

**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

Section	Page
<b>System Wiring Configuration</b>	
1. AKD2G System Cable Diagram	3
2. ACI-AKD-A ( Heidenhain Sin/Cos )	4
3. ACI-AKD-A ( Renishaw Sin/Cos )	5
4. AKD2G Primary Feedback X23	6-7
5. AKD2G Primary Feedback X41	8-9
6. DDL Motor Hall Sensor Connections	10
7. DDL Motor Power Connections	11
8. Motor Power Cable	12
9. Minimum Wiring Requirement for the AKD2G	13
<b>Configure the AKD2G Drive Using the Workbench Software</b>	14
1. Safety First	14
2. Connect to the AKD Drive	15
3. EXPAND "SETTINGS" AND SELECT THE MOTOR SETUP SCREEN	16-17
4. Select Motor from Pull Down List	18-22
5. Select Motor Temperature Sensor	23-26
6. Select the Feedback Type	27-28
7. Configuring Encoder Feedback Resolution	29-32
8. Test Encoder Direction and Resolution	33-34
9. Check Motor Feedback Resolution	35
10. Check Motor Phasing of Any Motor	36-37
11. Test Hall Sequence When Moving Motor In The Positive Direction	38-40
12. Motor Back EMF and Hall Sensor Signal Alignment	41
13. How to Verify the Motor's Commutation Alignment Angle: MOTOR.PHASE	42-46
14. Verify The Motor is Setup Correctly By Jogging It In Both Directions	47-51
15. Home Axis and Use Motion Tasking to Extend and Retract	52-54

