KOLLMORGEN

AKD2G SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS

Rev B 5-16-2024

This document shows the wiring requirements for connecting the DDL linear motors to the AKD2G servo drive. It also describes the setup procedure for configuring the AKD2G drive in the Workbench software.

Table of Contents

AKD2G System Configuration with Kollmorgen DDL linear motors with standard convention

Overview

This procedure covers the case where the feedback AXIS#.PL.FB counts up or positive when moving the coil in the same direction as the motor lead exit. In the case the feedback counts down or negative using this convention the standard procedure can still be followed assuming your feedback type is one where wiring changes can change the sign or direction of the feedback. If your feedback type does not allow the feedback count to be resolved by wiring, please follow the conventions in Appendix A.

Feedback Types that can be inverted by wiring:

Incremental Encoder with or without Halls
Sine Encoder with or without Halls

Feedback Types that cannot be inverted:

BISS
EnDAT
Hiperface
Hiperface DSL
Renishaw BISS C

System Wiring Configuration

1. AKD2G System Cable Diagram

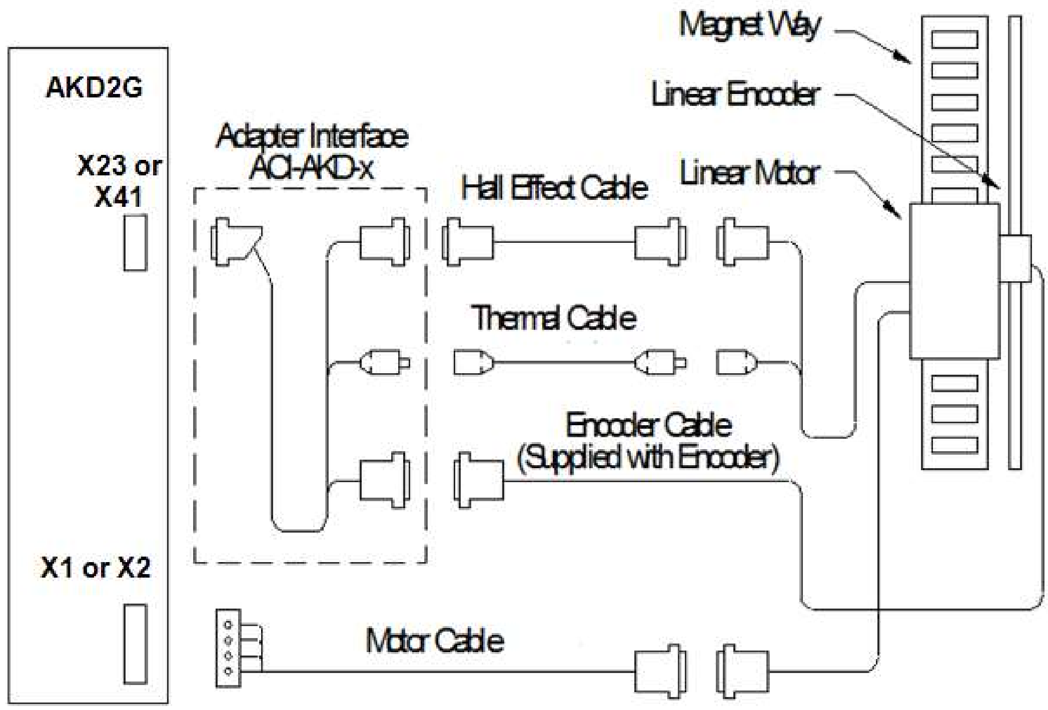
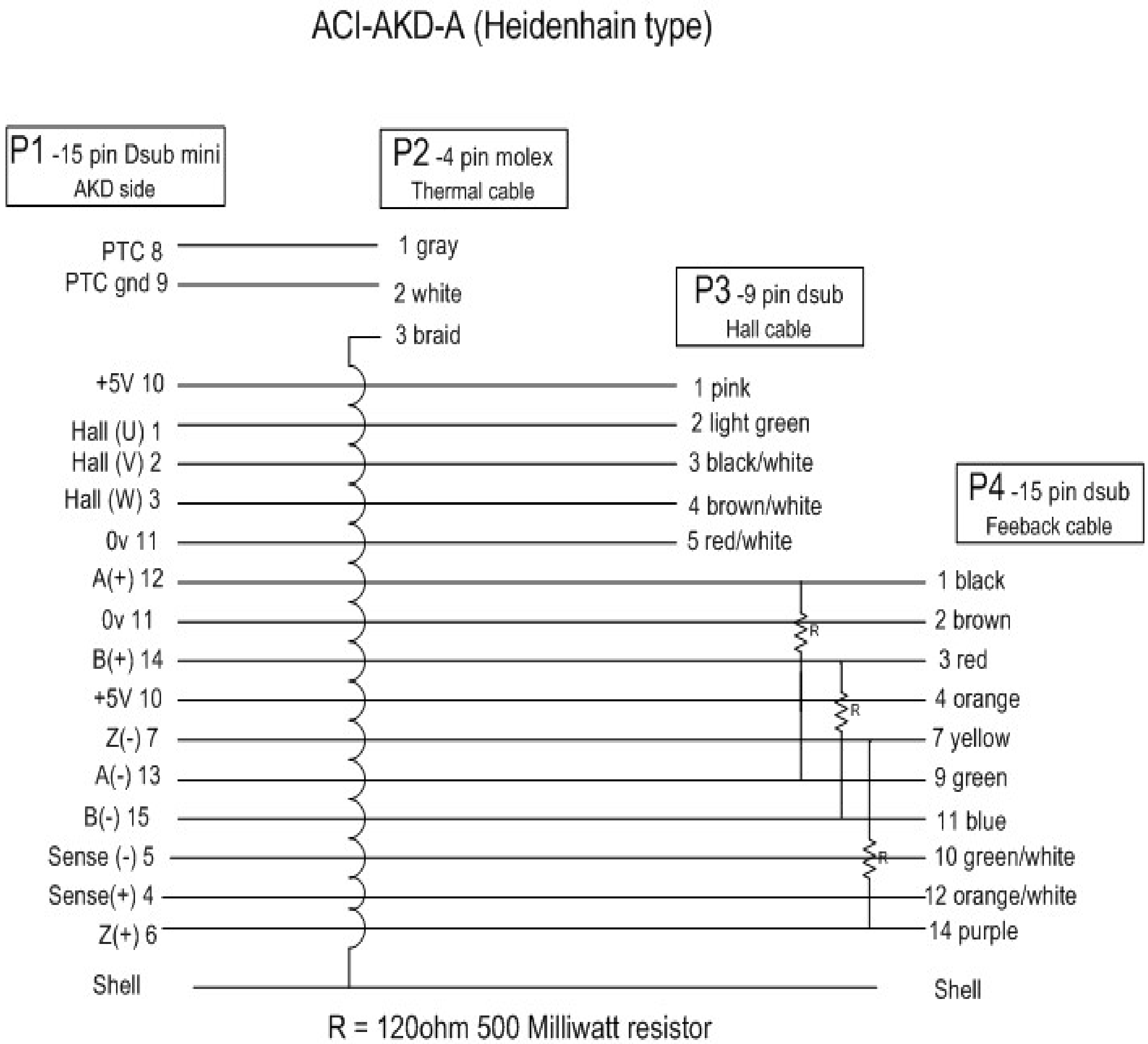


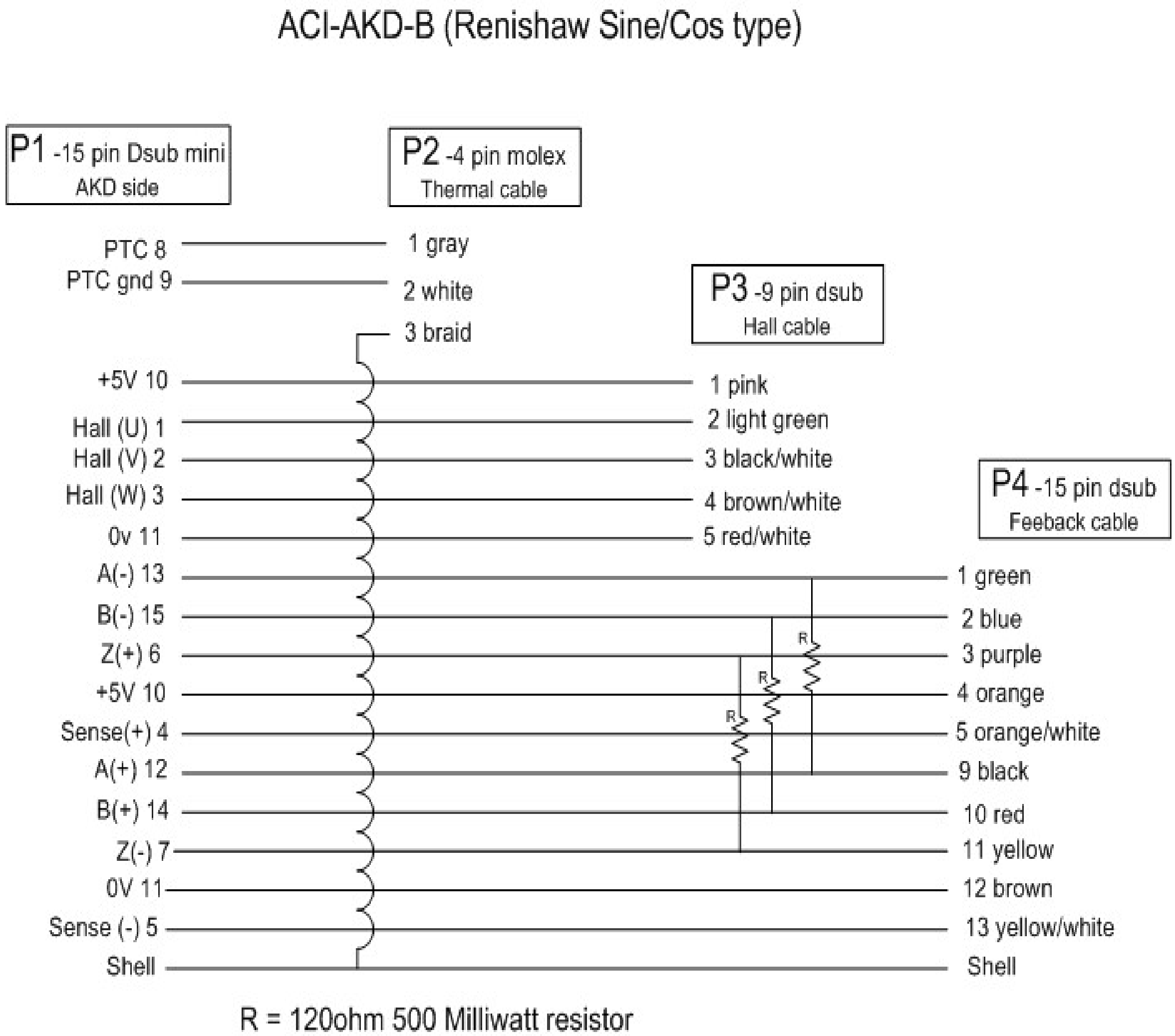
Figure 1

2. ACI-AKD-A (Heidenhain Sin/Cos) Cable Adapter



Note this is compatible with either X23 (F3-Option) or X41 (SFA)

3. ACI-AKD-A (Renishaw Sin/Cos) Cable Adapter



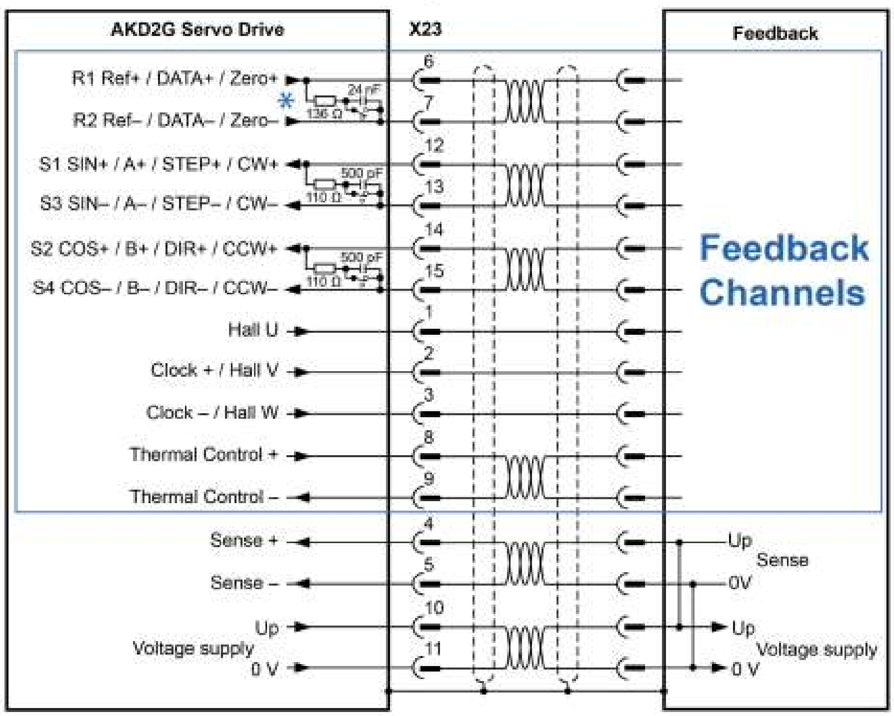
Note this is compatible with either X23 (F3-Option) or X41 (SFA)

4. AKD2G FEEDBACK X23

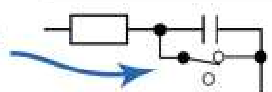
8.10.9 Feedback Connector X23

- Connectivity Option F3 or DX (→ # 28)
- Sub-D high density 15 pin, female
- Use Kollmorgen feedback cables
- Input for several feedback types
- Input for Electronic Gearing, (→ # 139)
- Output for encoder emulation (EEO1), (→ # 139)
- Digital input (→ # 154), Digital output (→ # 158)
- Mating connector data (→ # 54).

8.10.9.1 X23 Connector Pinout Summary



*AC / DC Selectable Termination: Older drives may not include a DC termination switch across pins 6 and 7. Please contact Kollmorgen Support for more information



Encoder power supply (X23 pins 10/11):

- Maximum voltage 9 V with shorted sense contacts (4/5), rated voltage 5 V +/-3.5%.
- Rated supply current is 350 mA.
- Voltage rise time ~4 ms with full load and 220 µF of capacitance.
- Encoder power lines capacitance 10 µF to 220 µF

Pin	SFD	Resolver	BiSS		EnDat		HIPERFACE	Sin/ Cos	Sin/ Cos +Hall	Incr. Enc.	Incr. Enc. +Hall	Hall	SSI	Step/ Dir	CW/ CCW
			B	C	2.1	2.2									
1	-	-	-	-	-	-	-	-	Hall U	-	Hall U	Hall U	-	-	-
2	-	-	CL+	CL+	CL+	CL+	-	-	Hall V	-	Hall V	Hall V	CL+	-	-
3	-	-	CL-	CL-	CL-	CL-	-	-	Hall W	-	Hall W	Hall W	CL-	-	-
4	S+	-	S+	S+	S+	S+	S+	S+	S+	S+	S+	-	-	-	-
5	S-	-	S-	S-	S-	S-	S-	S-	S-	S-	S-	-	-	-	-
6	COM+	R1 Ref+	D+	D+	D+	D+	D+	Z+	Z+	Z+	Z+	-	D+	-	-
7	COM-	R2 Ref-	D-	D-	D-	D-	D-	Z-	Z-	Z-	Z-	-	D-	-	-
8	-	Th+	Th+	-	Th+	-	Th+	Th+	Th+	Th+	Th+	Th+	Th+	Th+	Th+
9	-	Th-	Th-	-	Th-	-	Th-	Th-	Th-	Th-	Th-	Th-	Th-	Th-	Th-
10	+5 V	-	+5 V	+5 V	+5 V	+5 V	8 to 9 V	+5 V	+5 V	+5 V	+5 V	+5 V	+5 V	+5 V	+5 V
11	0 V	-	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V
12	-	S1 SIN+	A+	-	A+	-	SIN+	A+	SIN+	A+	A+	-	-	Step+	CW+
13	-	S3 SIN-	A-	-	A-	-	SIN-	A-	SIN-	A-	A-	-	-	Step-	CW-
14	-	S2 COS+	B+	-	B+	-	COS+	B+	COS+	B+	B+	-	-	Dir+	CCW+
15	-	S4 COS-	B-	-	B-	-	COS-	B-	COS-	B-	B-	-	-	Dir-	CCW-

CL = CLOCK, D = DATA, S = SENSE, Th = Thermal control, Z = Zero

= DC Terminated, can be overridden with DIO#.TERM

= Optional

5. X41 Feedback Connector

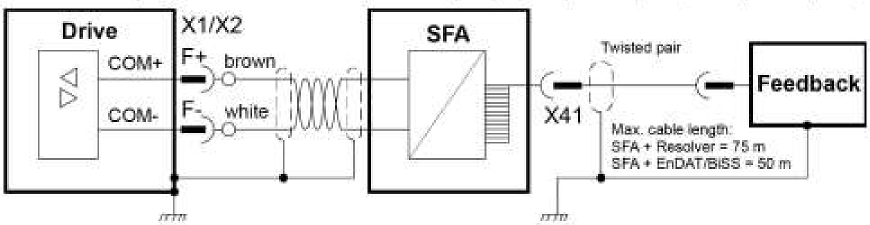
8.10.11 Feedback Connector X41 (SFA, accessory)

SFA (**S**mart **F**eedback **A**dapter) converts conventional feedback signals to a 2-wire serial signal. SFA can be laid into the cable duct or may be mounted to a DIN rail using a standard DIN rail clip.

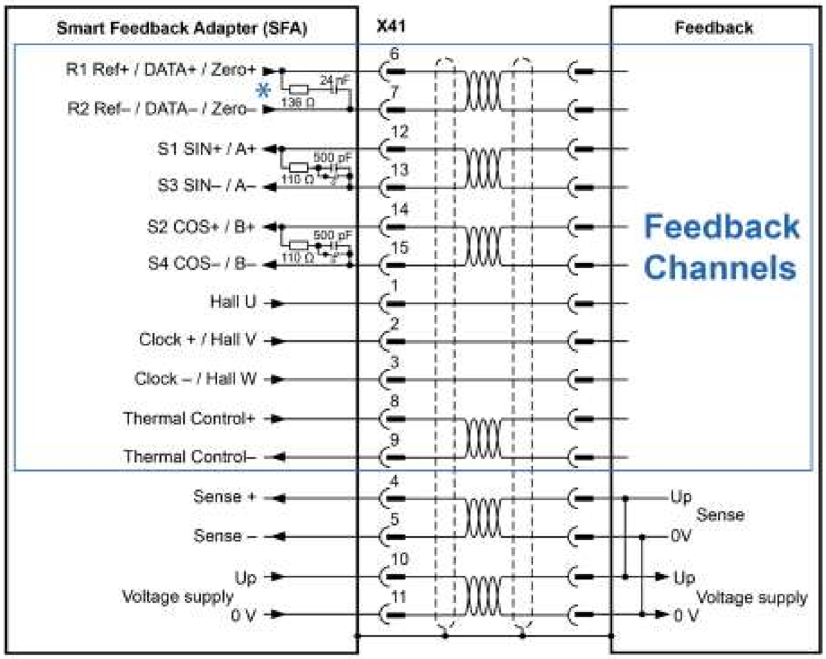
SFA provides a 15 pole HD Sub-D female connector X41 to the system for connection of a Kollmorgen motor feedback cable (see *Kollmorgen 2G Cable Guide*). Dimensions (LxWxD): 88.6 x 55.6 x 21.2 (28.6 with rail clip). Order codes see regional Accessories Manual.

- Sub-D high density 15 pin, female
- 1 m shielded cable with 3 flying leads for connection to X1 or X2 or X5
- The cable shield is connected by using shield wire to X5/1 or with cable ties to the X1/X2 shield plates.
- Connected feedback must be set in WorkBench.
- Only use Kollmorgen feedback cables. The cable shield must be grounded on the end near the SFA.
- SFA models with a metal DIN clip must be mounted inside a cabinet.
- Input for Electronic Gearing, (➔ # 139)
- Output for encoder emulation (EXX3/EXX4), (➔ # 139) - Only available on "-EXX" (Encoder) models
- Master-Slave (➔ # 141)

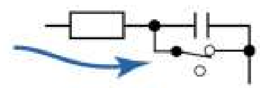
Connect the flying leads of the SFA cable to X1 (FB1, EXX3) or X2 (FB2, EXX4) or X5 (FB2, EXX4):



8.10.11.1 X41 Connector Pinout Summary



*The SFA does not include a DC termination switch across pins 6 and 7.



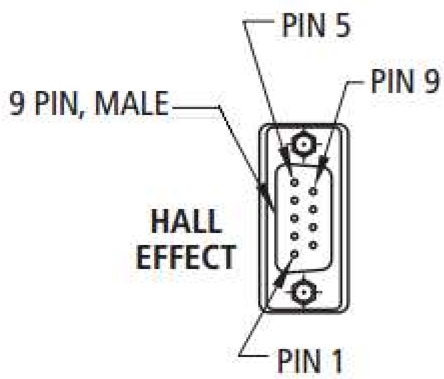
Operating Voltage: 7 to 12V, Maximum Load Current: 350mA

X41 Pin	SFD	Resolver (1)	BiSS B	BiSS C	EnDat 2.1	EnDat 2.2	HIPEFACE	Sin / Cos	Sin / Cos +Hall	Incr. Enc.	Incr. Enc. +Hall	Hall	SSI
1	-	-	-	-	-	-	-	-	Hall U	-	Hall U	Hall U	-
2	-	-	CL+	CL+	CL+	CL+	-	-	Hall V	-	Hall V	Hall V	CL+
3	-	-	CL-	CL-	CL-	CL-	-	-	Hall W	-	Hall W	Hall W	CL-
4	S+	-	S+	S+	S+	S+	S+	S+	S+	S+	S+	-	-
5	S-	-	S-	S-	S-	S-	S-	S-	S-	S-	S-	-	-
6	COM+	R1 Ref+	D+	D+	D+	D+	D+	Z+	Z+	Z+	Z+	-	D+
7	COM-	R2 Ref-	D-	D-	D-	D-	D-	Z-	Z-	Z-	Z-	-	D-
8	-	Th+	Th+	-	Th+	-	Th+	Th+	Th+	Th+	Th+	Th+	Th+
9	-	Th-	Th-	-	Th-	-	Th-	Th-	Th-	Th-	Th-	Th-	Th-
10	+5 V	-	+5 V	+5 V	+5 V	+5 V	8 to 9 V	+5 V	+5 V	+5 V	+5 V	+5 V	+5 V
11	0 V	-	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V
12	-	S1 SIN+	A+	-	A+	-	SIN+	A+	SIN+	A+	A+	-	-
13	-	S3 SIN-	A-	-	A-	-	SIN-	A-	SIN-	A-	A-	-	-
14	-	S2 COS+	B+	-	B+	-	COS+	B+	COS+	B+	B+	-	-
15	-	S4 COS-	B-	-	B-	-	COS-	B-	COS-	B-	B-	-	-

CL = CLOCK, D = DATA, S = SENSE, Th = Thermal control, Z = Zero
(1) : Resolver with AKD2G-CON-SFA-R00 only, all other feedback devices with AKD2G-CON-SFA-E00 only
= DC Terminated, can be overridden with DIO#.TERM
= Optional

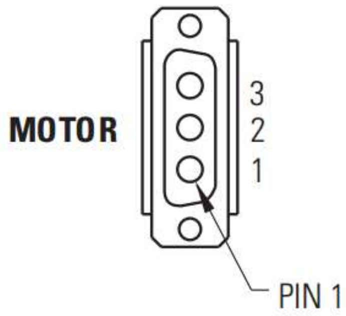
6. DDL Motor Hall Sensor Connections

DDL Motor Hall Sensor Connections



Motor Connector Pin Numbers	**Motor Hall Effect Colors**	**AKD2G Drive Connection Connector X23 or X41 Pin No.**
1	Yellow	1
2	Green	2
3	Black	3

7. DDL Motor Coil Connections



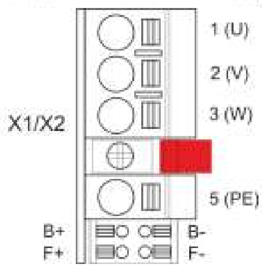
Motor Connector Pin Numbers	**Motor Coil Wire Color**	**AKD2G Drive Connection Connector X1 or X2**
1	Red	U
2	White	V
3	Black	W
Connector Shell	Grn/Yel	PE GND
Connector Shell	Violet	Shield

8. X1 and X2 Motor, Brake, Feedback Connection Pinout

8.5.5 Connector pinout

Information to wiring, mating connectors and cables (→ # 54).

