$(S_1)^2 / (2 * A)$ = Minimum Die Distance

Every time the controller accelerates the die to line speed to achieve a cut, the die typically overshoots the actual target, initially, and spends a little time trying to compensate for the overshoot. This results in something of a dampening curve. The higher the Acceleration, the longer it takes for the controller to position the die accurately. Increasing the Minimum Die Distance can decrease tolerance problems caused by this overshoot.

Maximum Die Distance

Depending on the setting of the On Tolerance Error parameter in the controller, this parameter may or may not be critical. If the On Tolerance Error parameter is set to "Stop No Cut," the controller will begin calculating its tolerance when the die reaches the Minimum Die Distance and will not fire the die until it's in tolerance. If the controller cannot achieve tolerance by the programmed Maximum Die Distance, it will not make the cut, but instead will stop the line, bring the die back to the home position, and give the operator an "Out of Tolerance" error.

If the On Tolerance Error parameter is set to "Cut and Stop," the controller will fire the die at the Minimum Die Distance and calculate tolerance error at the end of the Shear Dwell Down Time. In this instance, Maximum Die Distance is ignored.

In any case, the controller updates the Lag time of the servo system whenever the die is traveling between the Minimum and Maximum Die Distances.

Line Resolution

The Line Resolution parameter is the amount of material represented by one pulse from the line encoder. Line Resolution is calculated using the following formula:

P = Model of AMS Controls Encoder or the Pre-Quadrature Pulses per Rev. of a Non-AMS Controls Encoder
D = Diameter of the Measuring Wheel
C = Circumference of the Measuring Wheel
π= Pi, a Mathematical Constant Approximately Equal to 3.14

$C = \pi * D$

Line Resolution = C / (P * 4)

1. Reset the line/console. The drive should display “Ab” on the digital read out on the firmware module. This indicates the drive is powered up and ready for motion. If the module displays any other code, check the Bosch-Rexroth Functional Description manual for the appropriate firmware version. Call AMS Controls if questions arise. AMS Controls technicians are experts in the use of these drive systems with AMS Controls XL Series controllers. Bosch-Rexroth technicians may not be able to assist in start-ups because they do not know how our controller interfaces with the drive.

2. Enter the controller setup screen “Closed Loop Data” and select “Jog Die Accelerator” from the menu. The screen will display a position of 0.000”. Press the “Jog Forward” button. The motor should begin turning. Check the motor rotation. If the motor is turning in the wrong direction, see the section Reversing the Motor Direction.

3. Now that the motor is turning in control and in the proper direction, reconnect the motor to the actuator or roll feed mechanism. This should be done with the power removed from the drive and motor.

    *Before moving the die, over-travel limit-switches and the home switch must be in place. Over-travel switches should be part of the E-Stop chain for the machine. Shock absorbers should be mounted at both ends of the travel to maintain the AMS Controls warranty on the actuator and to protect the mechanical equipment from damage. Additional hard, or physical, stops should be added to prevent damage to equipment and personnel.

4. Press the “Manual Shear” button to home the die and zero the position reading on the controller. This will move the die to the home switch, bring the die off the switch, then back onto the switch and fire the press. If any Shear Die Distance has been programmed, the die will move to the programmed position before the press fires.

   The manual shear button must remain depressed until the controller fires the press, or the process will be aborted. This is a safety feature of the controller.

5. Enter the “Setup” menu and go to the “Closed Loop Data” submenu in the controller. Select “Die Test” from the “Closed Loop Data” submenu. Enter a test length and a line speed to simulate and press enter to begin the test. The die will begin to simulate production.

   It’s usually a good idea to start off at a low speed (10-50 fpm) and work up to a test that will simulate the line at maximum production speed. This will require that the Die Test be halted and restarted for each change in simulated line speed.

6. The AMS Controls Closed-Loop controller performs its main function by accelerating a cutting tool to line speed, matching position and speed of the target, and firing a press to actuate the cutting

tool. The controller accomplishes this by using the Acceleration and Minimum Die Distance programmed by the user.

One way to improve tolerance is to increase Minimum Die Distance. This gives the controller more distance to match speed and position of the target. Lowering Acceleration can accomplish the same thing by decreasing the amount of “overshoot” of the die once it has reached line velocity.

Try increasing Minimum Die Distance until it no longer seems to have an effect on the tolerance. At this point, begin increasing Loop Gain. Loop Gain is the final tool in fine-tuning the servo system.

Loop Gain should be increased until the tolerance begins to become more erratic. At this point, the closed loop is over-stable. Set the gain to a lower, more stable number.

Troubleshooting

Motor Spins Out of Control (Drive Not Responding Error)

Once you have commissioned your drive, you may experience the drive spinning uncontrollably when attempting to jog. This is most likely due to the analog command or encoder feedback being out of phase. Try the following, in most cases the first action item resolves the issue.