## **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

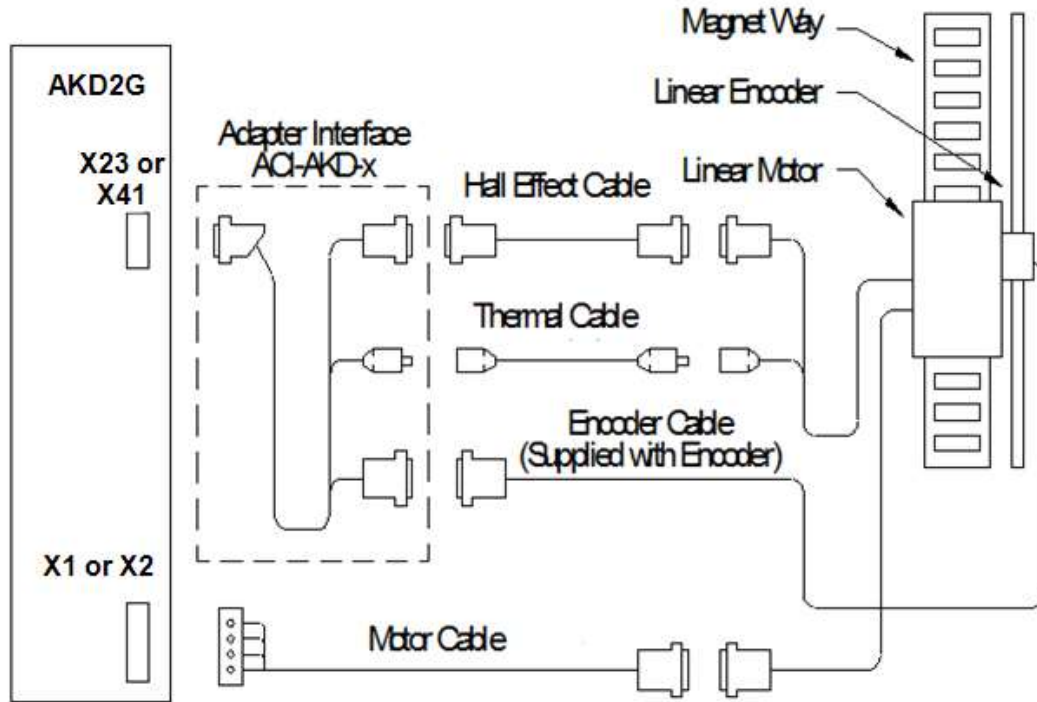
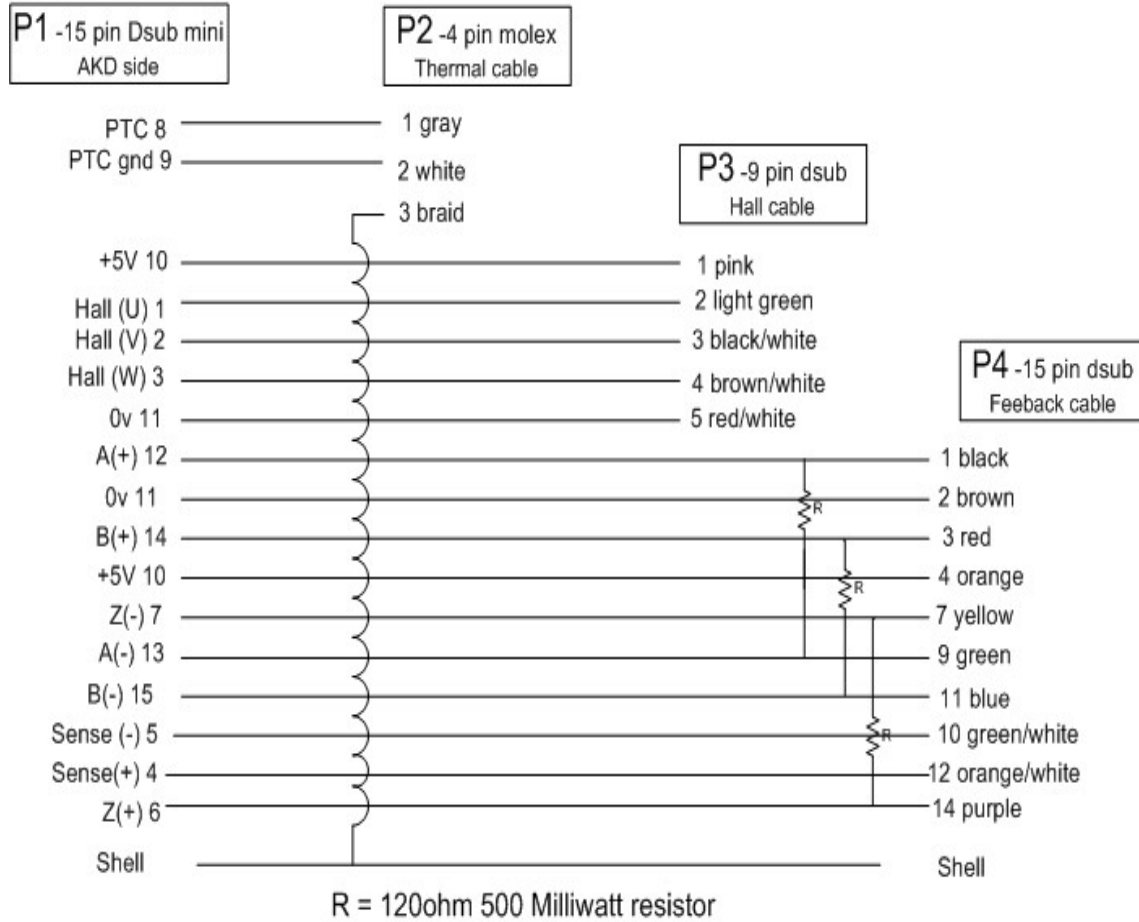