8.5.5.1 X1 and X2: Motor, Brake, Feedback 1

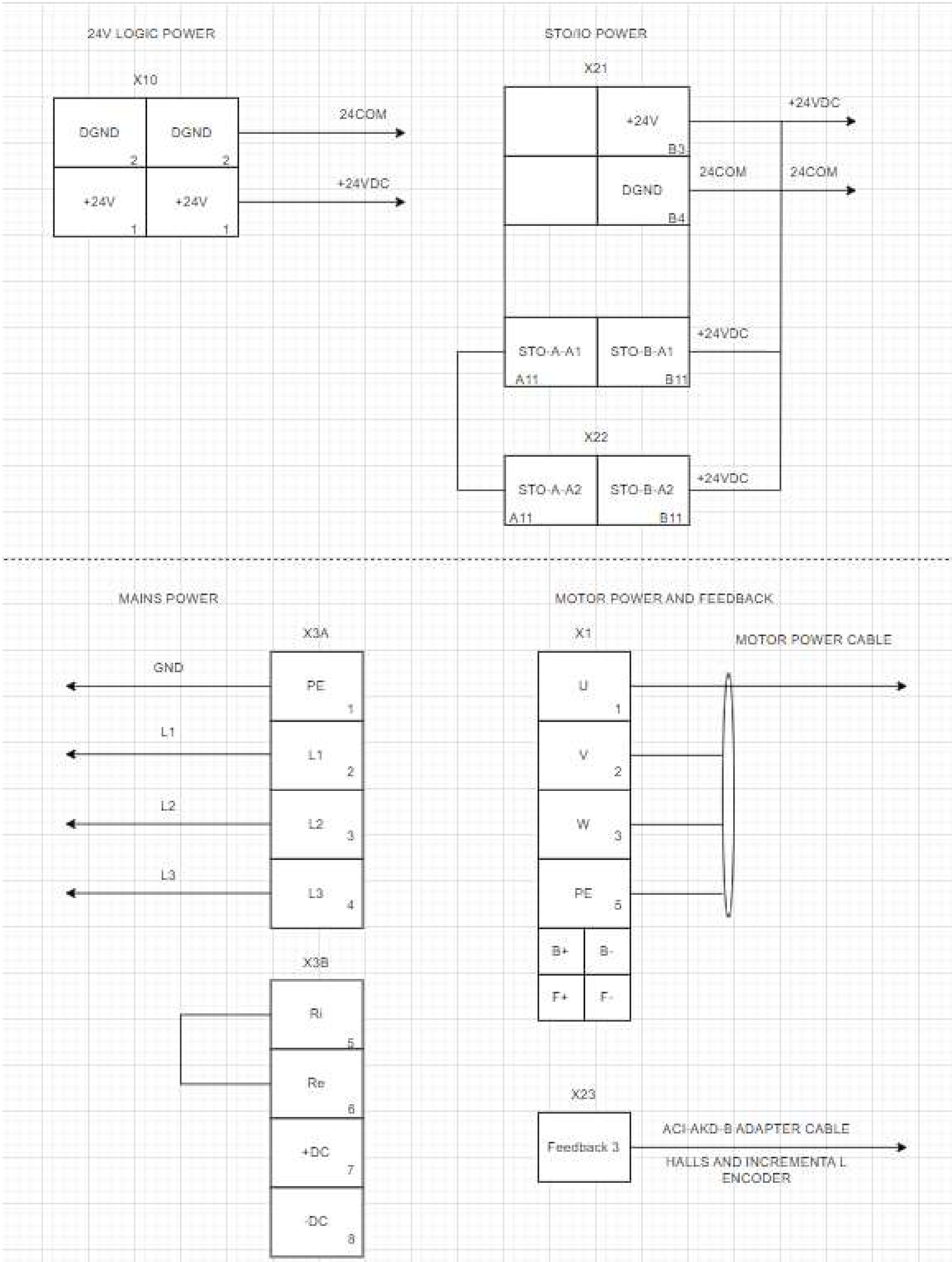


- 4 pin, pitch 7.62 mm plus 2x2 pin pitch 3.81 mm
- Spring clamps
- Locking screw, tightening torque 0.5 Nm (4.4 inlbs)
- Motor power, Motor brake (X1: axis 1, X2: axis 2)
- X1: Input for commutation feedback 1 (→ # 106)
- X2: Input for commutation feedback 2 (→ # 106)
- Wiring example:
  - DC Bus link (→ # 92)
  - Motor single cable connection (→ # 97)
  - Motor dual cable connection (→ # 99)

Pin	Label	Signal	Description
1	U	U	Motor phase U
2	V	V	Motor phase V
3	W	W	Motor phase W
	retention latch, shield screw		
5	PE	PE	Protective earth
B+	B+	BR+	Motor holding brake +
B-	B-	BR-	Motor holding brake -
F+	F+	COM+	SFD3 + or HIPERFACE DSL +
F-	F-	COM-	SFD3 - or HIPERFACE DSL -

9. Minimum Wiring Requirement for the AKD2G Drive

Note: This wiring demonstrates the bench test conducted to test this procedure. Please reference all wiring and safety requirements as detailed in the AKD2G installation manual.



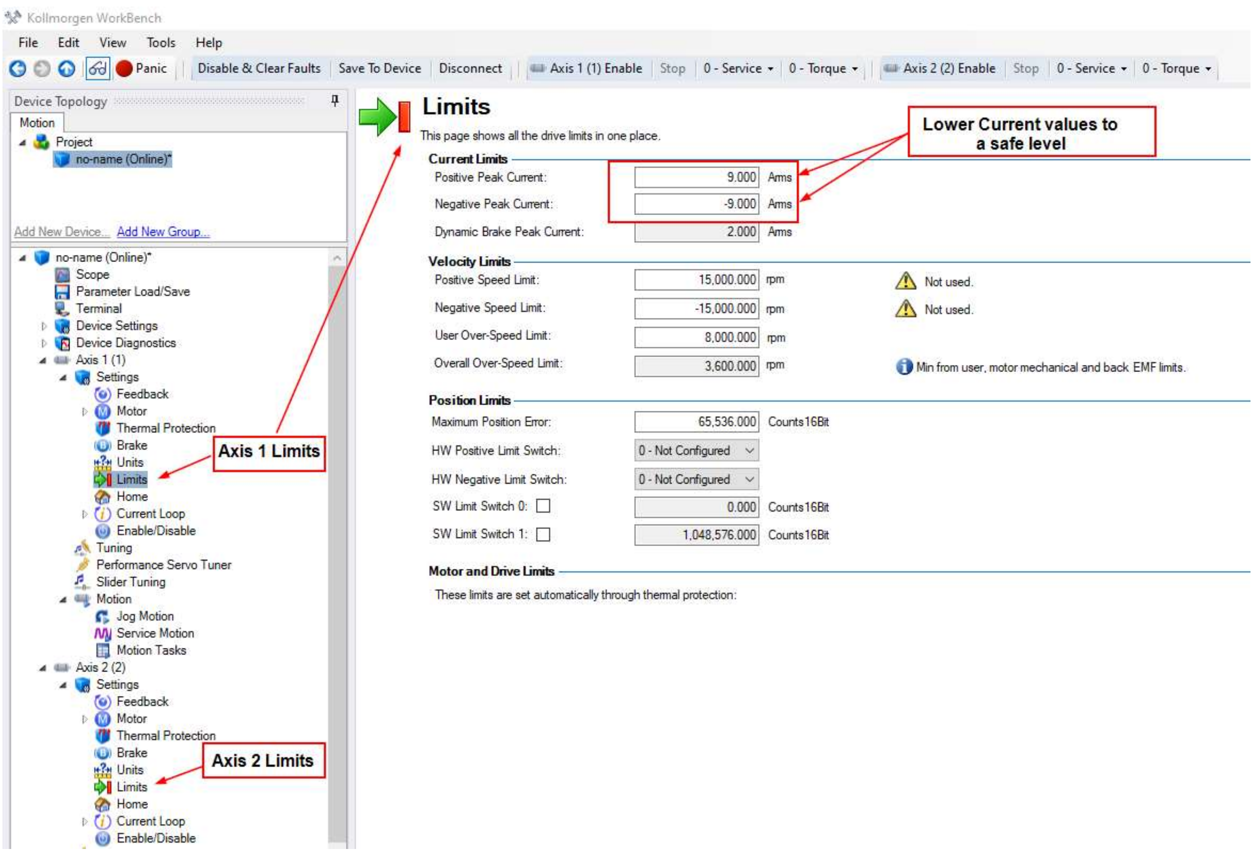
10. Configure the AKD2G Drive Using the Workbench Software

Install AKD2G Workbench. The software program can be found on the website (http://www.kollmorgen.com/en-us/products/drives/servo/AKD2G/), (http://kdn.kollmorgen.com/) and the Product Support Package (PSP) CD-ROM packaged with the drive. Follow the installation instructions. (If in doubt, install "Kollmorgen WorkBench GUI Full Version.")

1. Safety First

When first starting up the system, it is recommended to limit the peak current of the drive to a safe value and add wood blocks at each motor end stop to confirm it is operating correctly. If the motor was to run away at its full output force capability, it could cause serious injury or damage to the equipment.

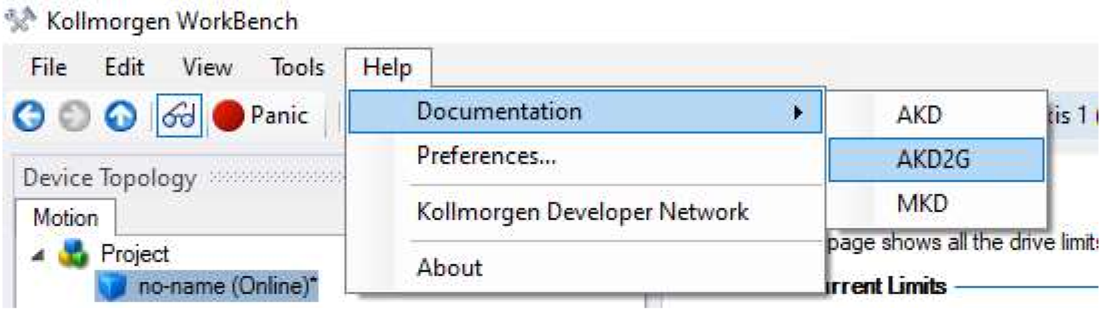
Axis 1 Limits Screen is shown and Axis 2 Limits navigation shown.



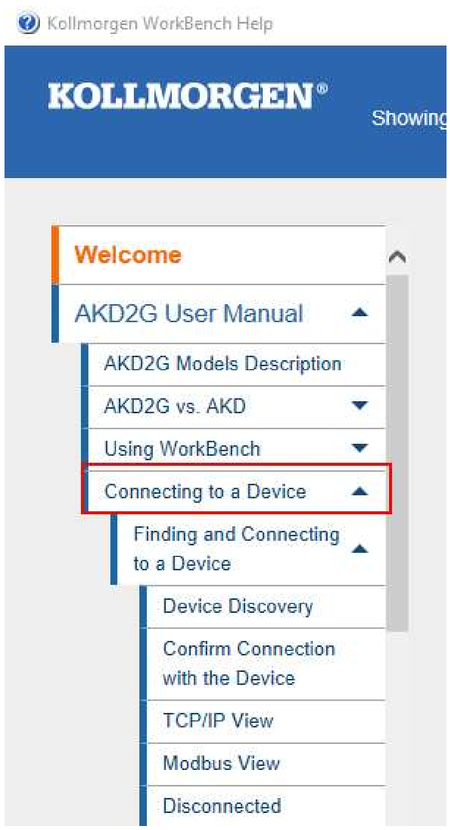
2. Connect to the AKD2G Drive

Follow the instruction from the WorkBench help file.

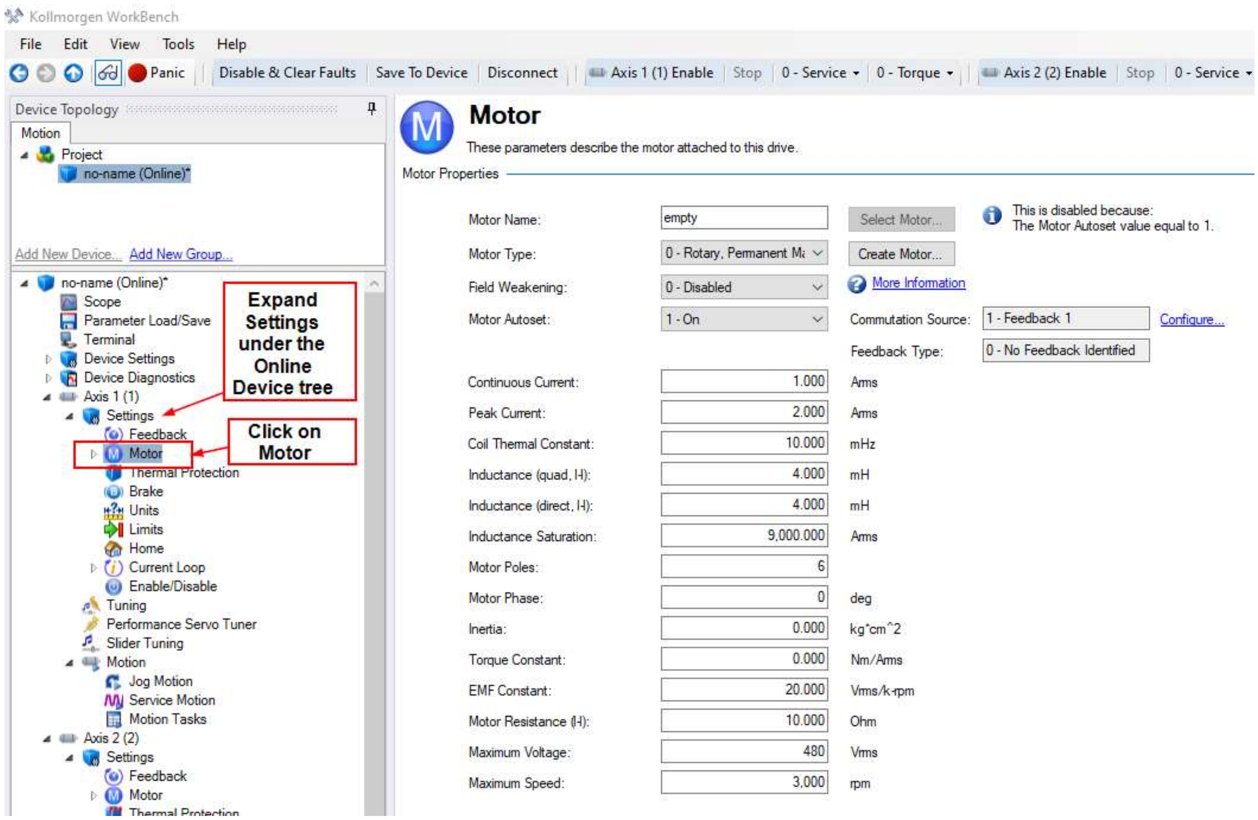
Help pulldown menu→Documentation->AKD2G



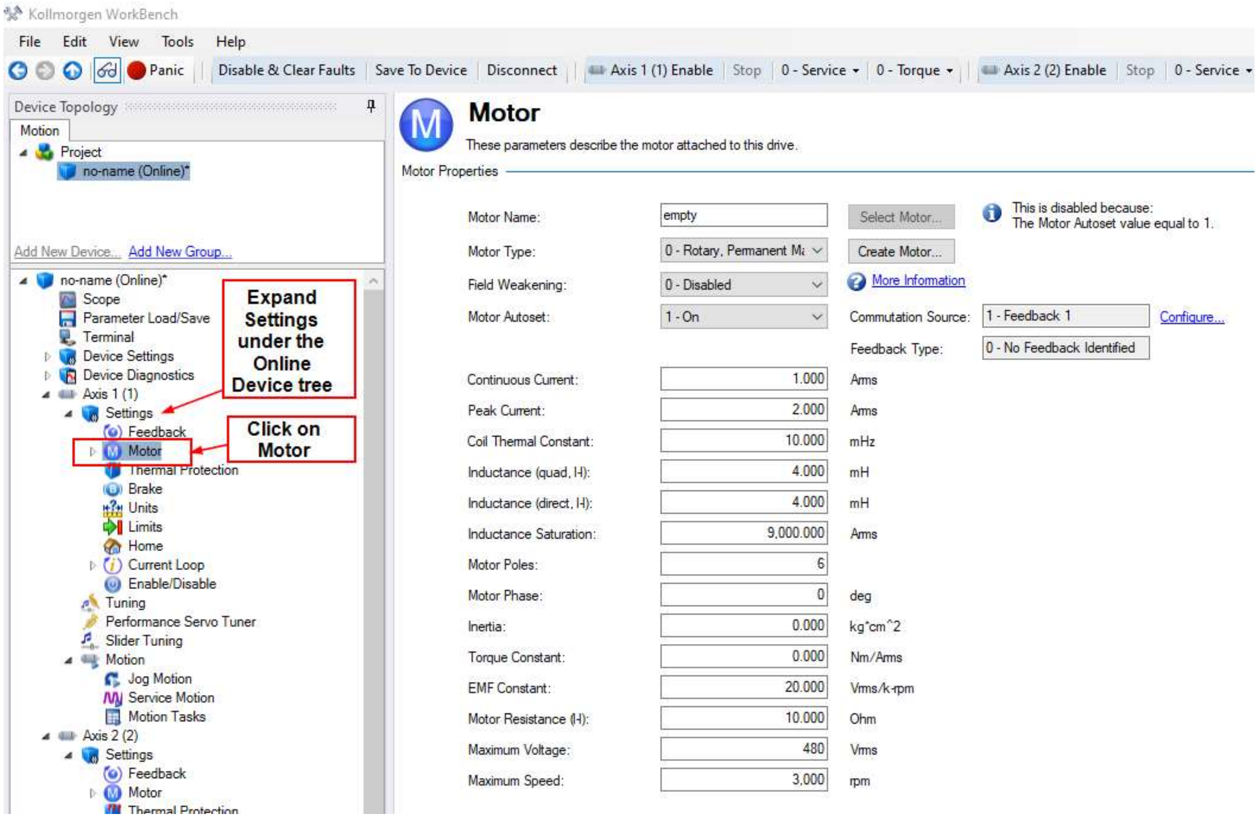
Navigate to “Connecting to a Device” in the Table of Contents.



3. Expand "Settings" and Select The Motor Setup Screen

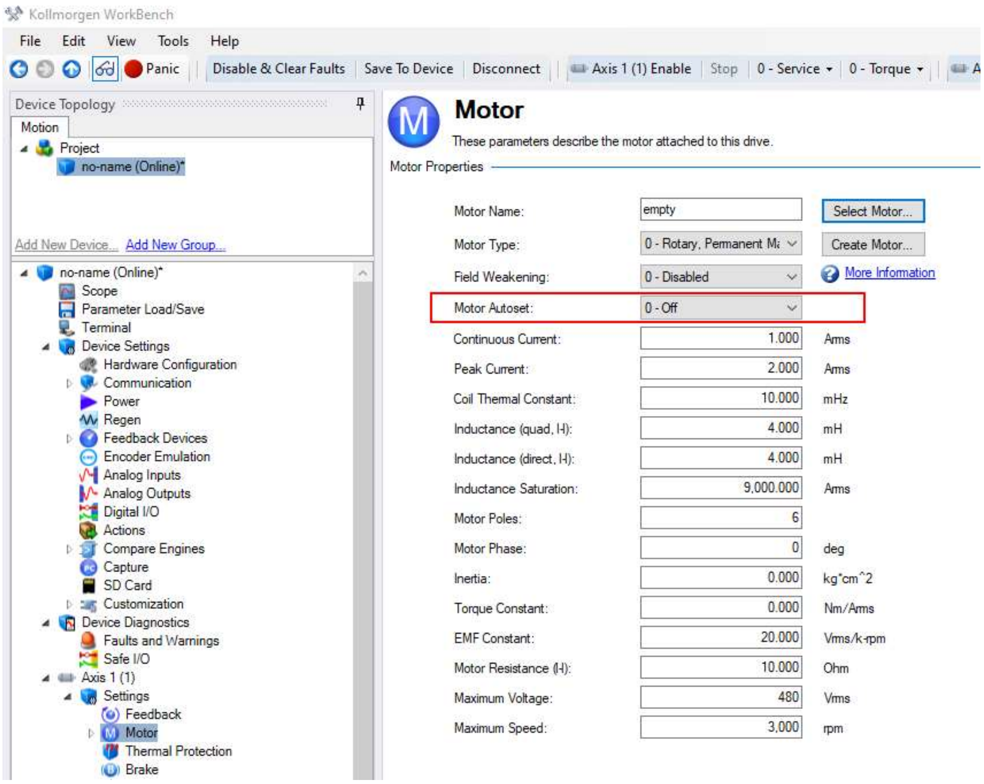


NOTE FOR THIS EXAMPLE AXIS 1 WILL BE SHOWN.

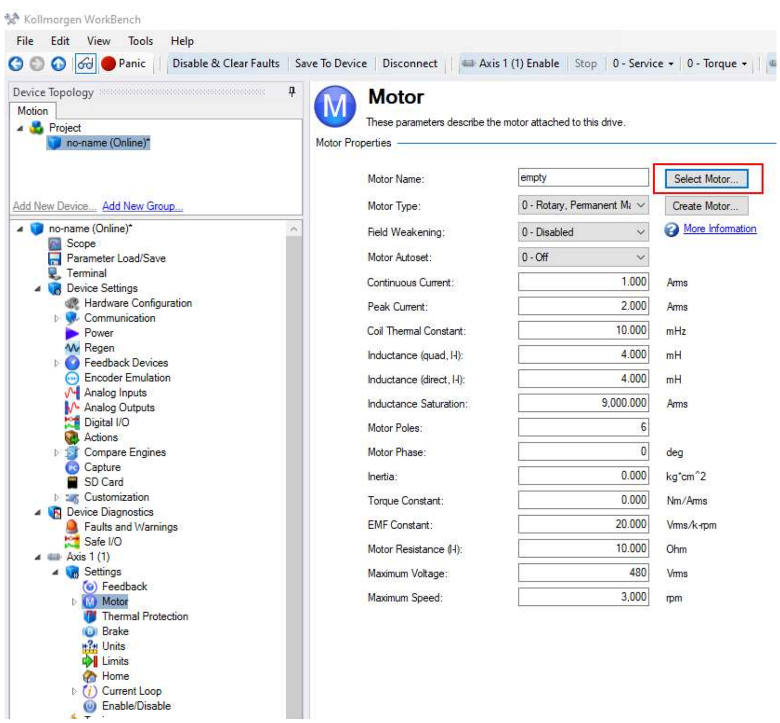


Selecting the Motor.

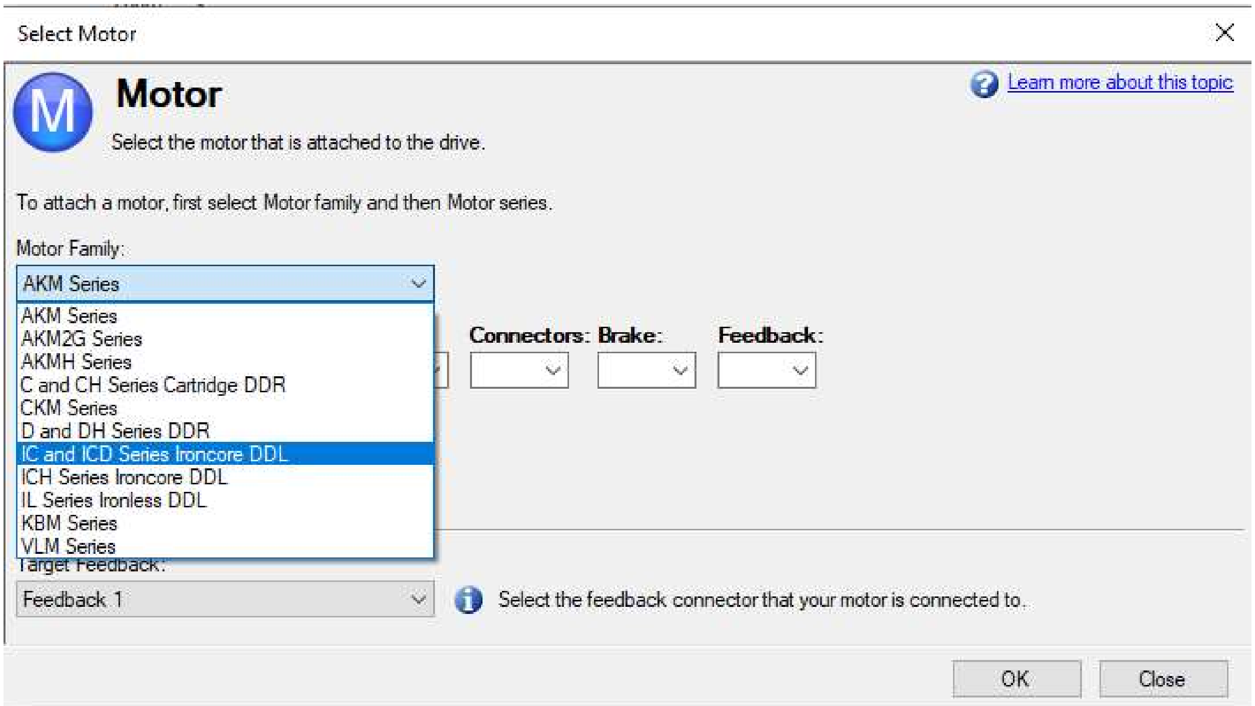
STEP 1: SET MOTOR AUTOSET= “OFF”.