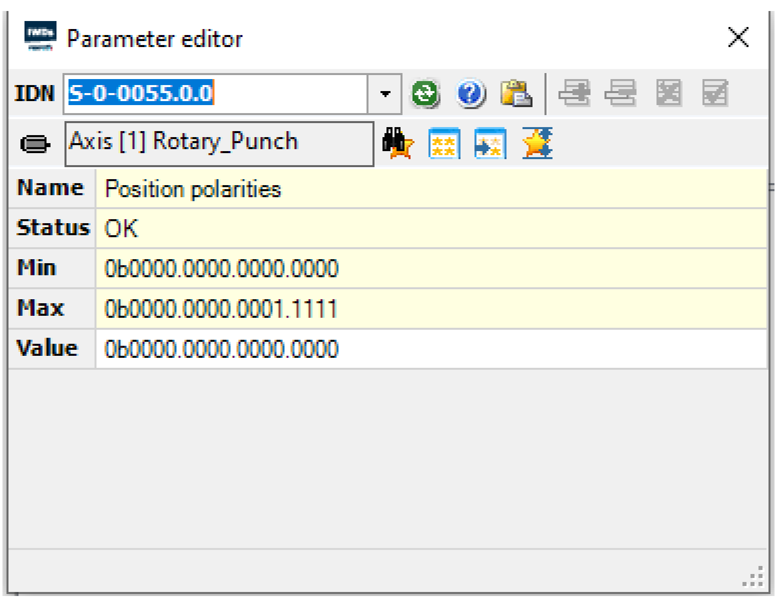
1. E-stop the system and Swap the Analog Command Wires
2. Check the analog command at the Controller and the Drive for voltage
3. Check the AMS Diagnostics/Closed Loop Data screen for Encoder Feedback

Reversing the Motor Direction

Once you have commissioned your drive, and you find that the motor is spinning in the opposite direction that is required, it is possible to invert this direction.

1. E-stop the system
2. Using the parameter editor (see page "Set Drive Language" section for an example on how to use it), set the below parameters to their alternate value. For example, if your parameters are currently set to 0, set them to 1. If they are already at 1, set them to 0.

    - S-0-0055 Position Polarity Parameter
    - S-0-0043 Velocity Polarity Parameter
    - S-0-0085 Torque Polarity Parameter



WARNING!! – If one of the above parameters are changed, they must ALL be changed. Failing to do so will cause out of control behavior of the machine and can cause significant damage to the machine if not done properly.

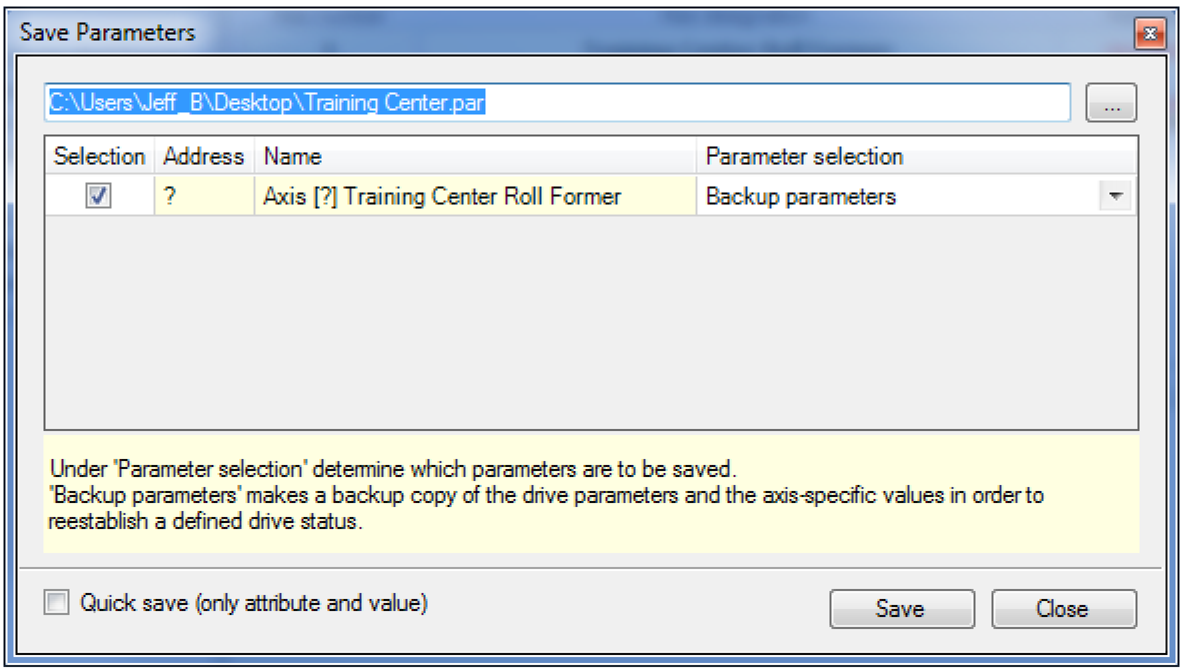
Backup and Restore Parameters

Back Up Parameters

It is recommended to back up or "Save" the parameters once the drive is commissioned in case parameters are lost. Prior to backing up parameters, you must first place the drive into a "Parameterization mode" or "Phase 2". See the section for Set Parameterization Mode for assistance. To back up the parameters do the following:

- Click "Parameterization."
- Click "Save…"
- Click the address bar at the top and choose a location to save the file.
- Click "Save."

Once the process is complete, click "Close". At this time, you must place the drive back into "Operation Mode" or "Phase 4". See the section Set Operating Mode for assistance.



Restore Parameters

In case of a problem, you may want to restore parameters from a known good state. In this case you may want to restore or “Load” parameters. Prior to loading parameters, you must first place the drive into a “Parameterization mode” or “Phase 2”. See the section Set Parameterization Mode for assistance. To restore the parameters, do the following:

- Click “Parameterization.”
- Click “Load…”
- Click the address bar at the top and choose a location to load the file.
- Click “Loading.”

Once the process is complete, click “Close”. At this time, you must place the drive back into “Operation Mode” or “Phase 4”. See the section Set Operating Mode for assistance.