Figure 1

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

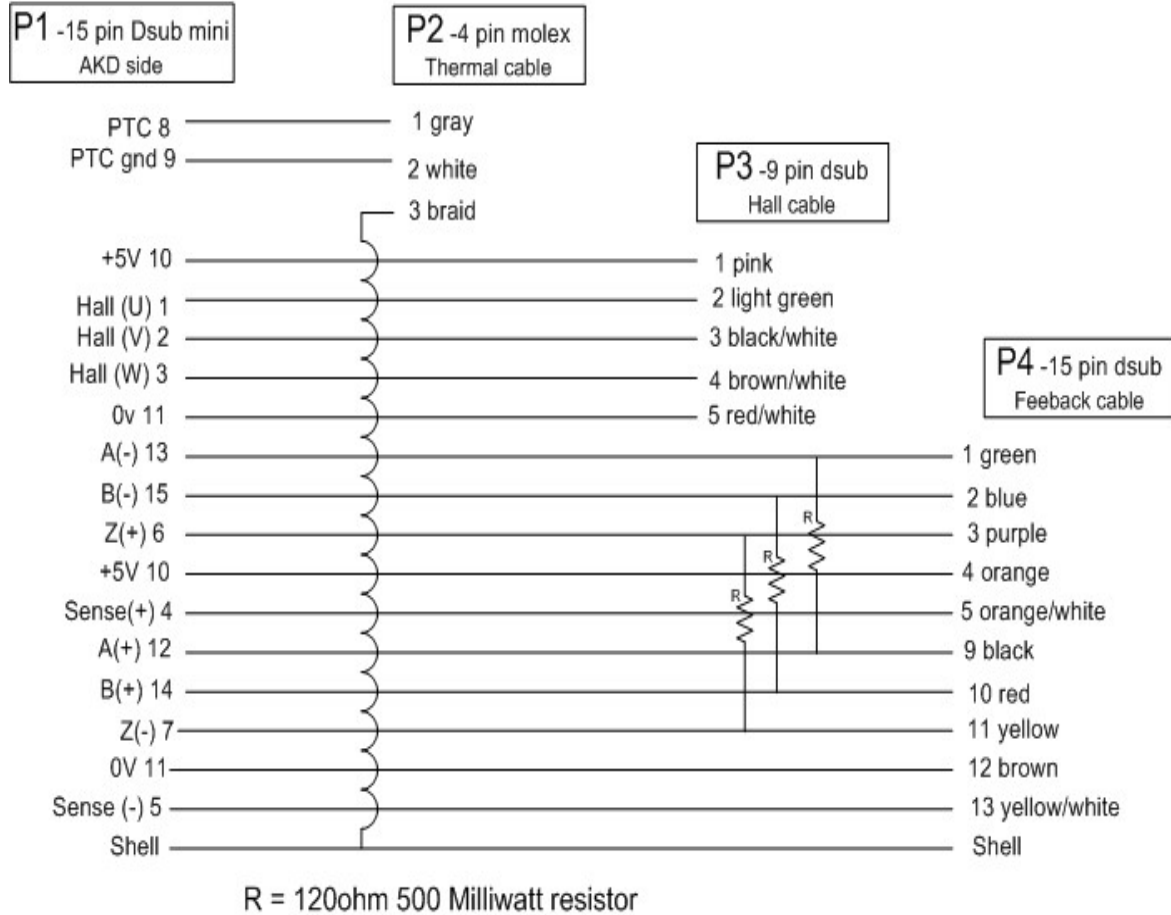
ACI-AKD-A (Heidenhain type)



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

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

ACI-AKD-B (Renishaw Sine/Cos type)