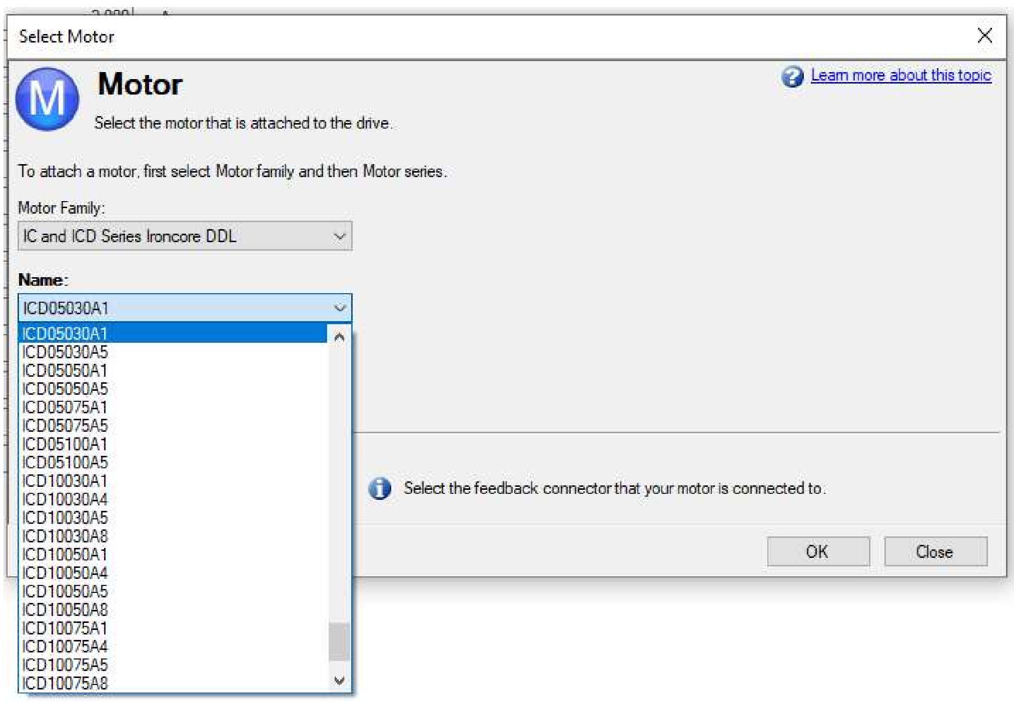
STEP 2: Click on Select Motor



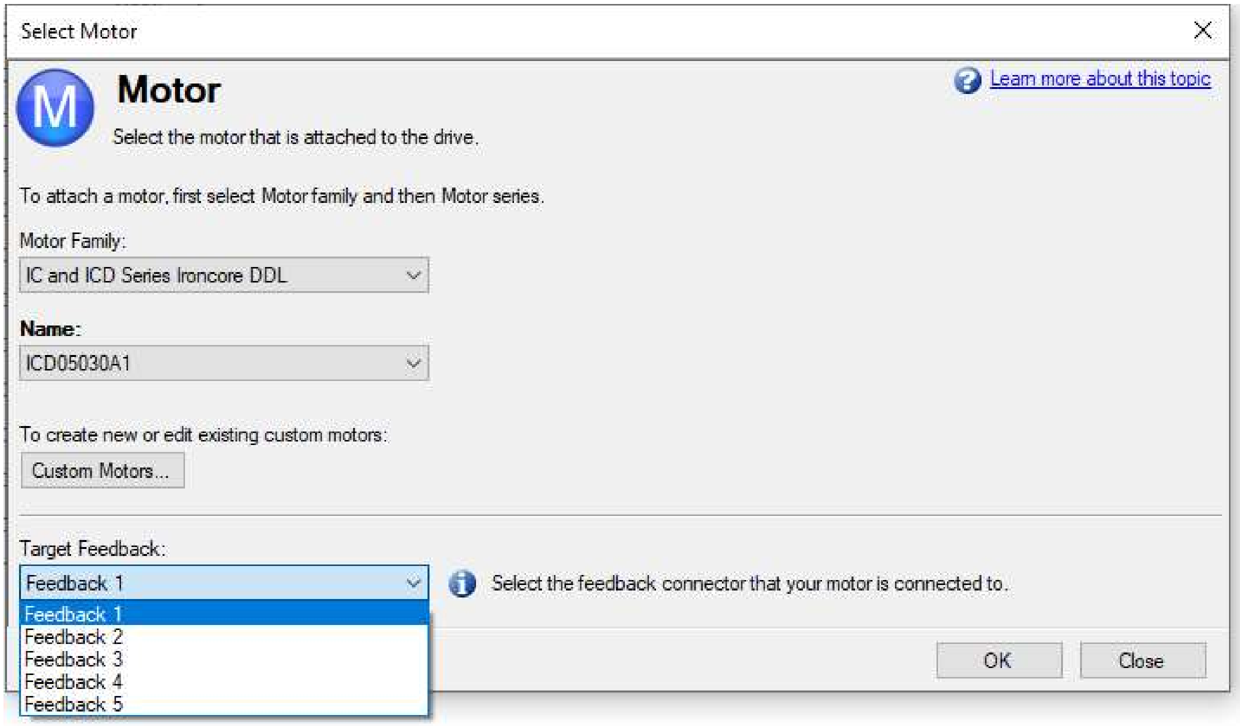
STEP 3: Change Motor Family to the correct motor type.
In this example the blah blah is used.



STEP 4: Select the Motor Part#.

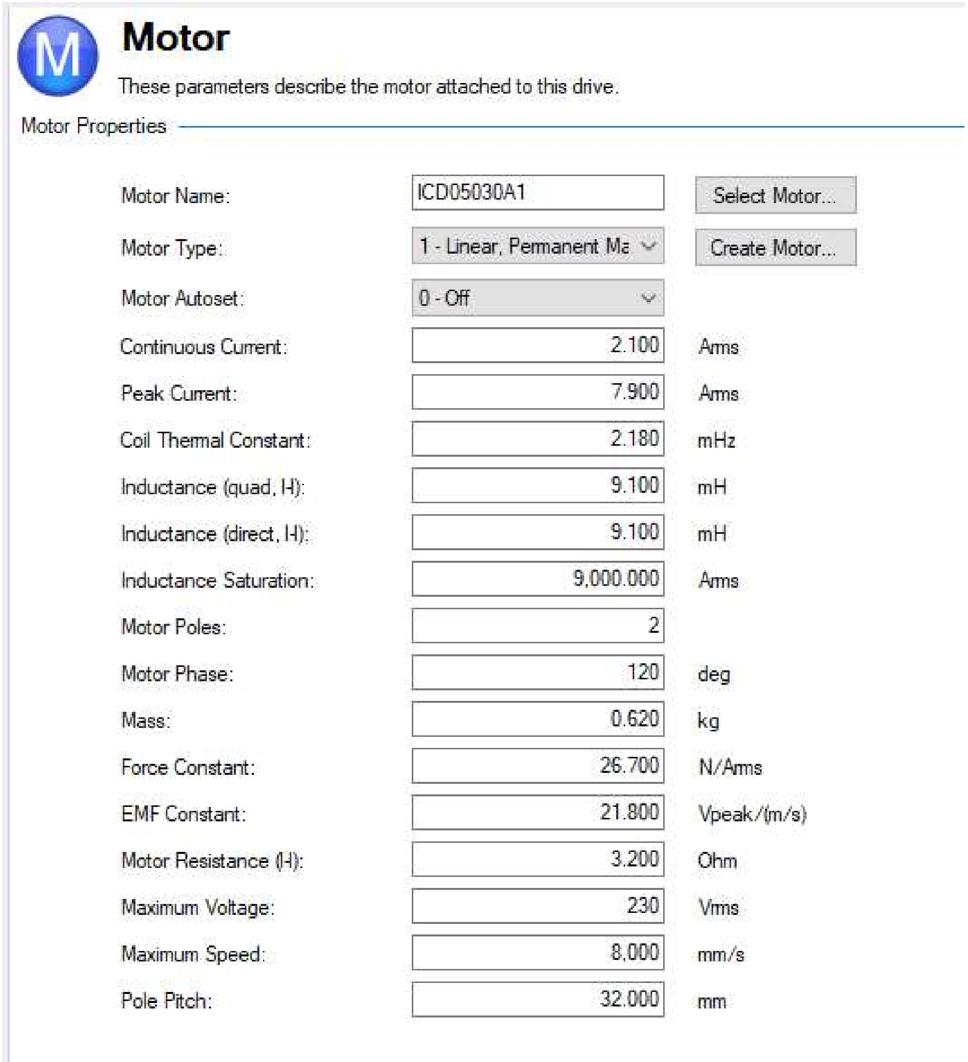


STEP 5: Select the Feedback # for the linear encoder used to commutate the motor. In this example the feedback is connected to X23 and Feedback 3 will be used.



STEP 6: Click OK.

The Motor screen attributes should look similar to the following:



Note the Pole Pitch is 32.000 mm for Kollmorgen DDL motors. It can be changed in a custom motor file for non-Kollmorgen linear servo motors. This value also is shown/used in AXIS#.MOTOR.PITCH.

AXIS#.MOTOR.PITCH

Description

This parameter is used with linear encoders. It defines a distance in millimeters which is determined by how the linear enocoder is used.

- When used with a linear motor, it defines the pole-to-pole pitch. The pitch is the distance between two similar poles. Kollmorgen linear motors have a pitch of 32mm.
- When using a linear encoder in a dual loop configuration in which the linear encoder is used as a secondary position feedback, the distance specified is equal to the distance the linear encoder travels given one rotation of the rotary motor.

NOTE

This parameter is required to be configured for AXIS#.MOTOR.TYPE = 1 or when using a linear encoder as the AXIS#.PL.FBSOURCE.

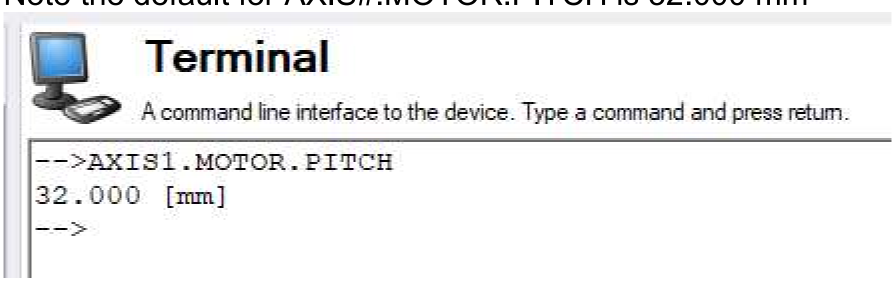
Context

For more information see Motor.

Versions

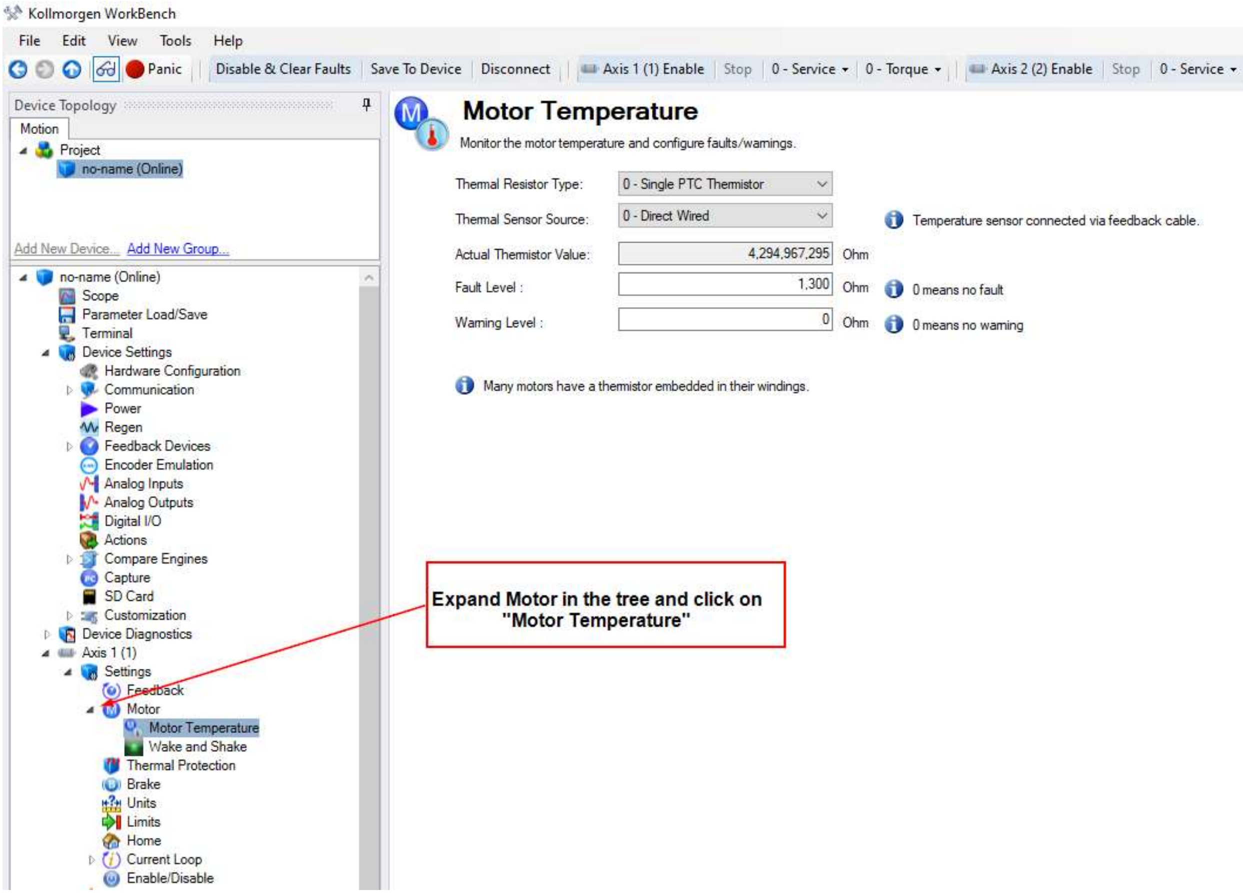
Action	Version	Notes
Implemented	02-00-00-000	
Added dual loop behavior	02-09-03-000	AXIS#.MOTOR.PITCH was not previously included in the resolution calculation when using a linear encoder only as a position source. In order to relate the rotary motor with the linear encoder for proper control, this parameter is now required to be set.

Note the default for AXIS#.MOTOR.PITCH is 32.000 mm



5. Select Motor Temperature Sensor

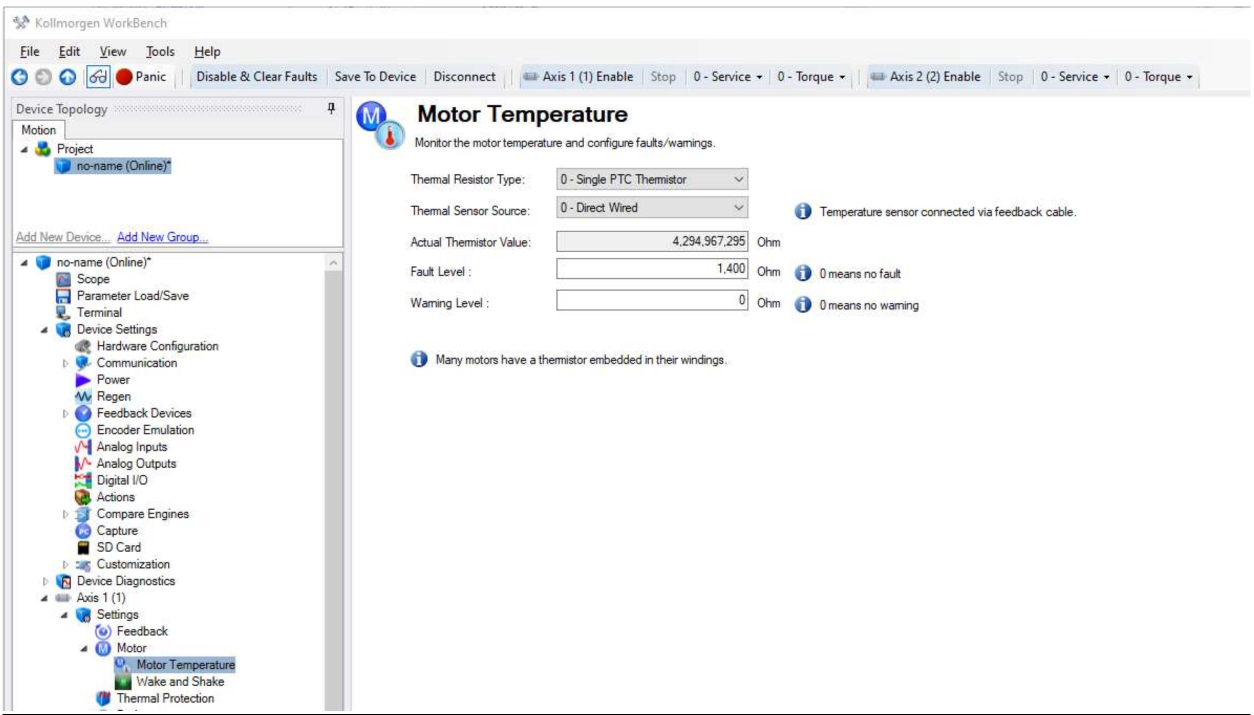
STEP 1: Expand Motor in the tree and click on "Motor Temperature"



STEP 2: Select the "Thermal Resistor Type" from the listbox according to one of the following options depending on your motor model number's Thermal Protection Option.

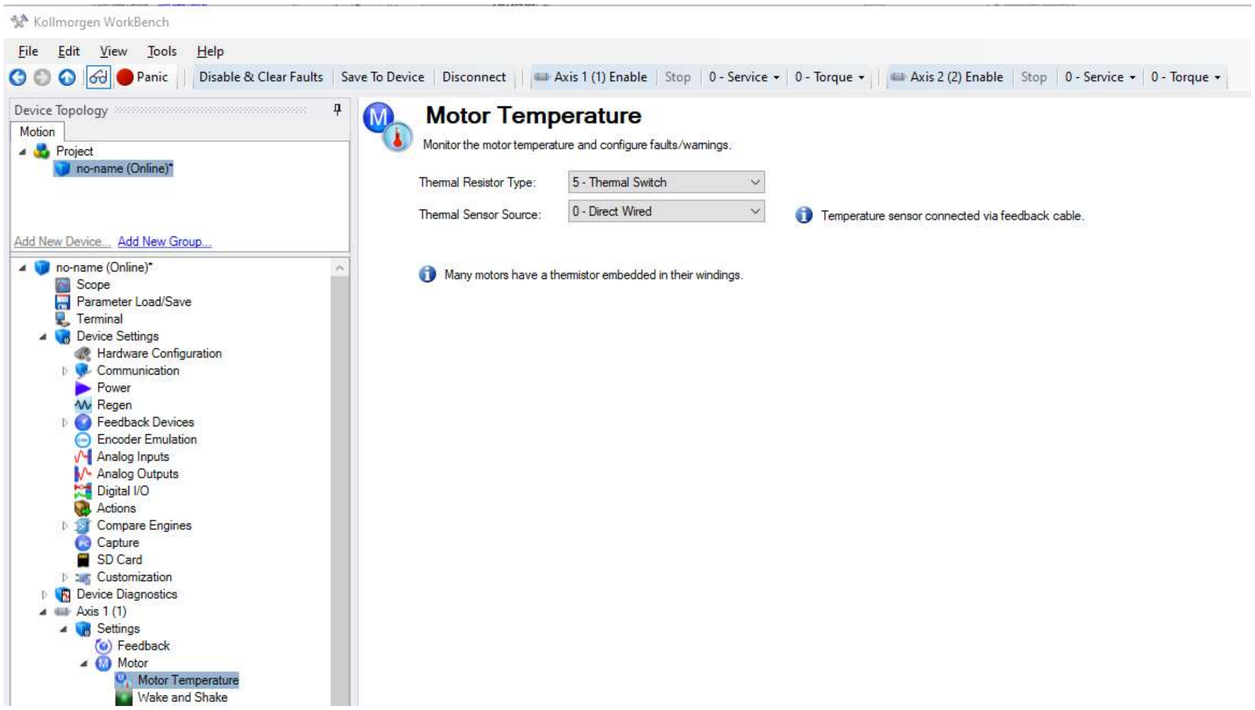
1. <u>Thermostat Option type "TR": PTC thermistor sensor</u>

   Kollmorgen DDL linear motors use a PTC thermistor sensor if the Thermostat Option selected is TR "Thermistor" (MOTOR.RTYPE = 0, "Single PTC Thermistor"). Set the value for the MOTOR.TEMPFAULT =1400.



2. <u>Thermostat Option type "TS": Thermal switch</u>

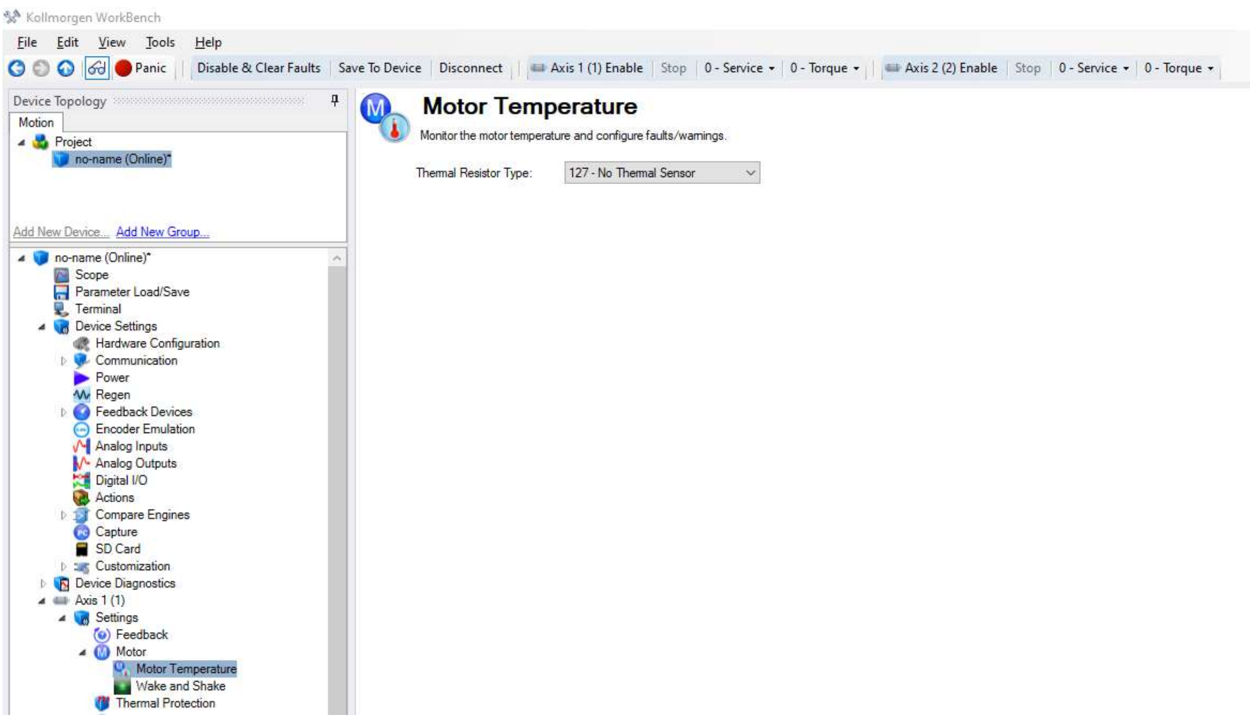
Kollmorgen DDL linear motors use a thermal switch if the Thermostat Option selected is TS Thermostat (MOTOR.RTYPE = 5, "Thermal Switch")



3. No Thermal Sensor

In the case a thermal sensor is not used in the application, the thermal protection setting can be set to 127-No Thermal Sensor.

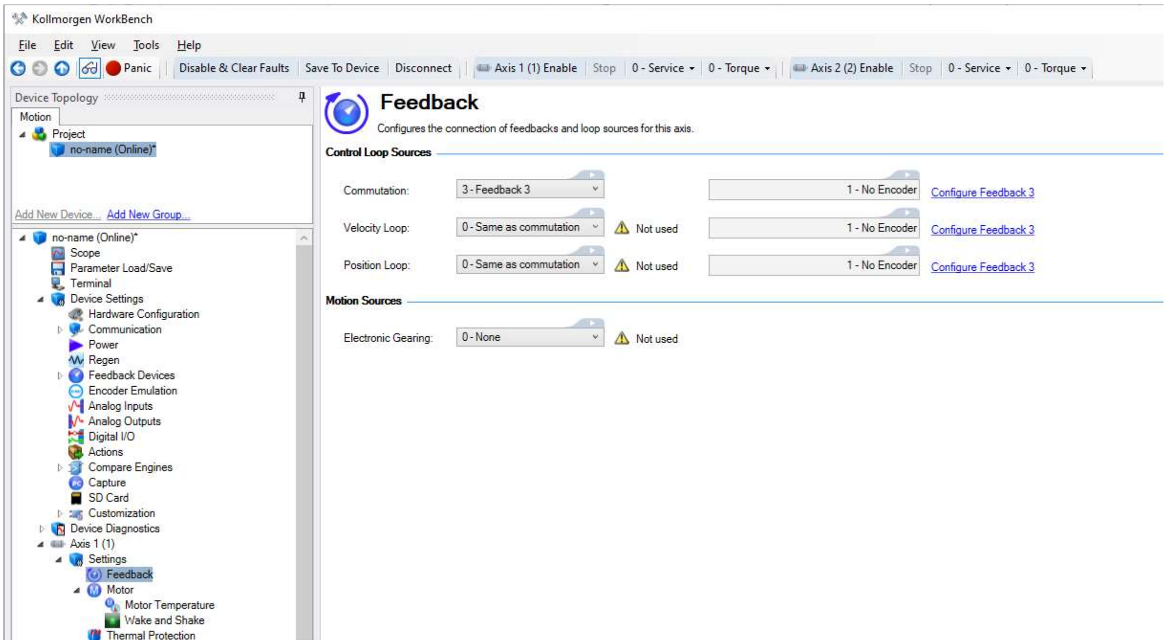
Note our demo setup used option 127-No Thermal Sensor



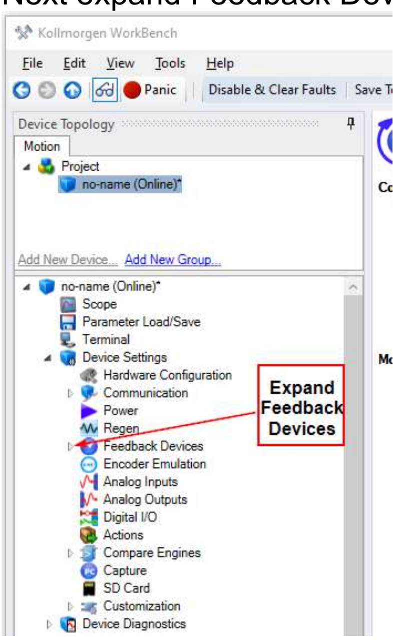
6. **<u>Select Feedback Type</u>**

Notes on the resolution setting are explained below.

Note from the Axis 1 Feedback screen the feedback source for commutation is Feedback 3 as well as the Velocity Loop and Position Loop feedback (same as commutation). This was selected during the motor configuration on the Motor screen.

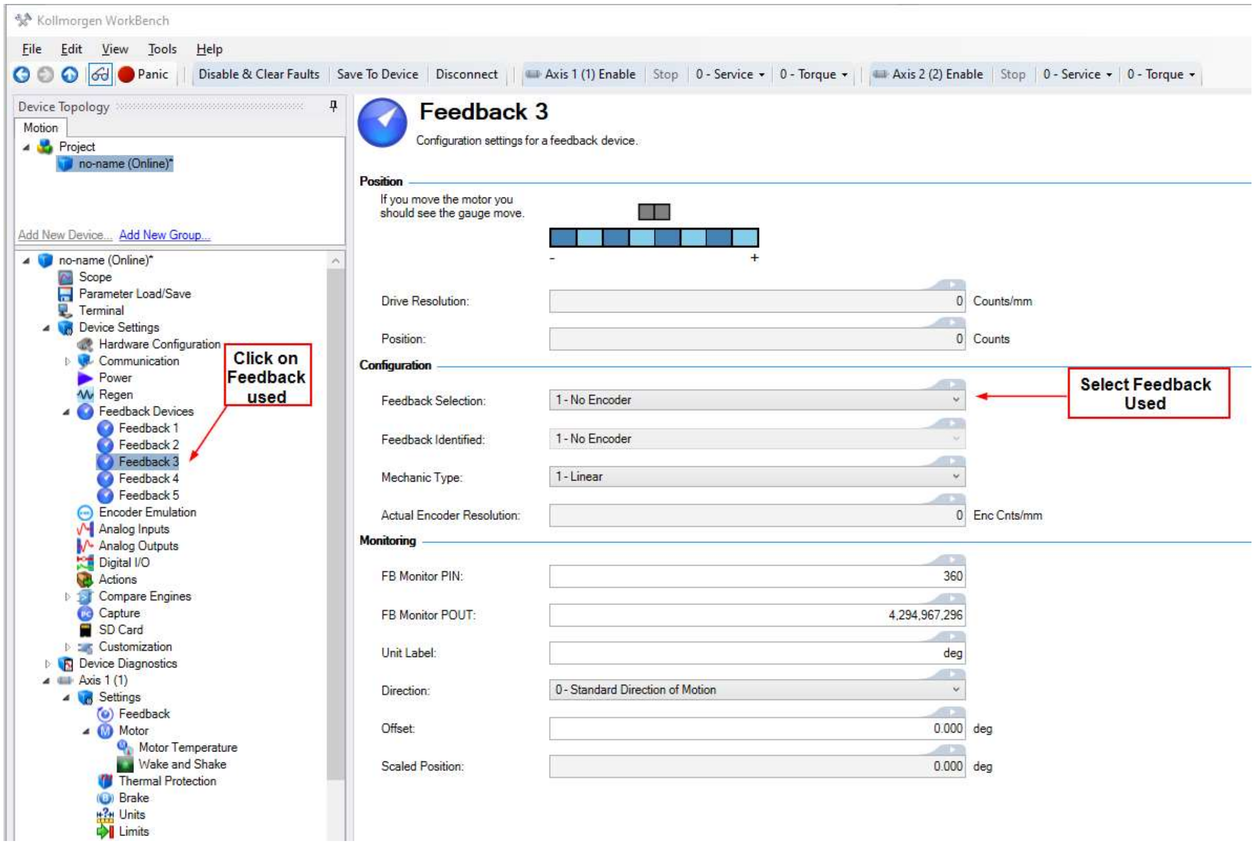


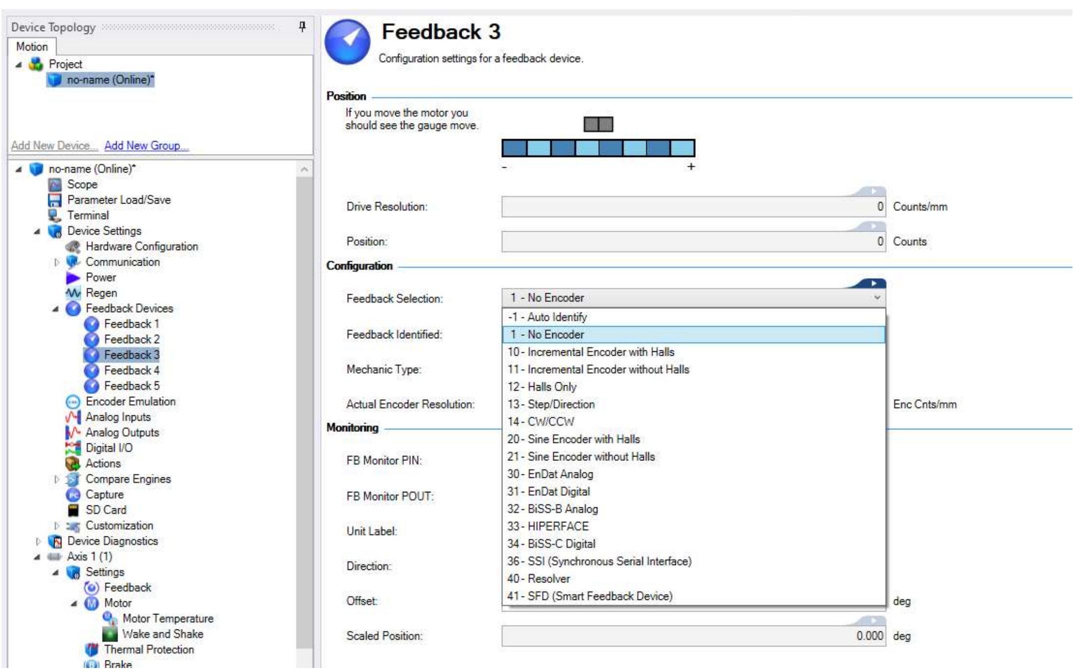
Next expand Feedback Devices under Device Settings->Feedback Devices



Click in the tree under Feedback Devices the Feedback number used (3 in this example).

Use the Feedback Selection listbox to select the encoder used in your application.

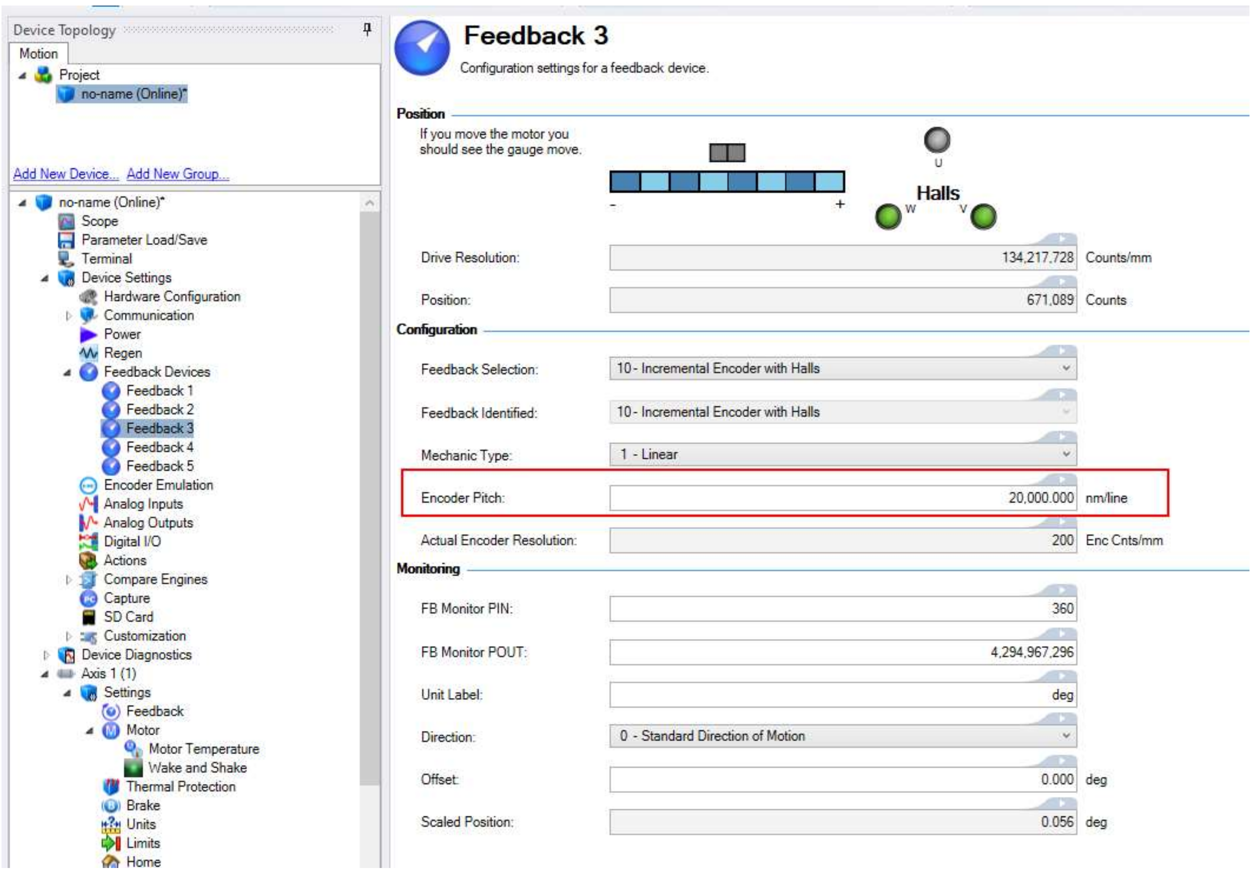




In this example our demo uses Incremental with Halls.

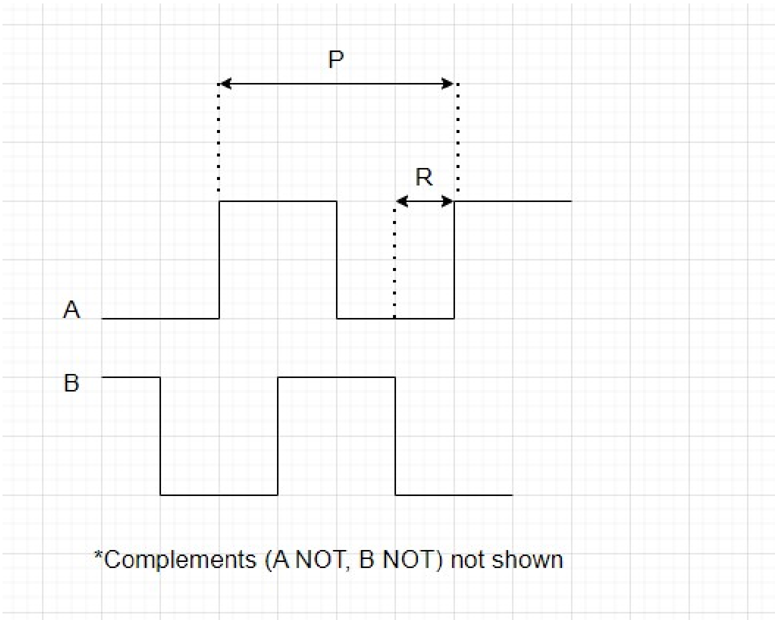
7. CONFIGURING ENCODER FEEDBACK RESOLUTION

Next the Encoder pitch must be entered. The following details and chart will assist in calculating and entering the correct value depending on your linear encoder specifications.



In this demo an incremental encoder was used.

To determine the Encoder pitch in nanometer/line use the following diagram and chart.



Examples:

	Period (um)	Resolution (um)
1 mictron readhead	4	1
5 micron readhead	20	5
0.1 micron readhead	0.4	0.1

$$Encoder\ Resolution\ (R) = R\ um$$

$$Encoder\ Resolution\ per\ Period\ (P)\ um/line = Encoder\ Resolution\ (R)(um) * 4$$

$$Encoder\ pitch\ \left(\frac{nm}{line}\right) = Encoder\ Resolution\ Per\ Period\ (P)(\frac{um}{line}) * \frac{1000\ nm}{1\ um}$$

$$Actual\ Encoder\ Resolution\ \left(\frac{counts}{mm}\right) = Encoder\ Resolution\ (R)\ (counts/um) * \frac{1000\ um}{1\ mm}$$

Example as in our case.

1 um readhead

1 count per 1 um

$Encoder\ Resolution\ (R) = 1\ um\ or\ 1\ count\ per\ um$

$Encoder\ Resolution\ per\ Period\ (P)\frac{um}{line} = 1(um) * 4 = 4\ um/line$

$$Encoder\ pitch\ \left(\frac{nm}{line}\right) = 4\left(\frac{um}{line}\right) * \frac{1000\ nm}{1\ um} = 4000\ nm/line$$

$$Actual\ Encoder\ Resolution\ \left(\frac{counts}{mm}\right) = 1\ \left(\frac{counts}{um}\right) * \frac{1000\ um}{1\ mm} = 1000\ counts/mm$$

Encoder Equivalent Resolution µm (1 count)	**Encoder Pitch nm/line (nm/period)**	**Actual Encoder Resolution Counts/mm (Read-only)**
50	200000	20
40	160000	25
25	100000	40
20	80000	50
10	40000	100
5	20000	200
2.5	10000	400
2	8000	500
1	4000	1000
0.5	2000	2000
0.4	1600	2500
0.2	800	5000
0.1	400	10000
0.05	200	20000
0.02	80	50000
0.01	40	100000

FB#.LINEPITCH

Description

This parameter defines the line pitch for linear encoders in nm per line. This is only used when using linear motor types. For rotary motors, see FB.ENCLINES.

Context

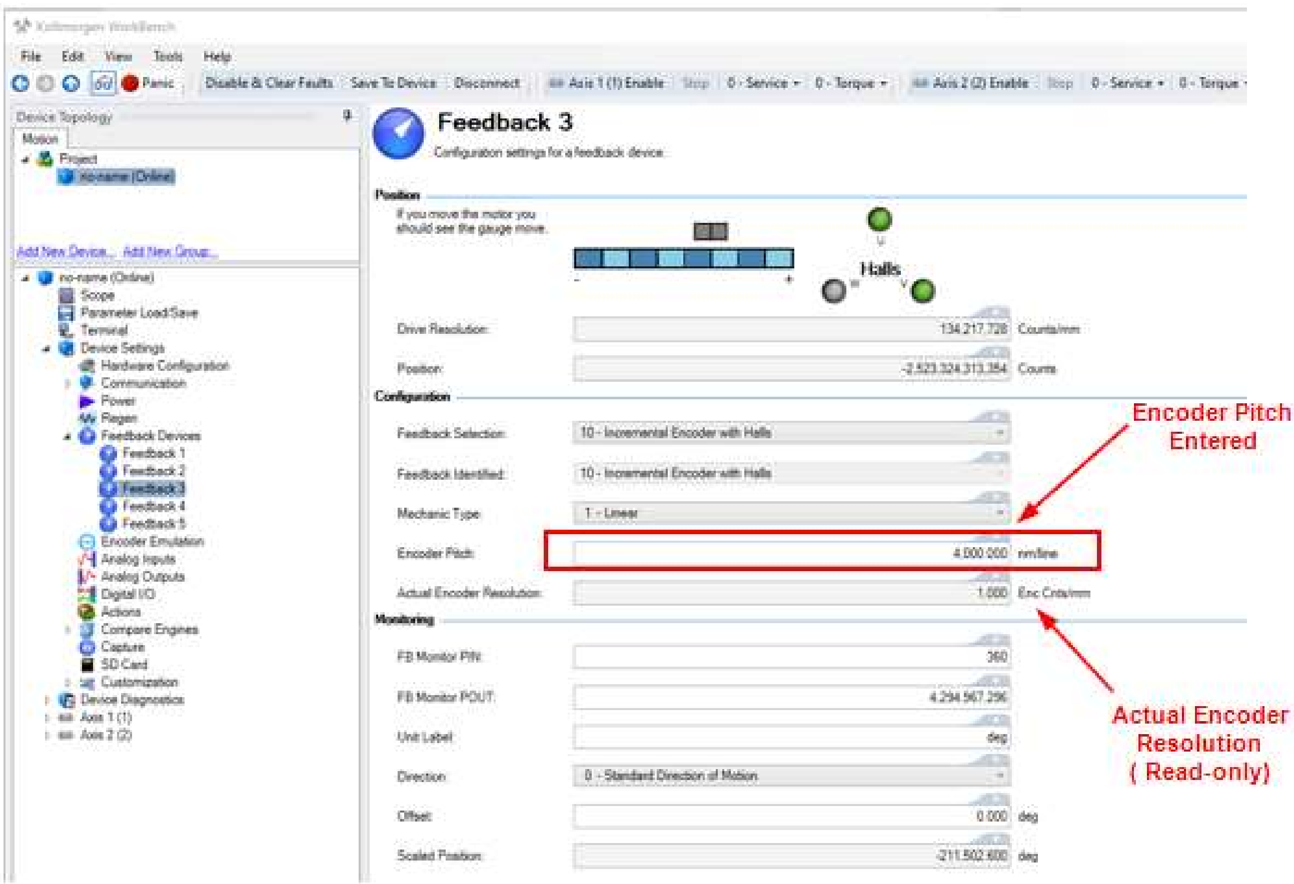
See Feedback # View and FB#.MECHTYPE.

Versions

Action	Version	Notes
Implemented	02-00-00-000	

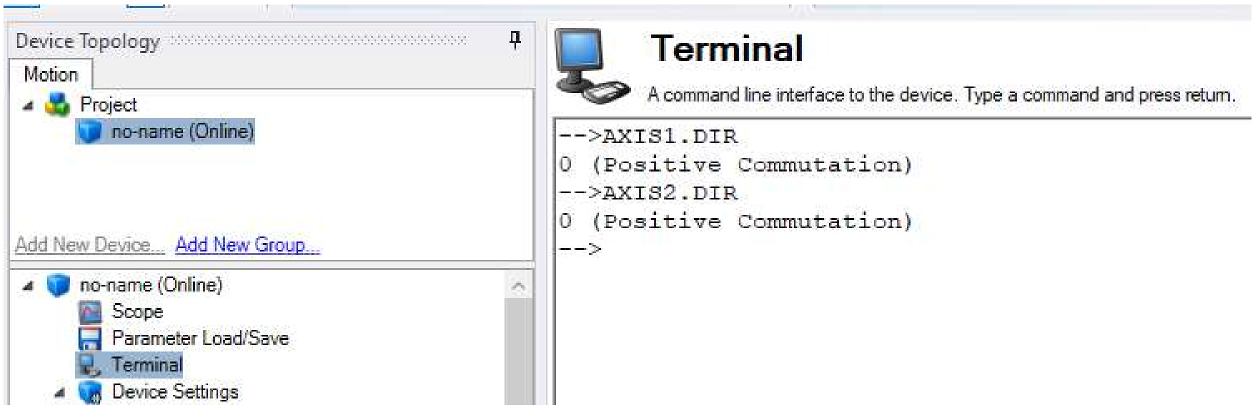
General Information

Type	Read/Write
Units	nm/line
Range	0.001 to 2000000.000
Default Value	20,000
Data Type	Integer
Stored in Non Volatile Memory	Yes

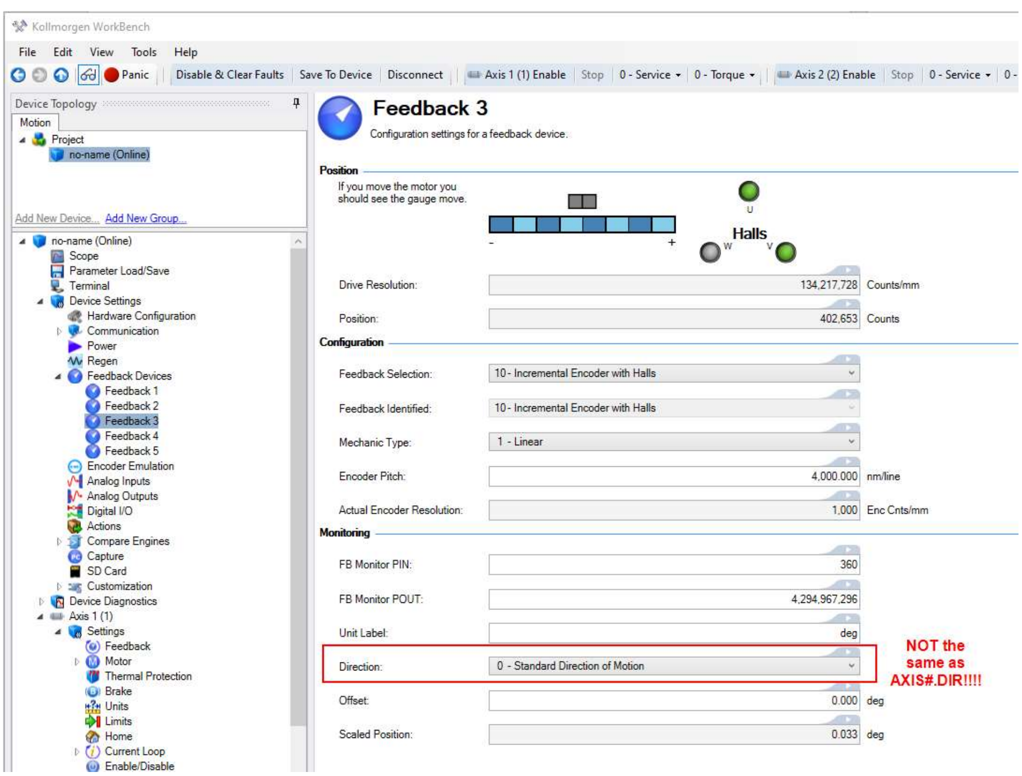


8. Test Encoder Direction and Resolution

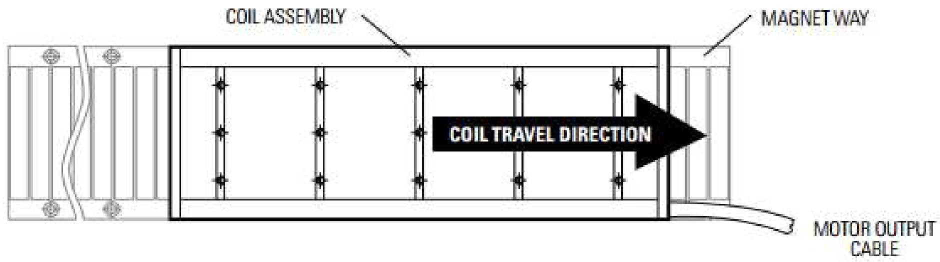
The direction of the encoder, the motor phase sequence, and hall sequence all need to match exactly. The hall phasing also needs to match the motor phasing exactly. This is very difficult to do by trial and error. **Axis Direction has to be set to zero (“AXIS1.DIR=0” or “AXIS2.DIR=0”)**



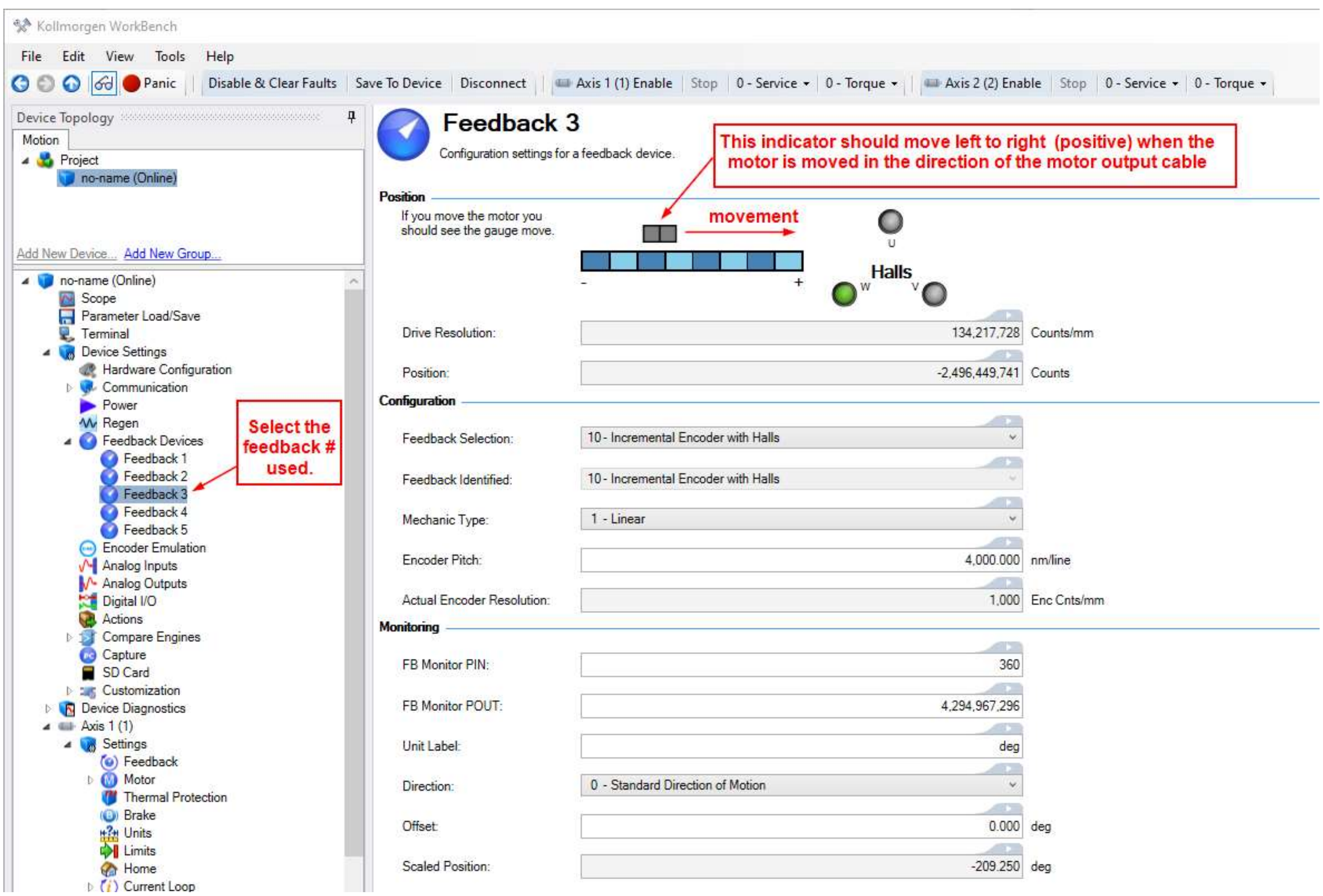
IMPORTANT NOTE: On the Feedback screen there is a setting (FB#.SCALED.DIR) which is for monitoring and not related to Commutation Direction (i.e. AXIS#.DIR).



From the commutation drawings in Figure 2 the motor “positive” direction is toward the end of the motor where the wires exit the motor.



The Feedback test available is the movement of the indicator on the Feedback screen for the given Feedback# of the motor (i.e. linear encoder).



If the encoder is counting in the wrong direction, swap the Sine+ and Sine- signal or the A and A\ signal. If this cannot be done if the Data channels of the encoder are being used. If changing the feedback direction is not possible, use Appendix A (Page 29) for the wiring configuration of the Hall sensors and the motor power connections.

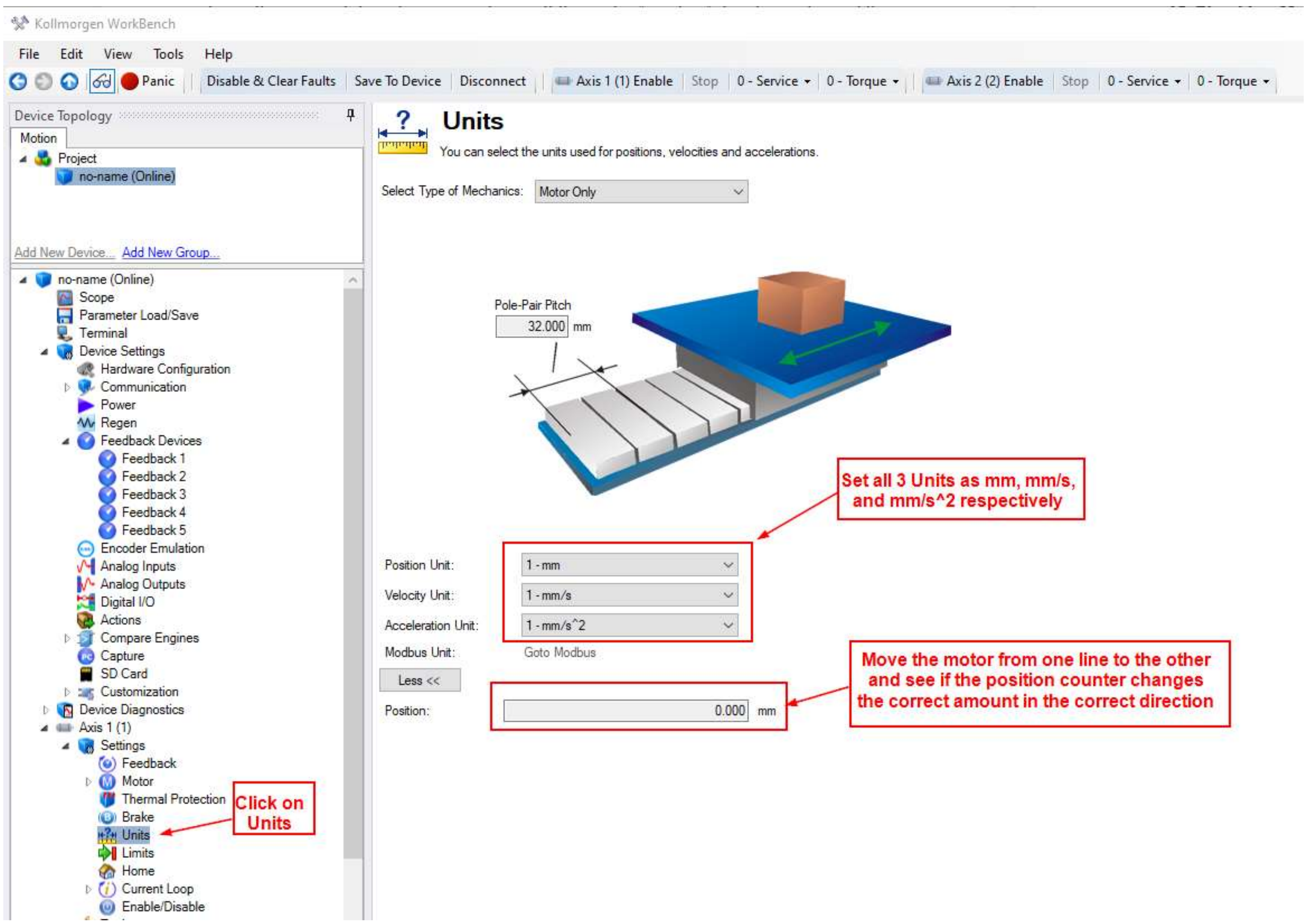
9. <u>Checking Motor Feedback Resolution</u>

The feedback resolution can be tested by marking two lines on the magnet way 32mm apart. You can use whatever length you want, but longer is more accurate.

STEP 1: Click on Units for the given Axis used.

STEP 2: Change the User Units to “mm”, “mm/s”, and “mm/s^2”

STEP 3: Move the motor from one line to the other and see if the position counter changes the correct amount in the correct direction. HINT: You can use AXIS#.HOME.SET in Workbench Terminal to zero the position feedback where # is 1 or 2 for the axis number in the command.

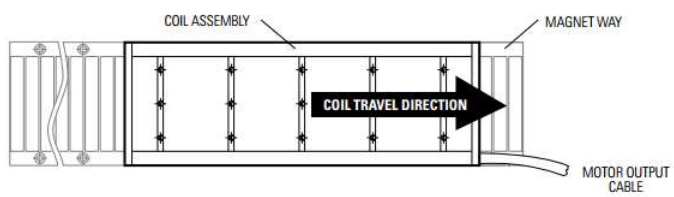


If the position display does not match the distance the motor is moved, you may need to revisit the encoder scaling section of this manual or confirm the feedback device scale.

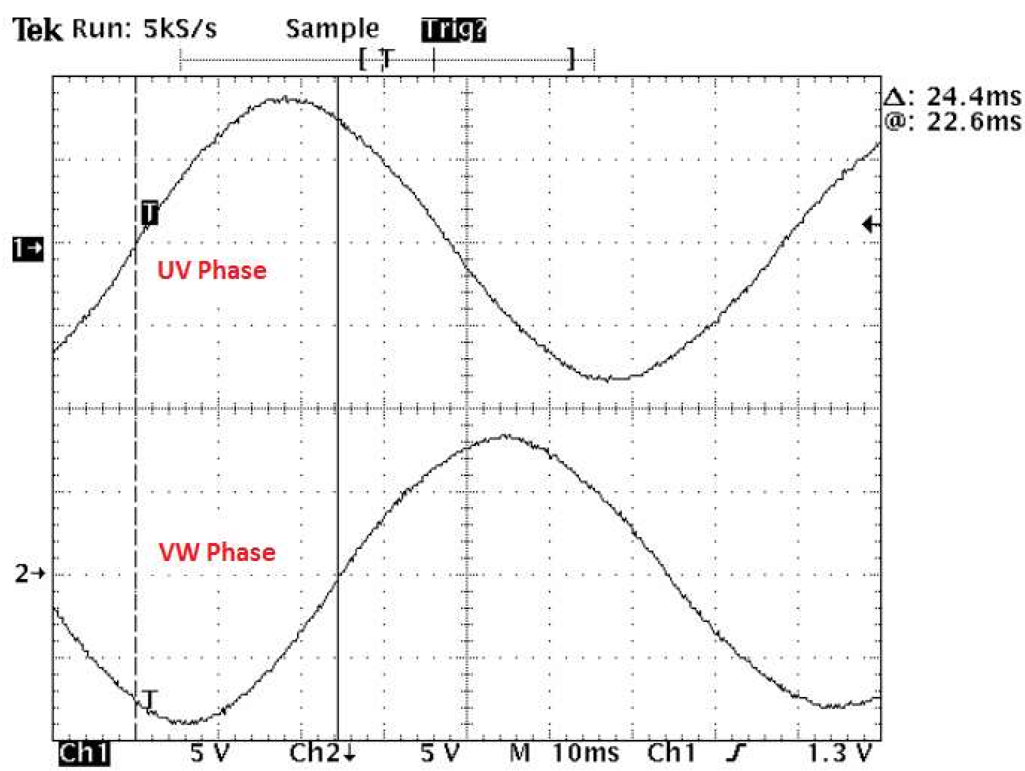
10. Check Motor Phasing of Any Servo Motor

This is useful for commissioning a third-party motor, as well as any frameless Kollmorgen motor, or any servo motor for which the phasing is unknown.

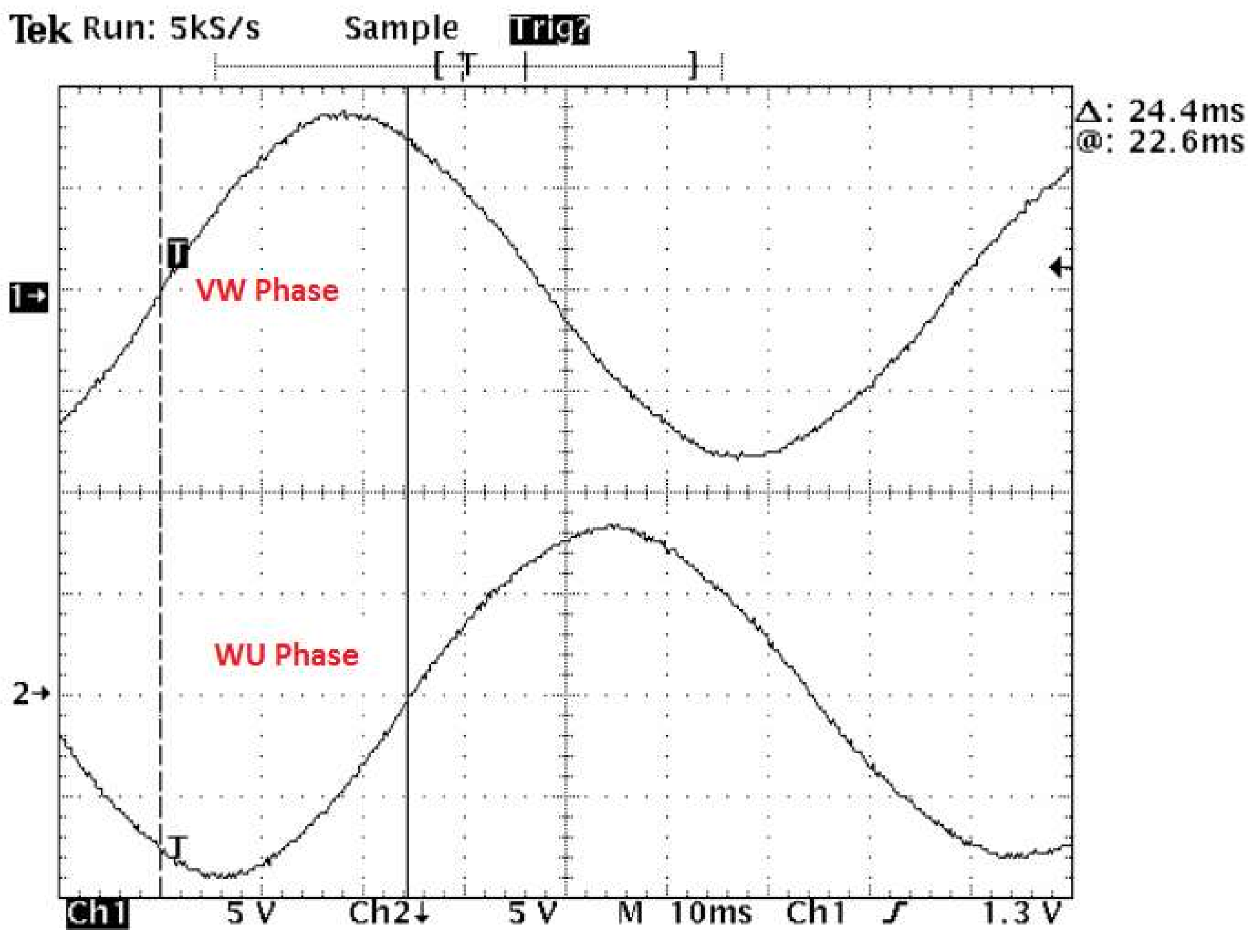
This part of the setup will require a two channel oscilloscope with isolated channels. Move the motor in the positive direction based on the motor manufactures specification. The AKD2G commutates a motor in the phase sequence of U V W in the positive direction.



When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by 120° of the V phase (V phase with reference to W phase).



While moving the motor in a positive direction the motor V phase (V phase with reference to W phase) will lead the back emf voltage waveform by 120° of W phase (W phase with reference to U phase).



Use Figure 2 to determine the Hall Sensor alignment of the motor. Make sure the feedback position value (PL.FB) is counting in the positive direction.

11. Test Hall Sequence When Moving Motor in the Positive Direction

The hall phasing can be check with the parameter FB#..HALLSTATE in terminal. This is a binary value, where “001” is Hall U, “010” is Hall V, and “100” is Hall W.

FB#.HALLSTATE

Description

FB#.HALLSTATE reads the Hall switch values (encoder feedback only).

The value is the sum of the three hall bit states, where FB#.HALLSTATE = Hall U + Hall V + Hall W. If the hall is not active, it returns 0. When a hall is active, each hall contributes the following value to the sum:

- Hall W = 1
- Hall V = 2
- Hall U = 4

Value	Hall W	Hall V	Hall U
1	√	-	-
2	-	√	-
3	√	√	-
4	-	-	√
5	√	-	√
6	-	√	√

The following sequences indicate the direction of rotation.

Sequence	Direction
1,5,4,6,2,3,1	Positive
1,3,2,6,4,5,1	Negative

These commands are not recordable on FB1 and FB2.

For recording on FB1 and FB2, see FB#.MONITOR#.SOURCE and FB#.MONITOR#.DATA.

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

What does this mean?

Type	Read Only
Units	Terminal: Binary Scope: N/A
Range	Terminal: See description above Scope: 1 to 6
Default Value	N/A
Data Type	Terminal: String Scope: Integer
Stored in Non Volatile Memory	No

FB#.HALLMAP.U

Description

FB#.HALLMAP.U reads and writes to a mapping register used to correct mis-wired motors without physically changing the wiring. This keyword only effects feedback devices that have halls (see FB#.SELECT for feedback types with halls).

FB#. HALLMAP.U can be set to one of the following values:

Value	Description
0	The output is the U input value. (Default)
1	The output is the V input value. (Swap U with V)
2	The output is the W input value. (Swap U with W)
3	The output is fixed at 0.
4	The output is U input inverted value. (When input U=0, U output is 1)
5	The output is V input inverted value. (When input V=0, U output is 1)
6	The output is W input inverted value. (When input W=0, U output is 1)
7	The output is fixed at 1.

Versions

Action	Version	Notes
Implemented	02-10-00-000	

General Information

Type	Read/Write
Units	N/A
Range	0 to 7
Default Value	0
Data Type	Integer
Stored in Non Volatile Memory	Yes

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

Using the Scope is easier to capture and analyze.

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

Note with the AKD2G the FB#.HALLSTATE only reports the decimal value.

I checked this with Terminal and the sequence reported was 1, 5, 4, 6, 2, 3, 1.

Step(CW)	FB#.HALLSTATE
1	1
2	5
3	4
4	6
5	2
6	3
1	1

12. Motor Back emf And Hall Sensor Signal Alignment

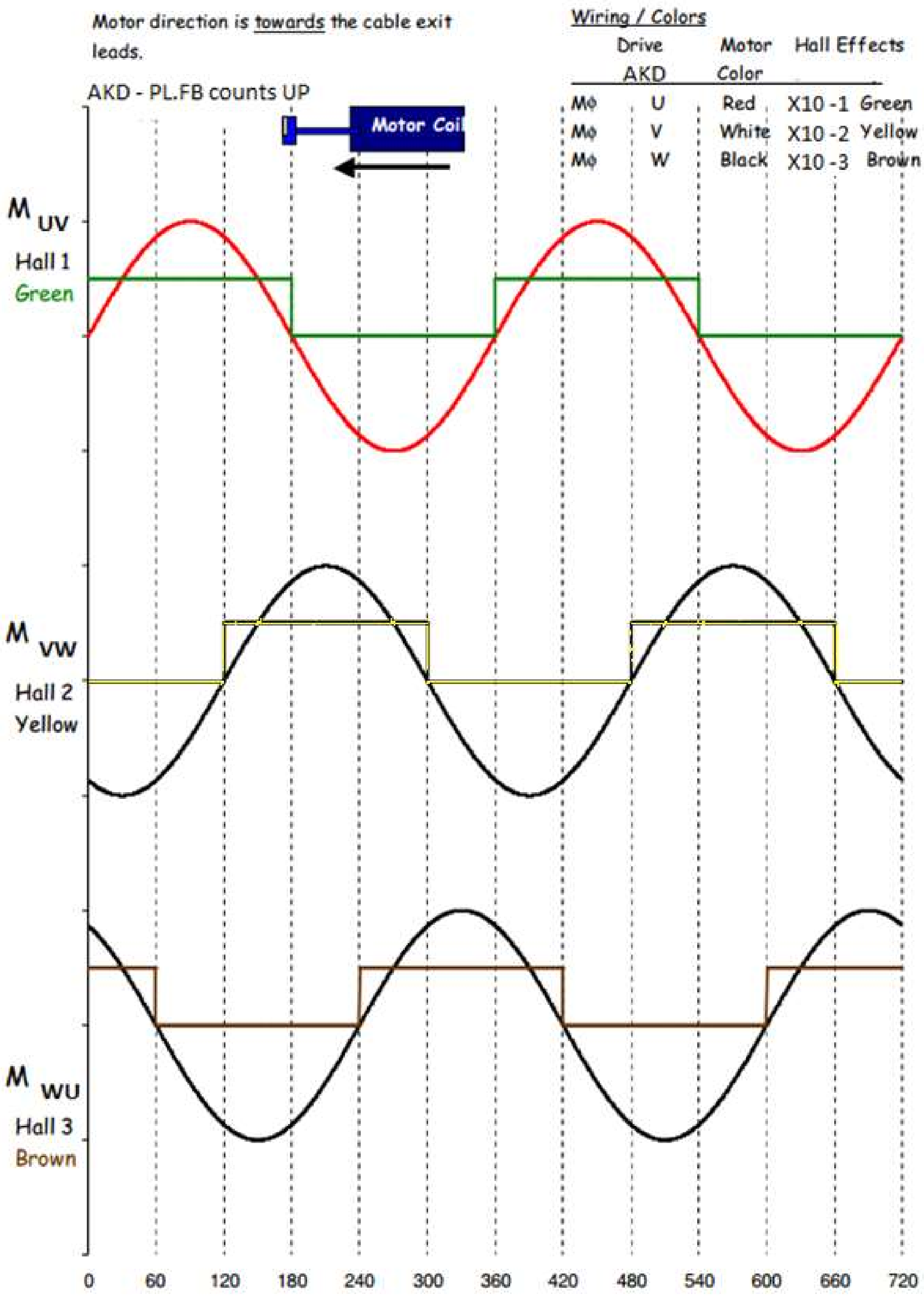


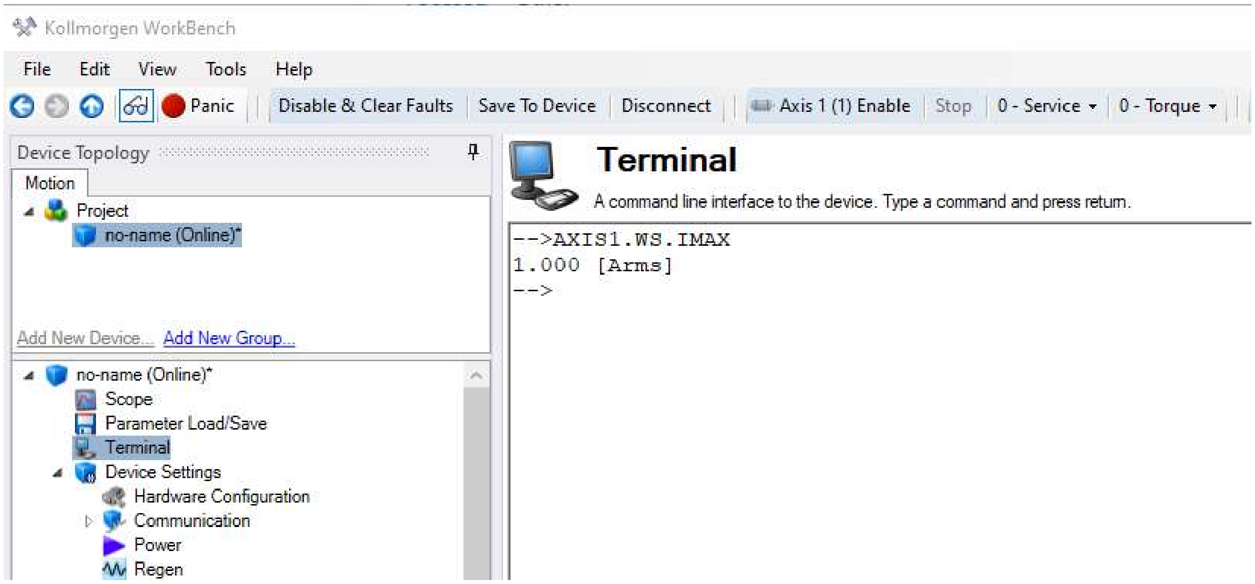
Figure 2

When using a Kollmorgen DDL motor, **MOTOR.PHASE = 120** when the feedback direction is positive toward the "Lead Exit End" of motor (that is, the end of the motor where the leads come out), and when the hall alignmet and motor phasing match exactly as shown in Figure 2.

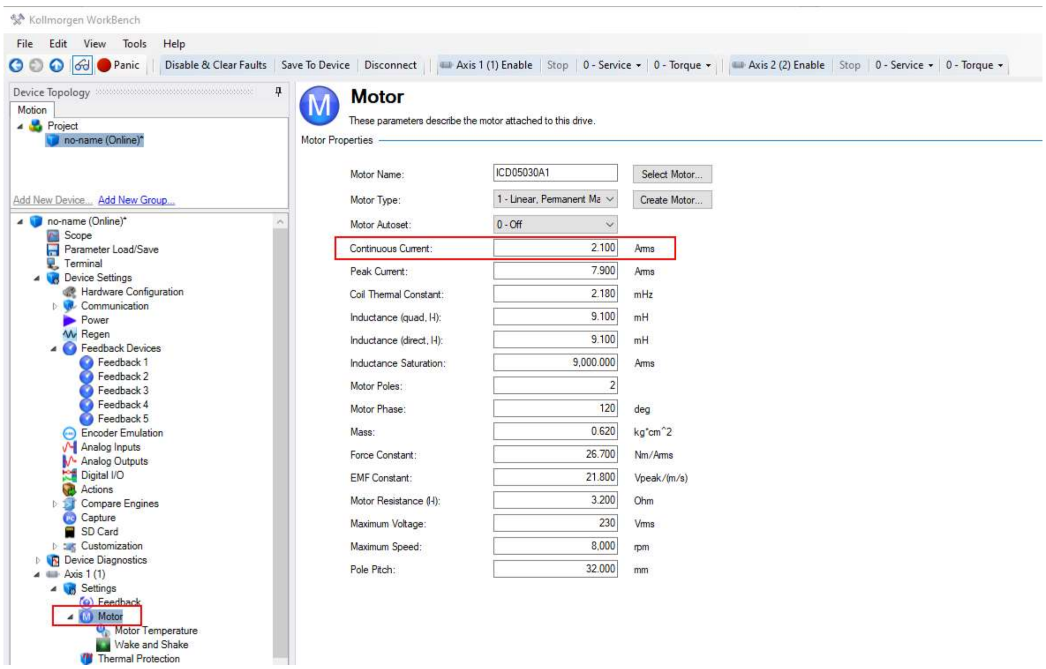
13. How to Verify the Motor's Commutation Alignment Angle (MOTOR.PHASE)

STEP 1: Set the Wake & Shake Current for the axis used (b7axis 1 or axis 2) equal to continuous of your linear motor in the Terminal Screen.

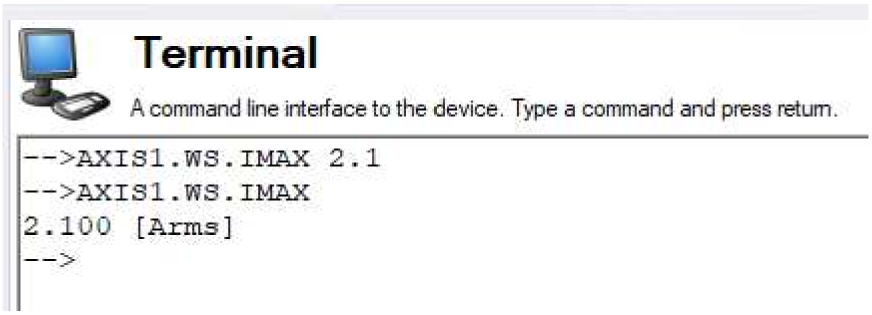
The keyword is AXIS#.WS.IMAX where # is 1 or 2 for the axis number.



The continuous current rating of the motor can be seen from the Motor screen.

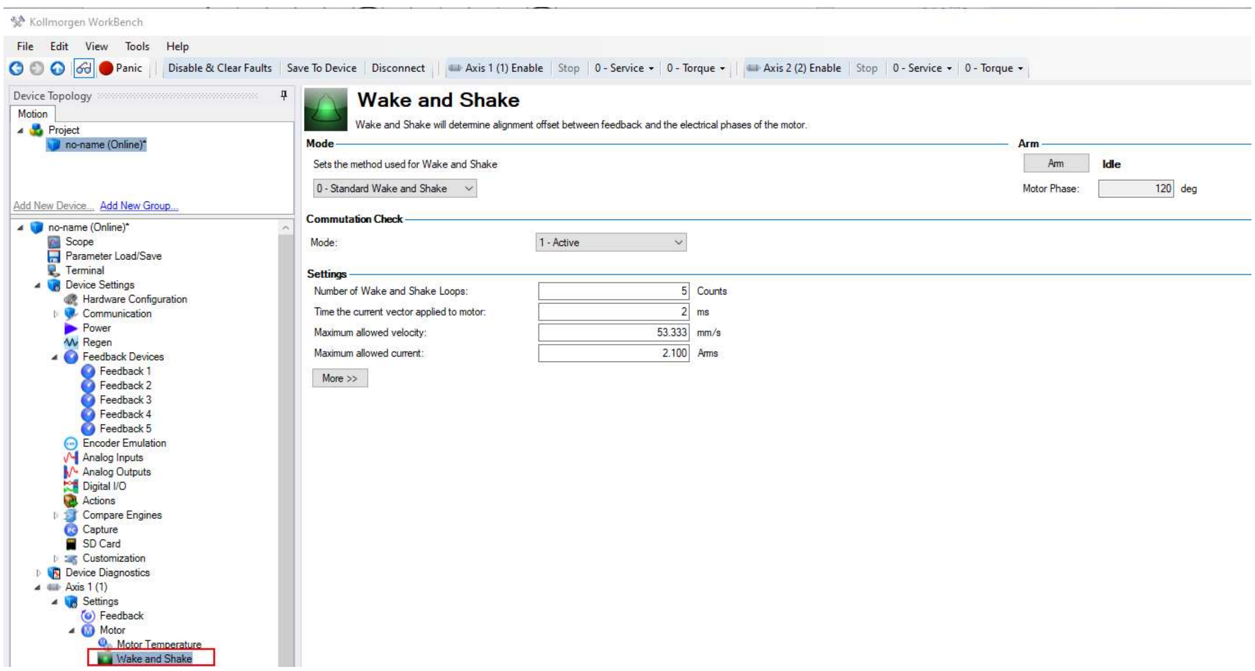


Returning to the Terminal set the AXIS#.WS.IMAX to the continuous current rating from the Motor screen.

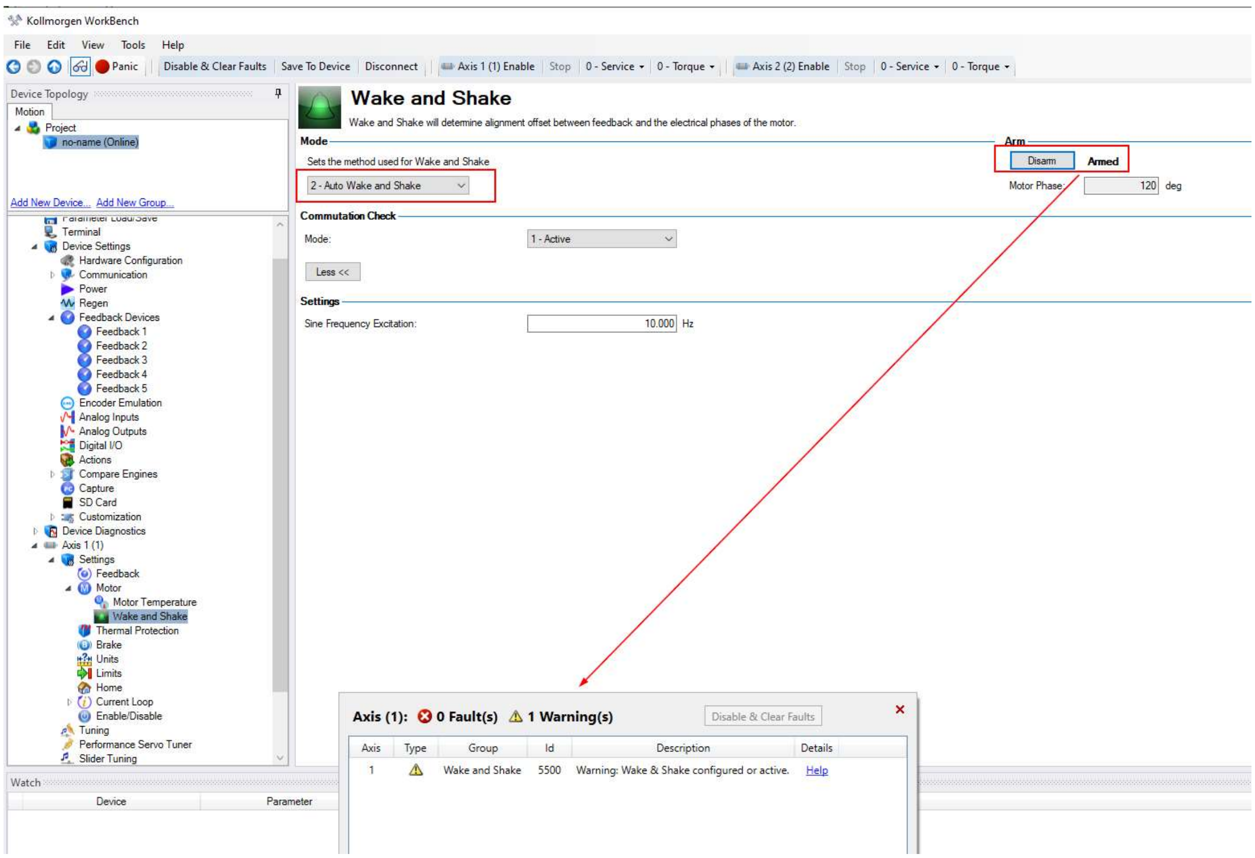


STEP 2:Setup the Wake and Shake Routine.

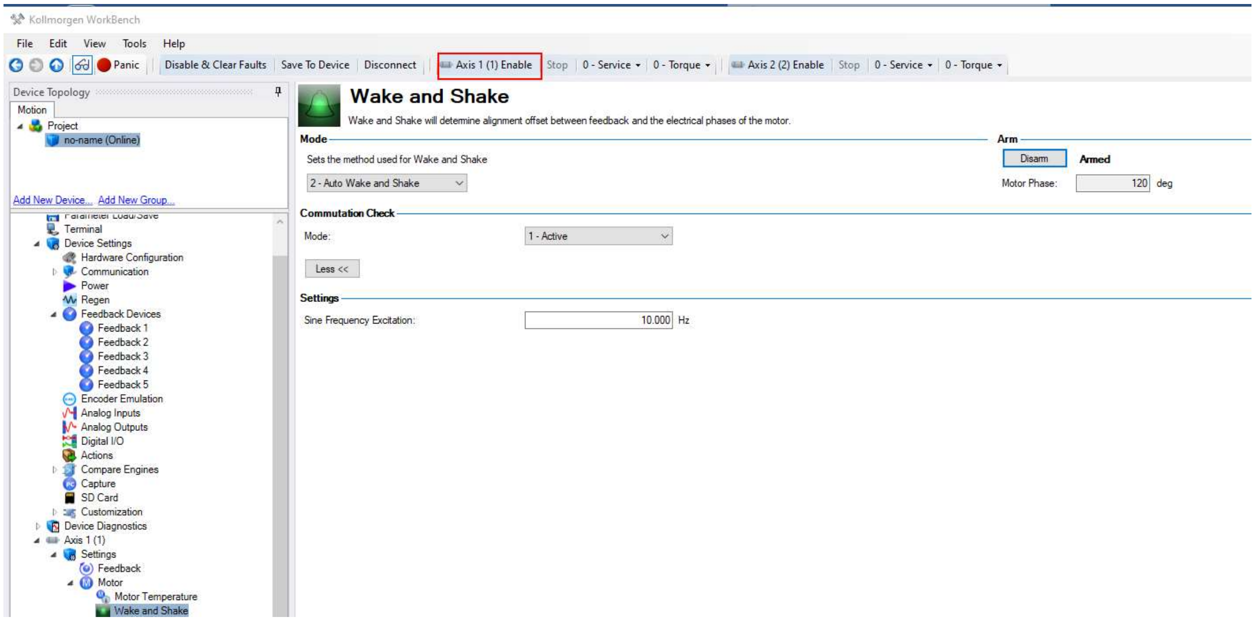
Navigate to the Wake and Shake screen under the Axis#->Settings->Motor->Wake and Shake.



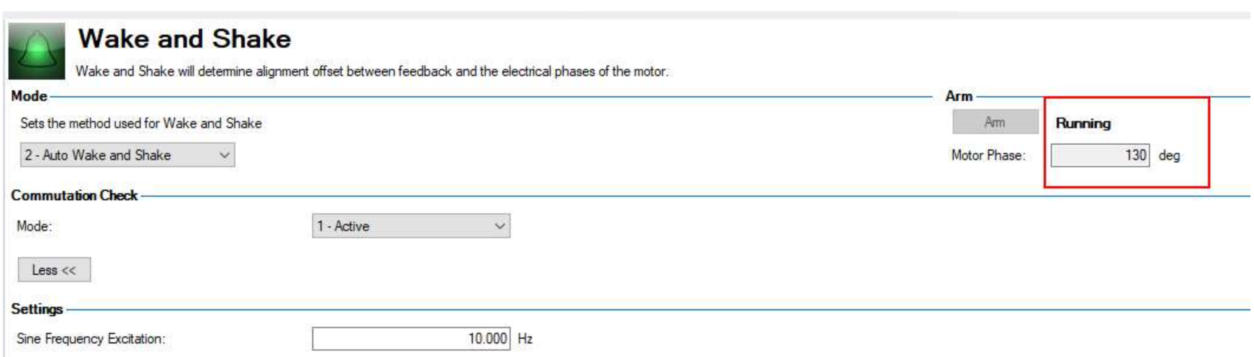
Change the Wake and Shake mode to 2-Auto Wake and Shake and click on the “Arm” button to arm the Wake and Shake routine. The status to the right of the Arm button should change from Idle to Armed. Note you cannot arm the W&S if the axis is already enabled (disable prior to arming). Also note a warning will issue to indicate the W&S is configured and active.



Start the W&S Routing by enabling the Axis.

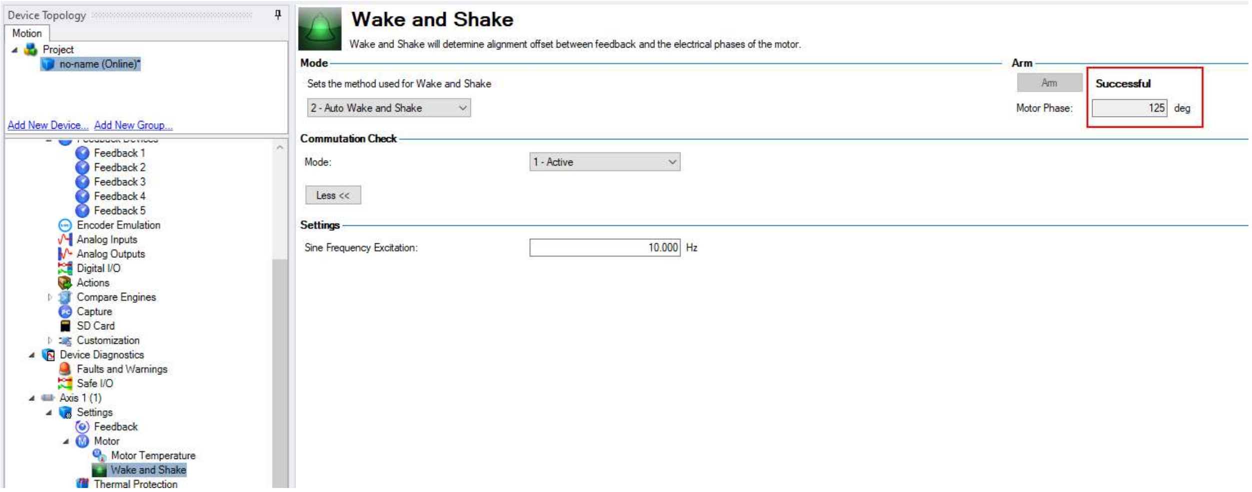


The status to the right of the Arm button should change to “Running” while the W&S is executing. Monitor the Motor Phase read-only on the W&S screen while the W&S runs.This indicates the W&S algorithm is searching for the correct commutation angle in deg.



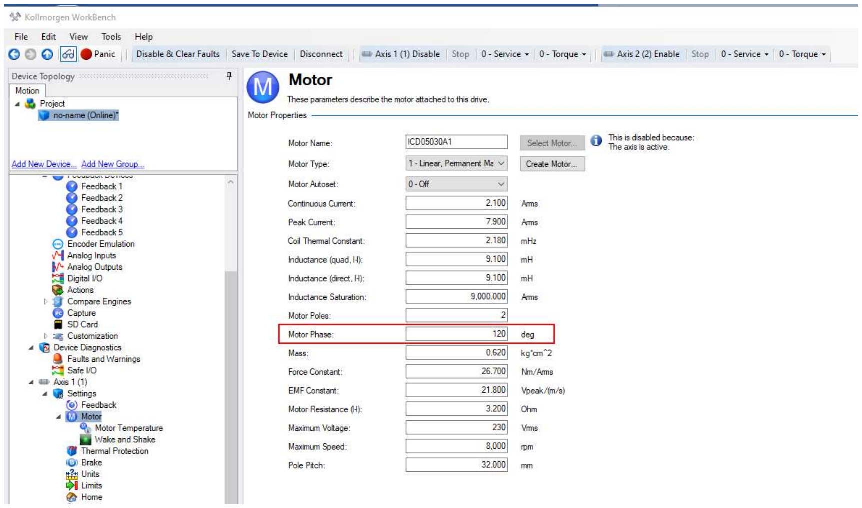
The W&S will either finish and indicate “Successful” if it was able to determine the Motor Phase or “Error” if the W&S algorithm failed.

Note for the standard convention the Motor Phase should be approximately 120 degrees.



When commissioning the linear motor system, the Wake and shake routine should be performed in several different positions of the motor’s travel. The MOTOR.PHASE values should be no more than 5 degrees different in the different positions. This checks consistency.

The Motor Phase on the Motor Screen is automatically populated with the result of the W&S. It is important once you have the correct value to Save to Device to save the value to non-volatile memory.



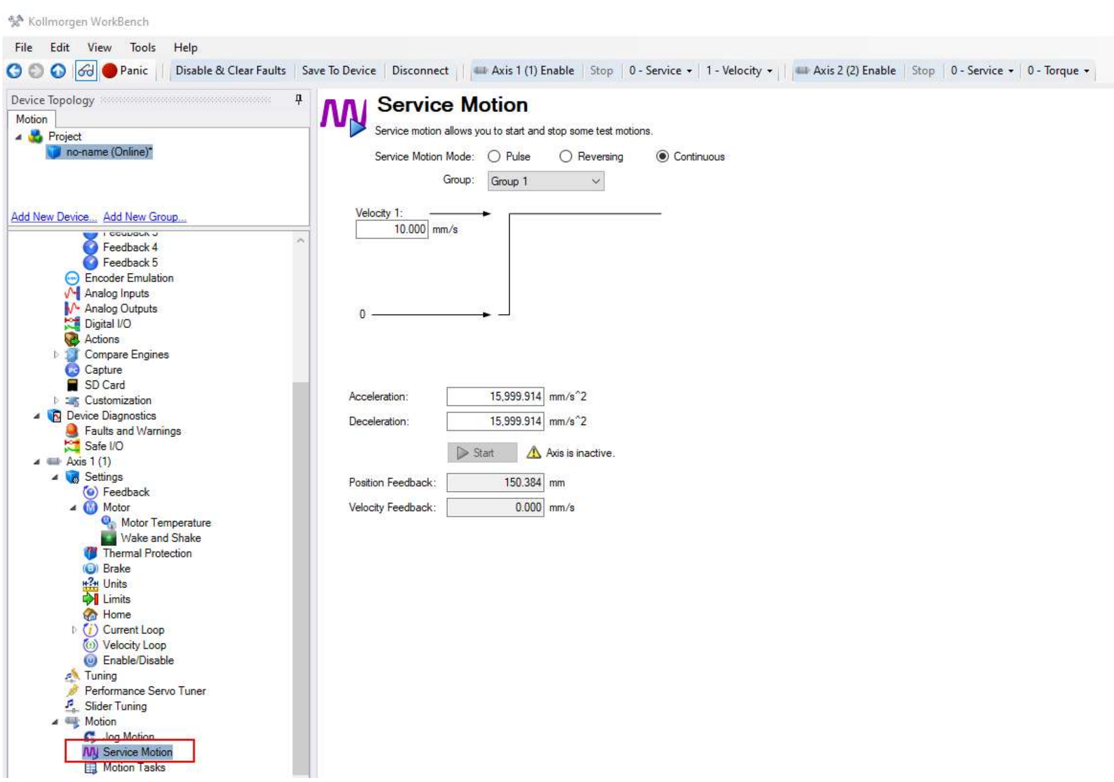
14. Verify the Motor is Setup Correctly by Jogging it in Both Directions

Make sure the AKD2G drive's peak current is limited before doing this exercise. A linear motor runaway can result in damage to the system equipment or possible bodily injury.

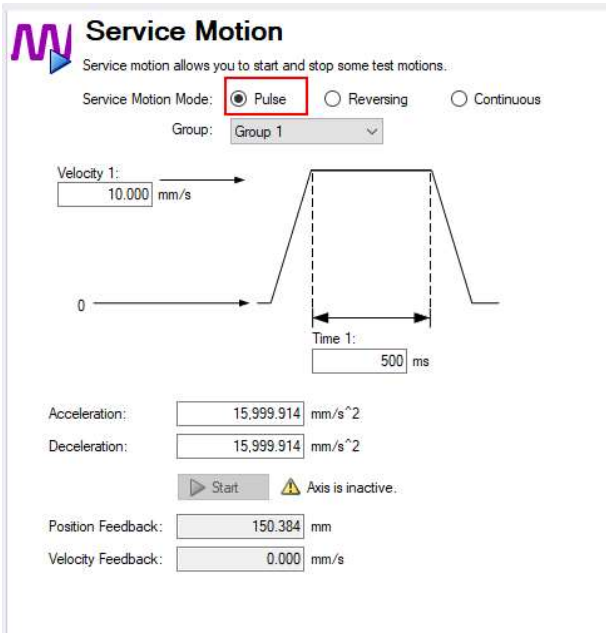
STEP 1: Start with the Axis disabled.

STEP 2: Select the Service Mode and operation Mode. In this example we'll first use Service and Velocity.

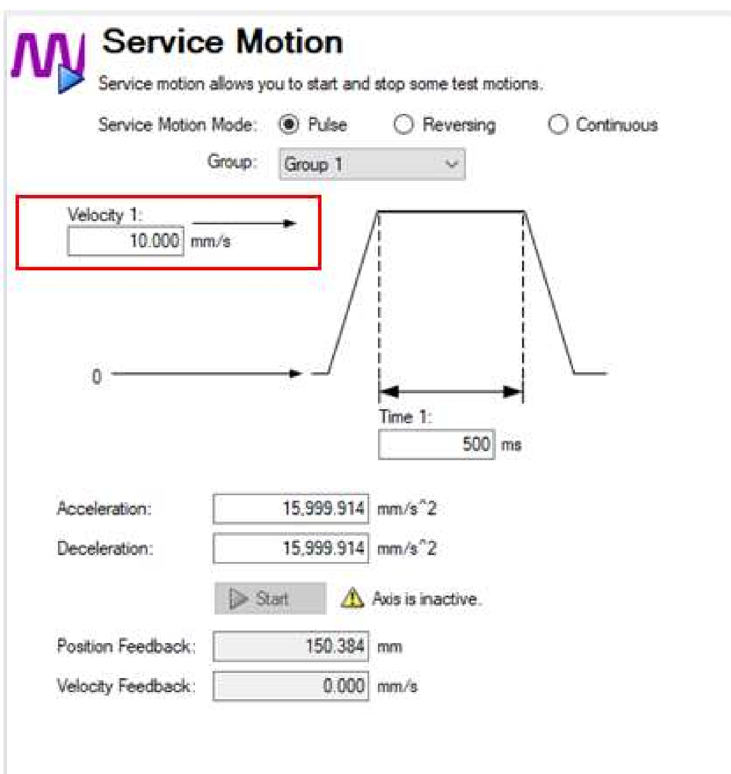
STEP 3: Click on the Axis' Service Motion Screen.



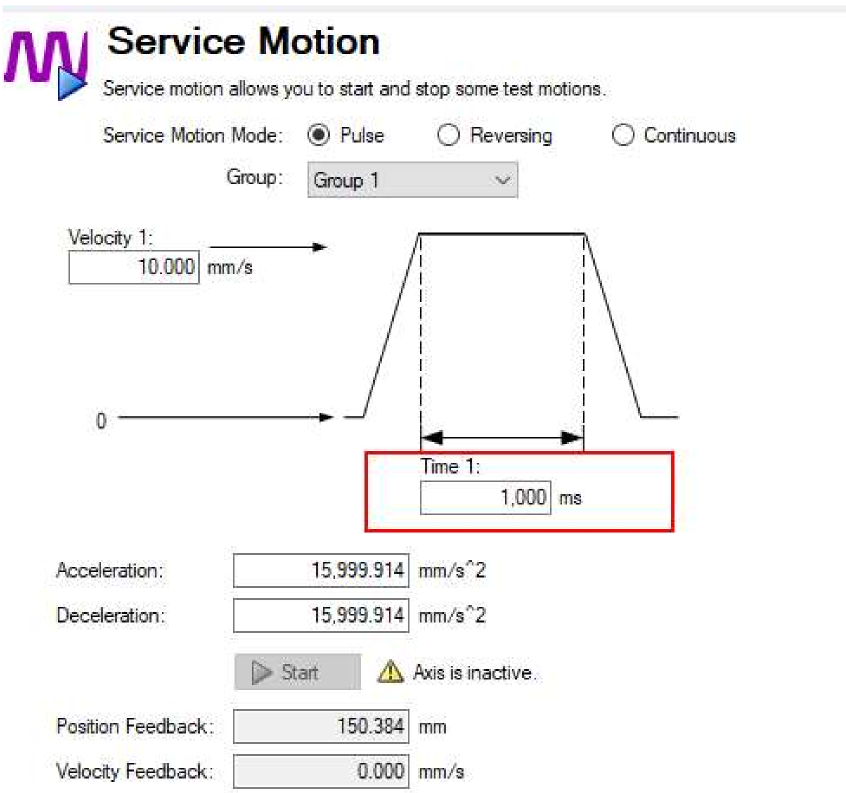
STEP 4: Select the Service Motion Mode. In this example we'll start by using Pulse



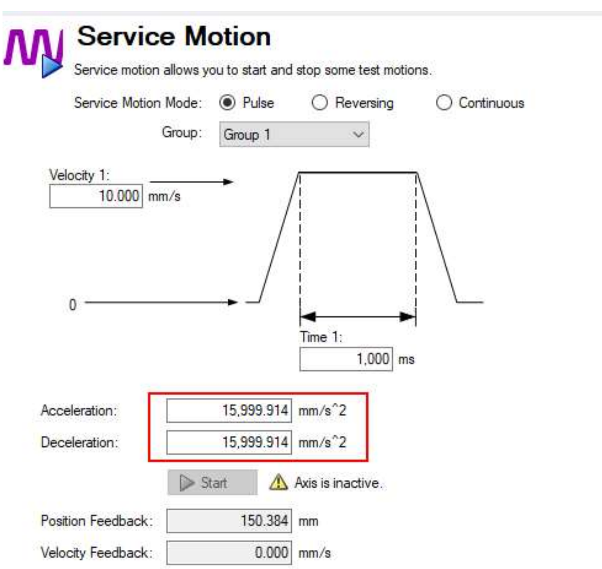
STEP 5: Input a slow jog velocity. In this example we've entered 10 mm/s.



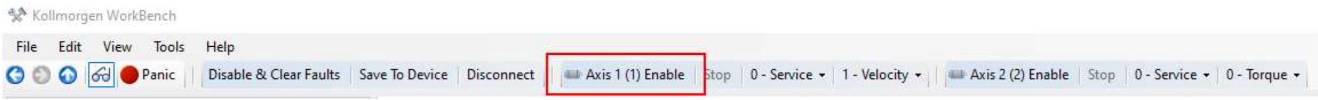
STEP 6: Input the time (duration) of the pulse. Make sure the move time does not allow the motor to hit the hard stops (end of travels) with the given target velocity inputted in STEP 6. It is recommended to start this test at the mid-stroke of travel.



STEP 9: Adjust the Accel/Decel for Service Motion as desired.

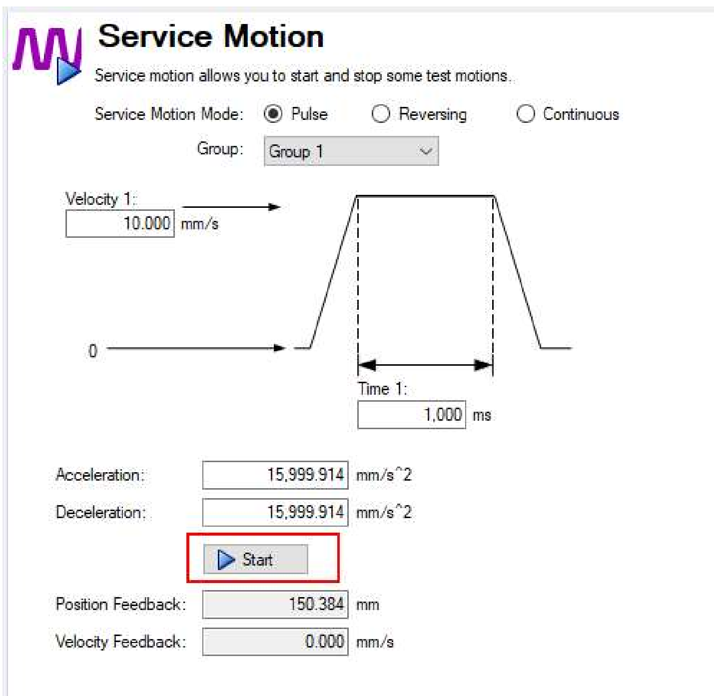


STEP 10: Enable the Axis.

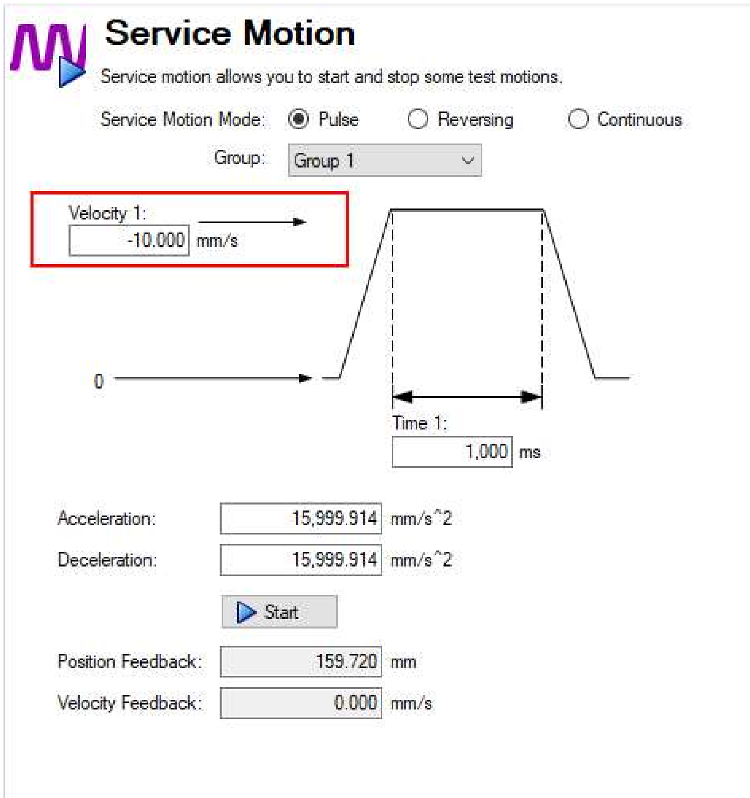


Axis 1 is shown in the status bar.

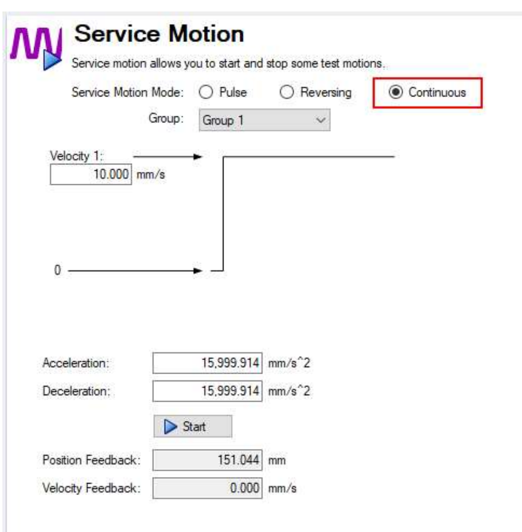
STEP 9: Click the Service Motion Start Button to pulse (move) the axis in the forward (positive) direction.



STEP 10: Set the slow jog velocity to a negative value. We used -10 mm/s in this example. Press the Start button in the Service Motion screen to pulse(move) the axis in the negative (reverse) direction.

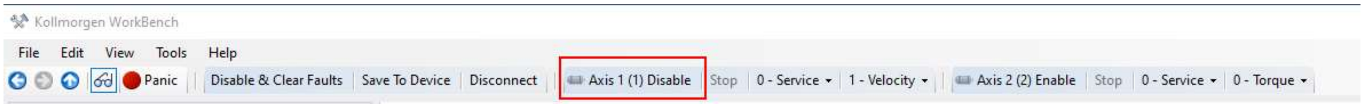


STEP 11: Set the Service Motion Mode to Continuous and Start/Stop using the Service Motion Control first with a positive Velocity setpoint and then a negative Velocity setpoint to jog the axis continuously in both directions.



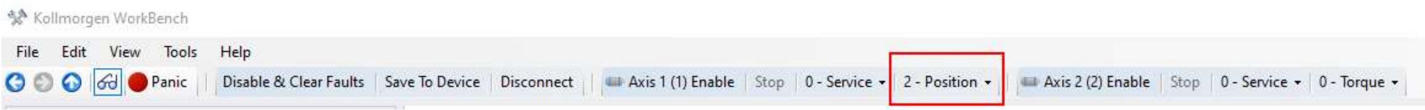
15. Home Axis and Use Motion Tasking to Extend and Retract

STEP 1: Disable the axis.

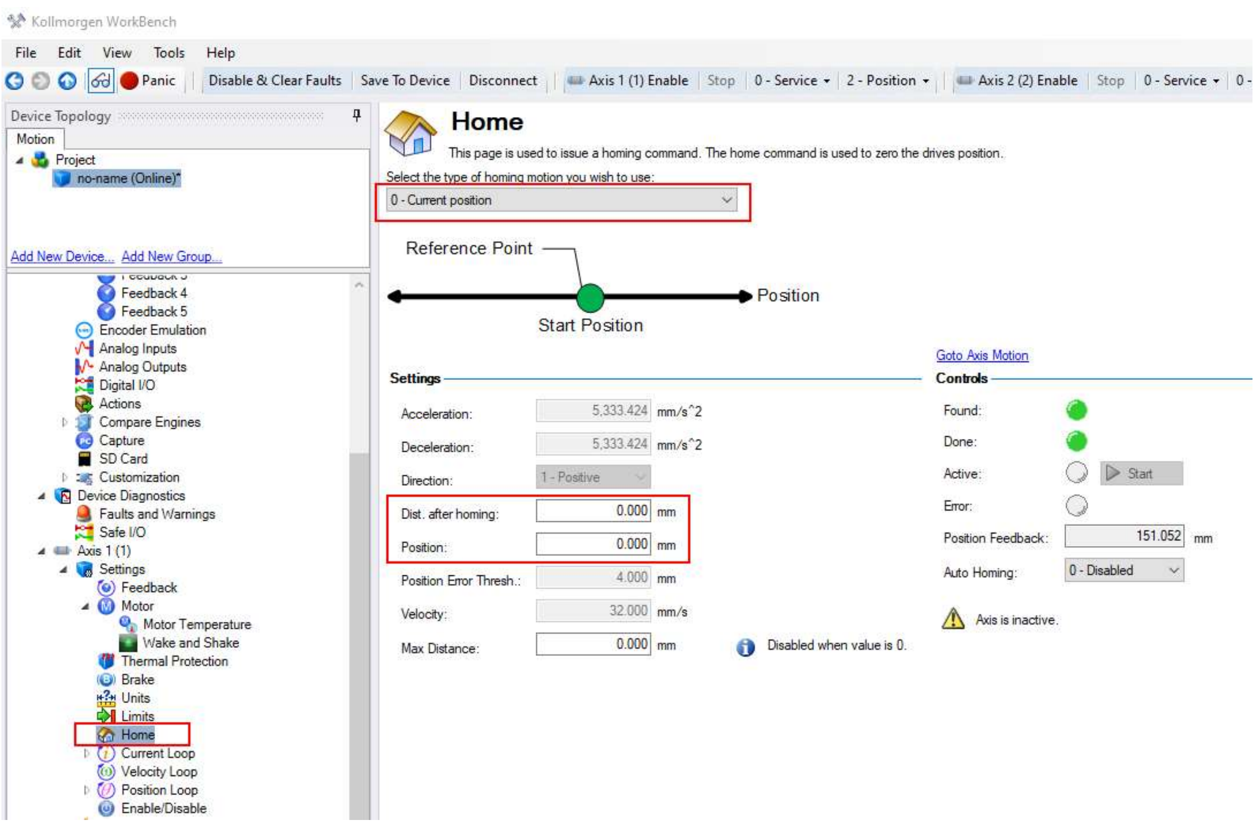


STEP 2: Safely move the motor to the desired home position.

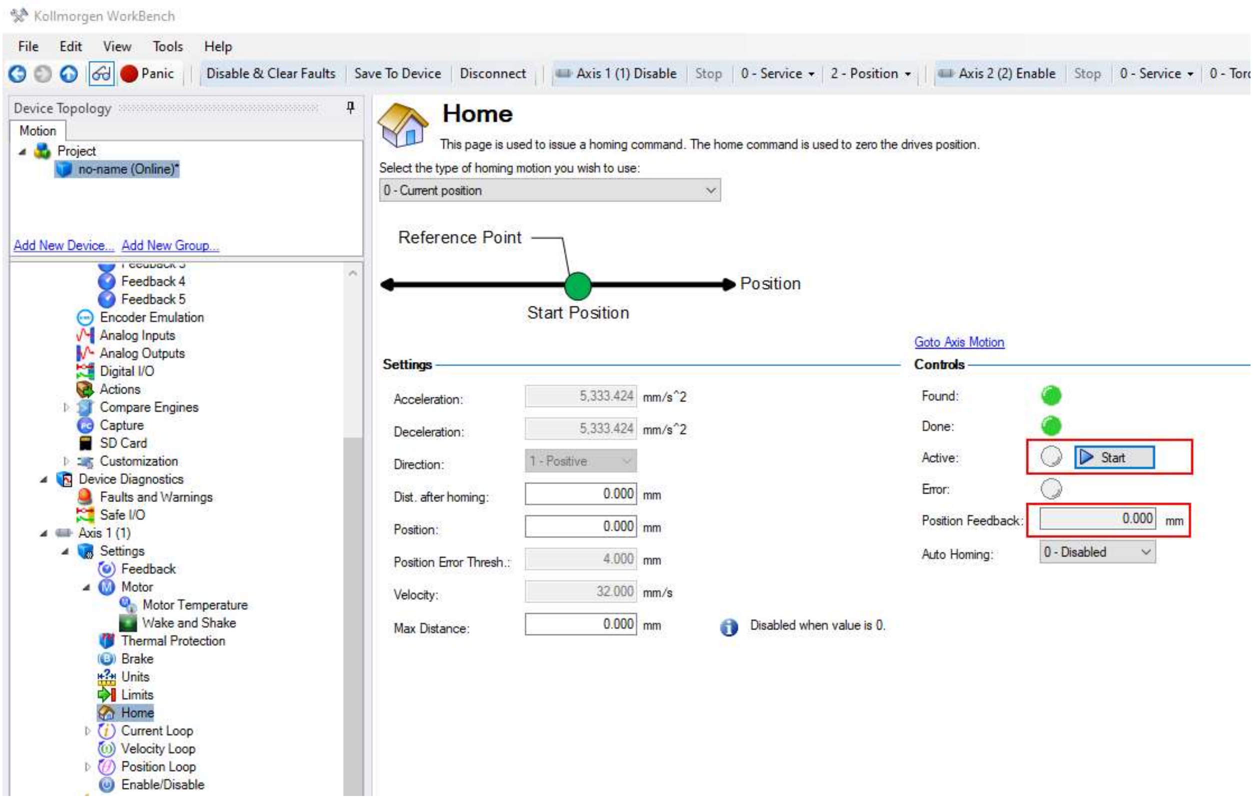
STEP 3: Change the Axis' operation mode to Position.



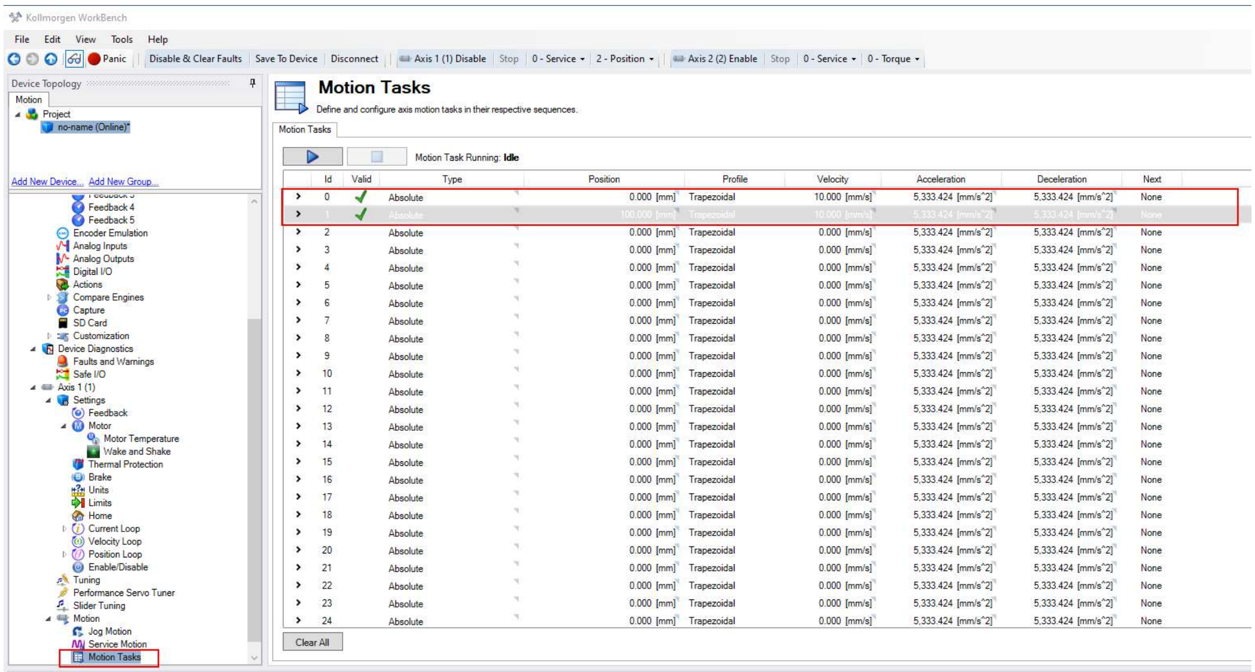
STEP 4. Home the axis using Current Position and 0 for Dist. After homing and Position.



Enable the axis and press the Start button on the Home screen. Note the Position Feedback read-only on the Home screen should read 0.000 mm after homing.



STEP 5. Setup two motion task one to extend the motor/axis out to X mm and one for a return to home (both absolute motion tasks). Execute the extend (i.e. out to 100mm). Measure the physical location of your motor (i.e. carriage) and compare the position feedback shown in Workbench vs. your measurement. Retract by executing the return to home (i.e. Zero Position) and measure again.

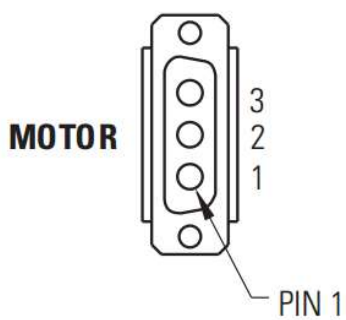


The linear motor initial commissioning is now complete!

Appendix A

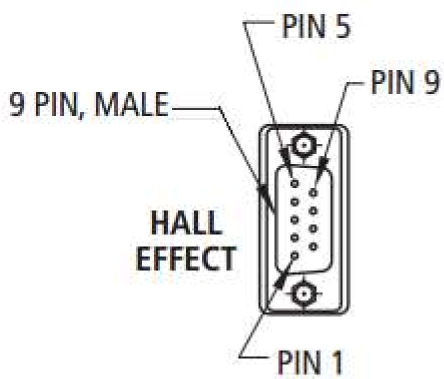
Configuring a DDL Liner Motor with Feedback Counting in the Opposite Direction

1. DDL Motor Coil Connections



Motor Connector Pin Numbers	Motor Coil Wire Color	AKD2G Drive Connection Connector X2
1	Red	W
2	White	V
3	Black	U
Connector Shell	Grn/Yel	PE GND
Connector Shell	Violet	Shield

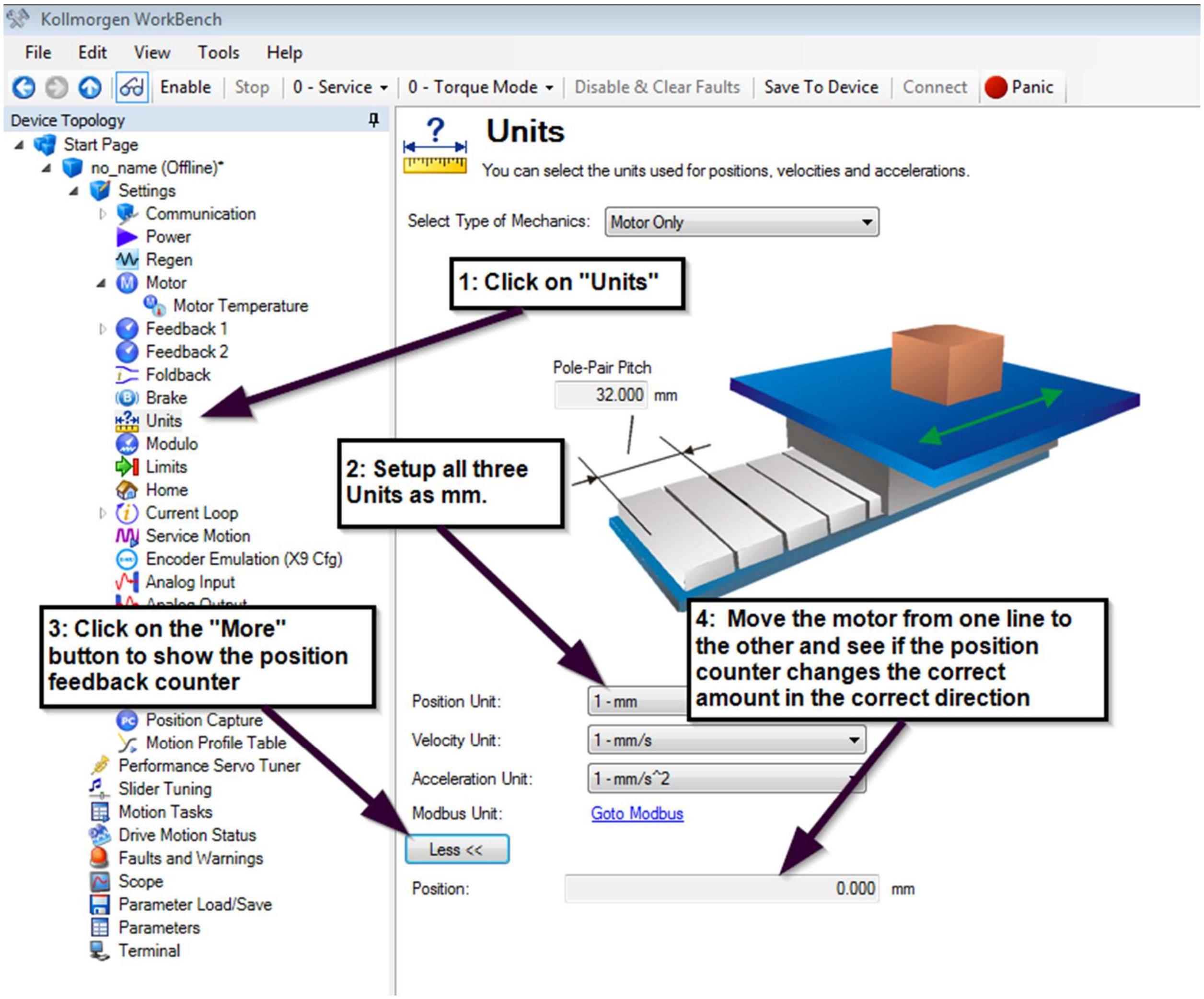
2. DDL Motor Hall Sensor Connections



Motor Connector Pin Numbers	**Motor Hall Effect Colors**	**AKD2G Drive Connection Connector X10 Pin No.**
1	Yellow	2
2	Green	1
3	Black	3

3. Checking Motor Feedback Resolution

The feedback resolution can be tested by marking two lines on the magnet way 32mm apart. You can use whatever length you want, but longer is more accurate. Change the User Units to “mm”.

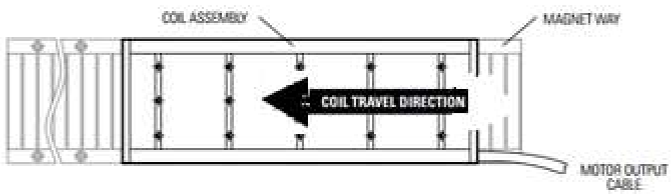


If the position display does not match the distance the motor is moved, you may need to revisit the encoder scaling section of this manual or confirm the feedback device scale.

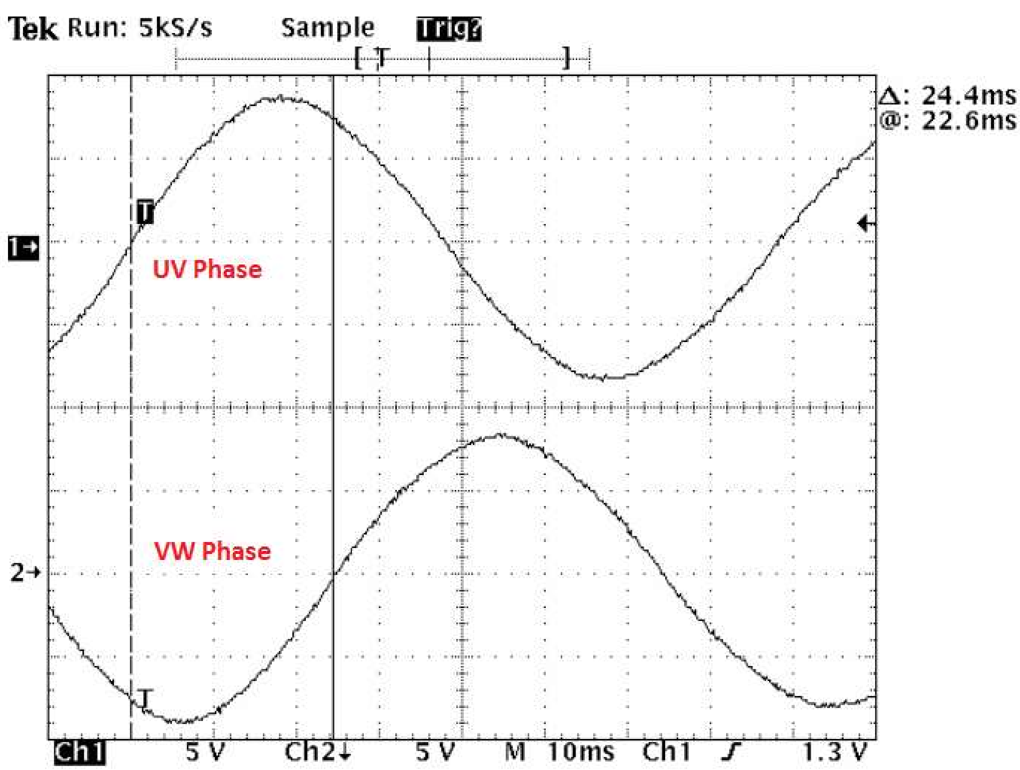
4. Check Motor Phasing of Any Servo Motor

This is useful for commissioning a third-party motor, as well as any frameless Kollmorgen motor, or any servo motor for which the phasing is unknown.

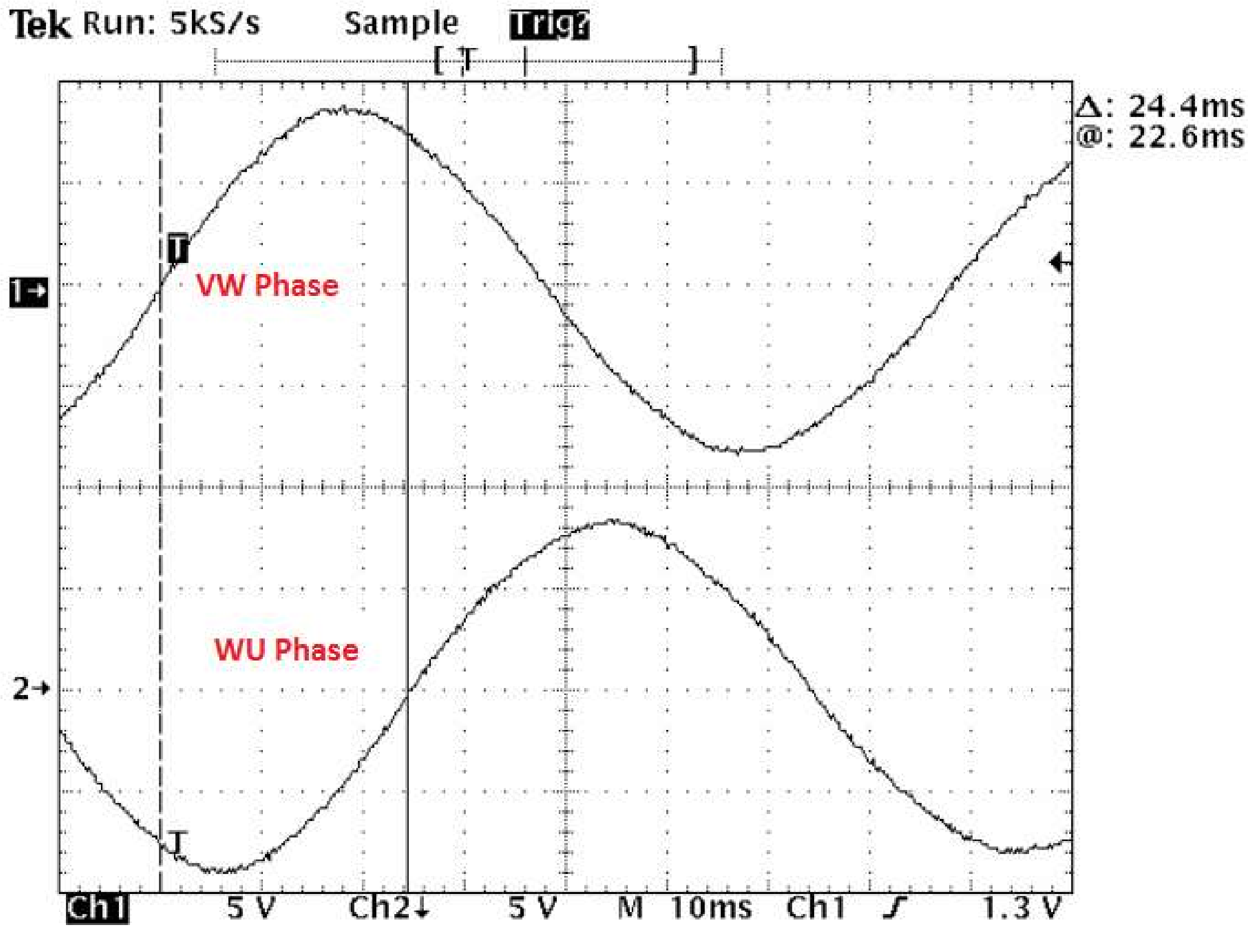
This part of the setup will require a two channel oscilloscope with isolated channels. Move the motor in the positive direction based on the motor manufactures specification. The AKD2G commutates a motor in the phase sequence of U V W in the positive direction.



When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by 120° of the V phase (V phase with reference to W phase).



While moving the motor in a positive direction the motor V phase (V phase with reference to W phase) will lead the back emf voltage waveform by 120° of W phase (W phase with reference to U phase).



Use Figure 3 to determine the Hall Sensor alignment of the motor. Make sure the feedback position value (PL.FB) is counting in the positive direction.

5. Test Hall Sequence When Moving Motor in the Positive Direction

The hall phasing can be check with the parameter FB#..HALLSTATE in terminal. This is a binary value, where “001” is Hall U, “010” is Hall V, and “100” is Hall W.

FB#.HALLSTATE

Description

FB#.HALLSTATE reads the Hall switch values (encoder feedback only).

The value is the sum of the three hall bit states, where FB#.HALLSTATE = Hall U + Hall V + Hall W. If the hall is not active, it returns 0. When a hall is active, each hall contributes the following value to the sum:

- Hall W = 1
- Hall V = 2
- Hall U = 4

Value	Hall W	Hall V	Hall U
1	√	-	-
2	-	√	-
3	√	√	-
4	-	-	√
5	√	-	√
6	-	√	√

The following sequences indicate the direction of rotation.

Sequence	Direction
1,5,4,6,2,3,1	Positive
1,3,2,6,4,5,1	Negative

These commands are not recordable on FB1 and FB2.

For recording on FB1 and FB2, see FB#.MONITOR#.SOURCE and FB#.MONITOR#.DATA.

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

What does this mean?

Type	Read Only
Units	Terminal: Binary Scope: N/A
Range	Terminal: See description above Scope: 1 to 6
Default Value	N/A
Data Type	Terminal: String Scope: Integer
Stored in Non Volatile Memory	No

FB#.HALLMAP.U

Description

FB#.HALLMAP.U reads and writes to a mapping register used to correct mis-wired motors without physically changing the wiring. This keyword only effects feedback devices that have halls (see FB#.SELECT for feedback types with halls).

FB#. HALLMAP.U can be set to one of the following values:

Value	Description
0	The output is the U input value. (Default)
1	The output is the V input value. (Swap U with V)
2	The output is the W input value. (Swap U with W)
3	The output is fixed at 0.
4	The output is U input inverted value. (When input U=0, U output is 1)
5	The output is V input inverted value. (When input V=0, U output is 1)
6	The output is W input inverted value. (When input W=0, U output is 1)
7	The output is fixed at 1.

Versions

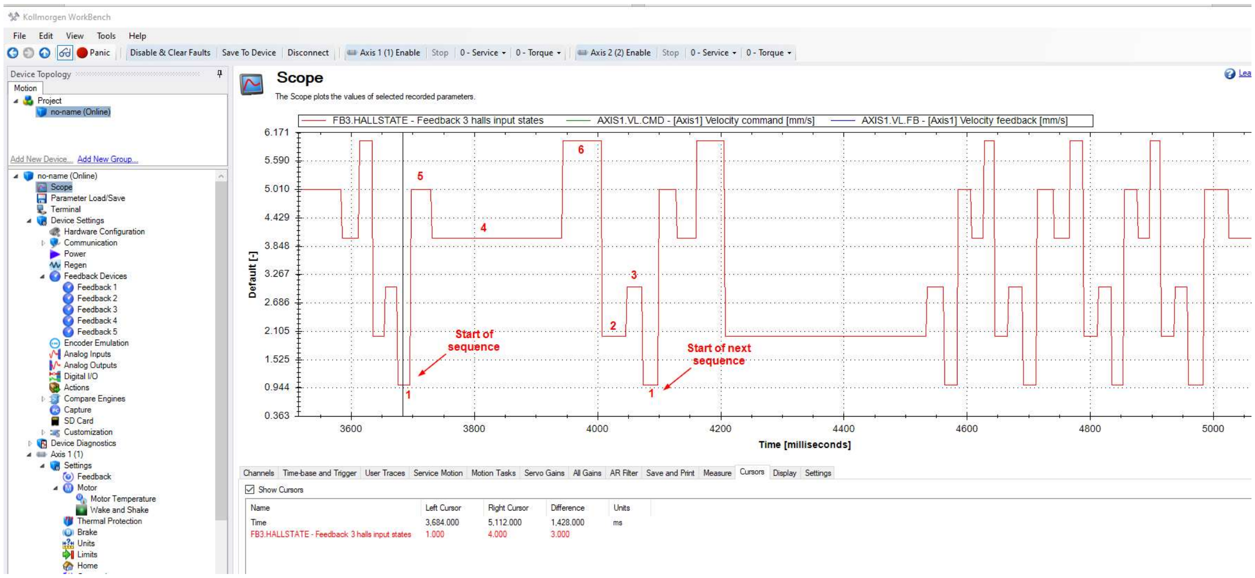
Action	Version	Notes
Implemented	02-10-00-000	

General Information

Type	Read/Write
Units	N/A
Range	0 to 7
Default Value	0
Data Type	Integer
Stored in Non Volatile Memory	Yes

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

Using the Scope is easier to capture and analyze.



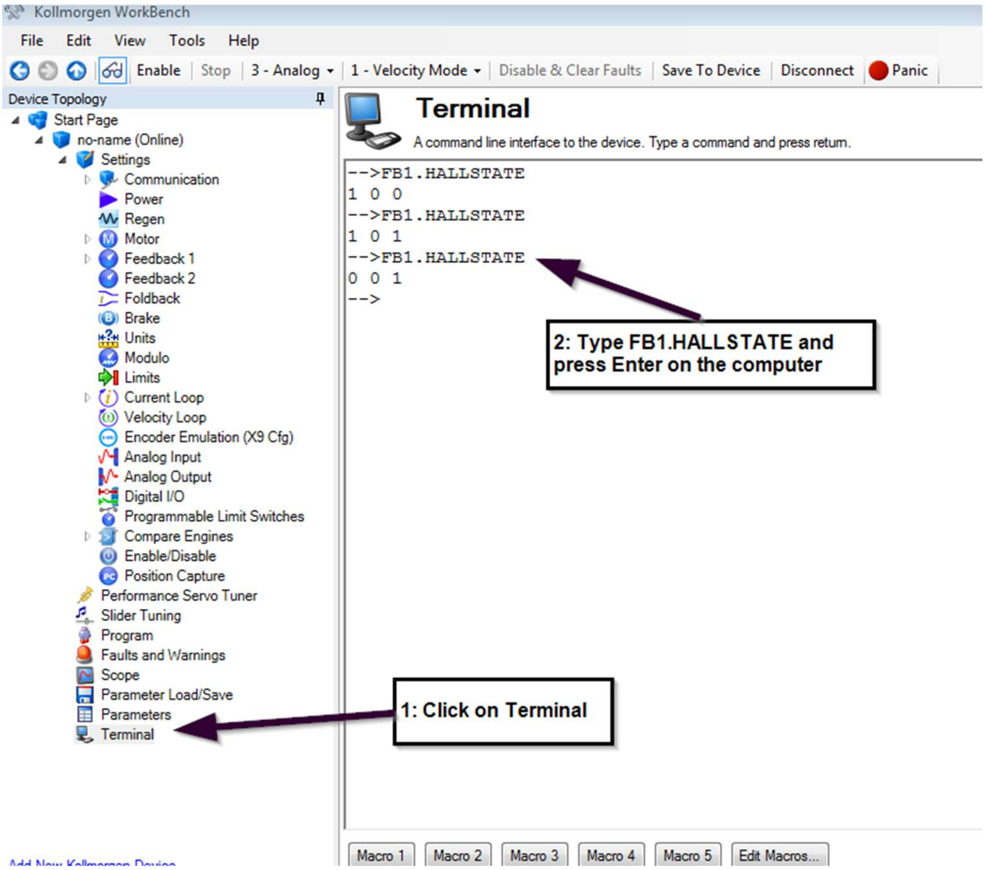
Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

Note with the AKD2G the FB#.HALLSTATE only reports the decimal value.

I checked this with Terminal and the sequence reported was 1, 5, 4, 6, 2, 3, 1.

Step(CW)	FB#.HALLSTATE
1	1
2	5
3	4
4	6
5	2
6	3
1	1

The hall phasing can be check with the parameter FB1.HALLSTATE. This is a binary value, where “001” is Hall U, “010” is Hall V, and “100” is Hall W.



6. MOTOR BACK EMF AND HALL SENSOR SIGNAL ALIGNMENT

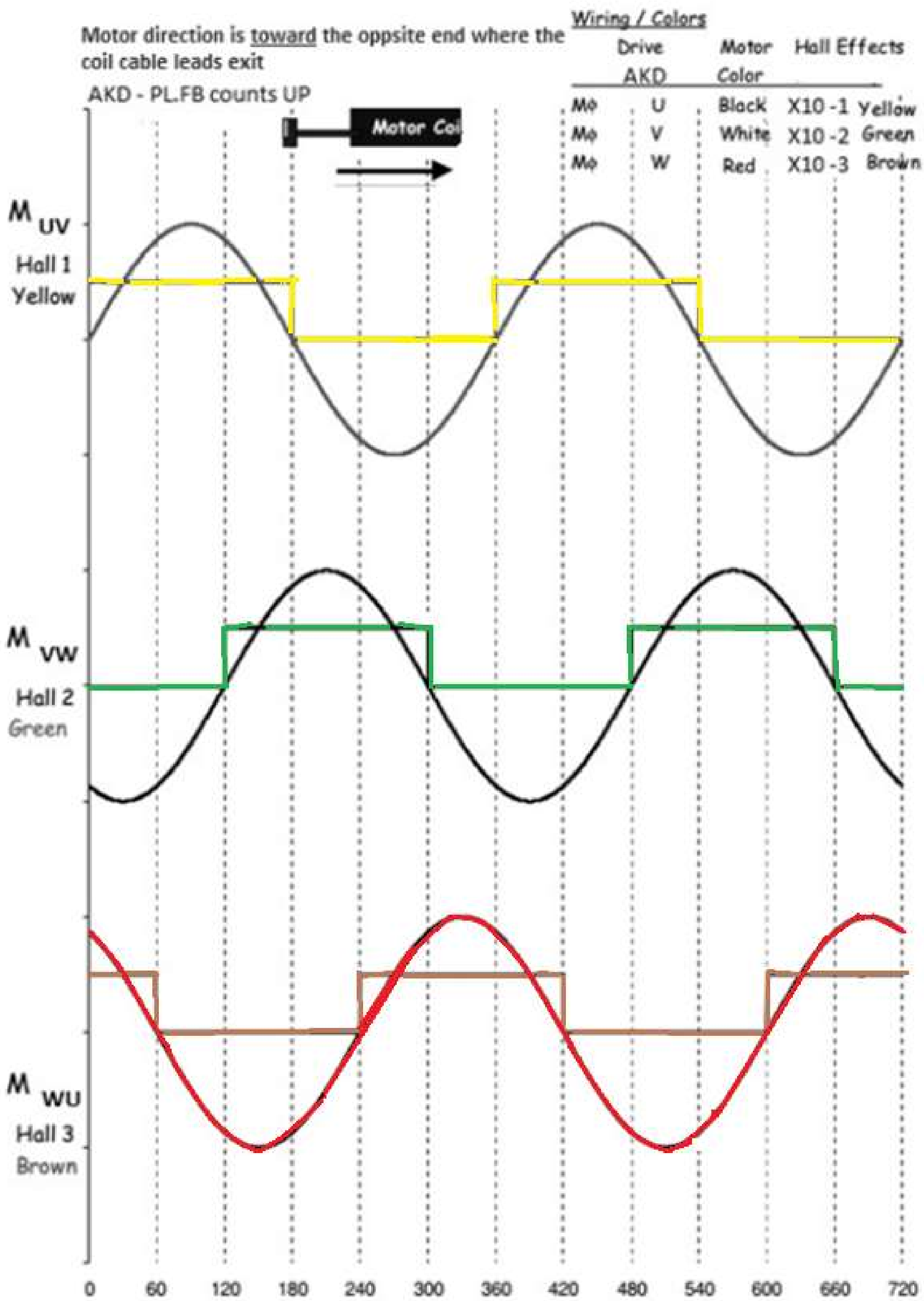


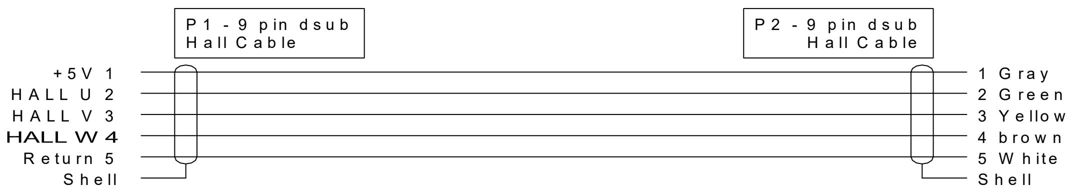
Figure 3

When using a Kollmorgen DDL motor, **MOTOR.PHASE = 120** when the feedback direction is positive toward the "Lead Exit End" of motor (that is, the end of the motor where the leads come out), and when the hall alignmet and motor phasing match exactly as shown in Figure 3.

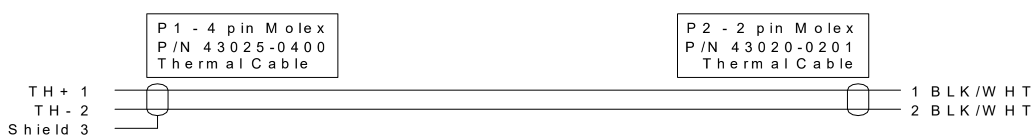
Return to **13. Start the Wake and Shake Routine** on "page 42"

Appendix B

1. Hall Effect Cable



2. Thermal Sensor Cable



3. Motor Power Cable