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

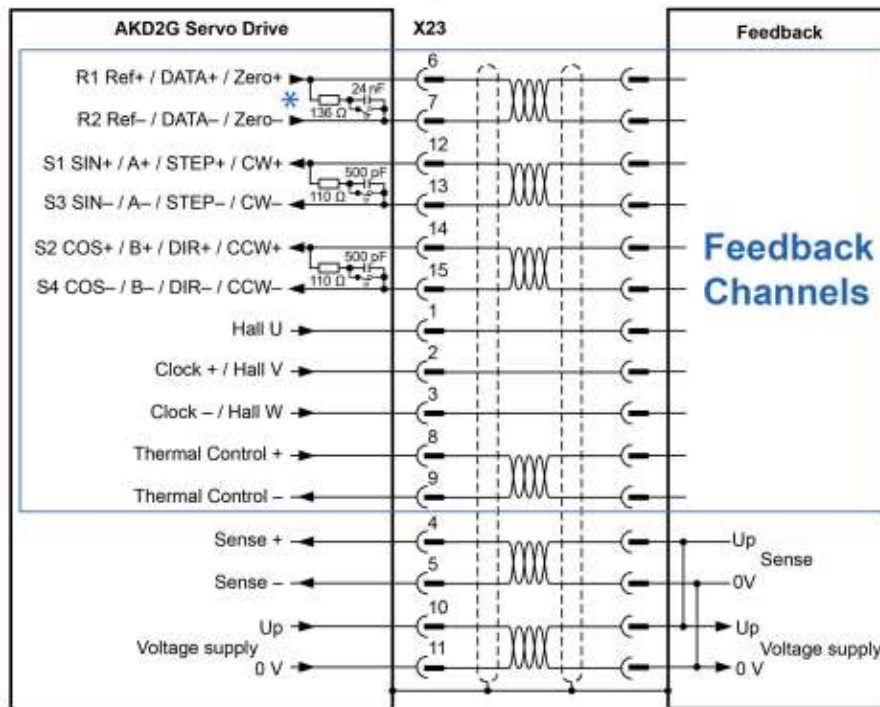
## 4. AKD2G FEEDBACK X23

### 8.10.9 Feedback Connector X23

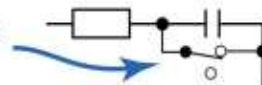


- Connectivity Option F3 or DX (→ # 28)
- Sub-D high density 15 pin, female
- Use Kollmorgen feedback cables
- Input for several feedback types
- Input for Electronic Gearing, (→ # 139)
- Output for encoder emulation (EEO1), (→ # 139)
- Digital input (→ # 154), Digital output (→ # 158)
- Mating connector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

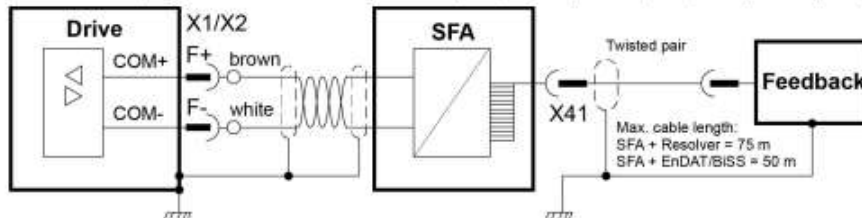
SFA provides a 15 pole HD Sub-D female connector X41 to the system for connection of a Kollmorgen motor feedback cable (see *Kollmorgen 2G Cable Guide*). Dimensions (LxWxD): 88.6 x 55.6 x 21.2 (28.6 with rail clip).

Order codes see regional Accessories Manual.



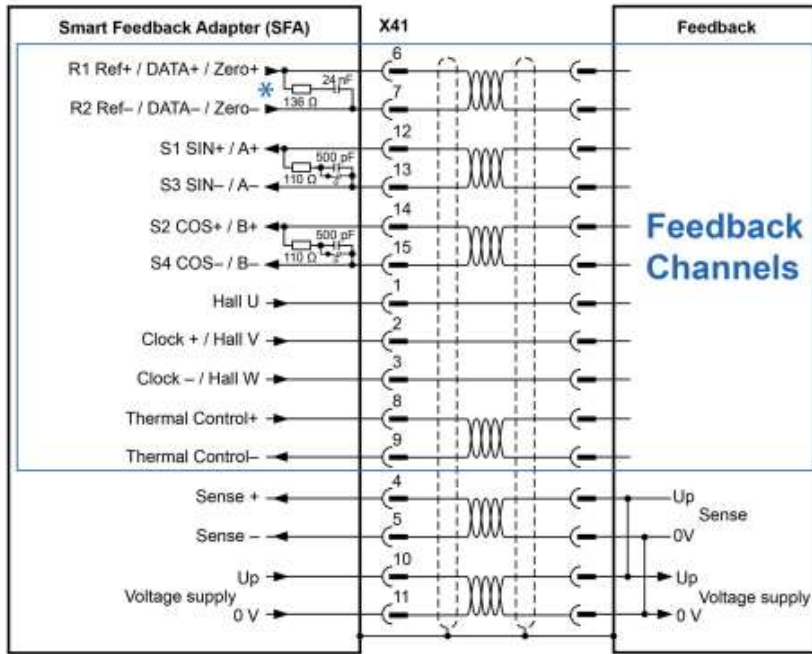
- Sub-D high density 15 pin, female
- 1 m shielded cable with 3 flying leads for connection to X1 or X2 or X5
- The cable shield is connected by using shield wire to X5/1 or with cable ties to the X1/X2 shield plates.
- Connected feedback must be set in WorkBench.
- Only use Kollmorgen feedback cables. 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):

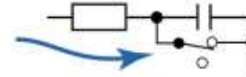




### 8.10.11.1 X41 Connector Pinout Summary



\* 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		EnDat		HIPEFACE	Sin / Cos	Sin / Cos +Hall	Incr. Enc.	Incr. Enc. +Hall	Hall	SSI
			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+
9	-	Th-	Th-	-	Th-	-	Th-	Th-	Th-	Th-	Th-	Th-	Th-
10	+5V	-	+5V	+5V	+5V	+5V	8 to 9V	+5V	+5V	+5V	+5V	+5V	+5V
11	0V	-	0V	0V	0V	0V	0V	0V	0V	0V	0V	0V	0V
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

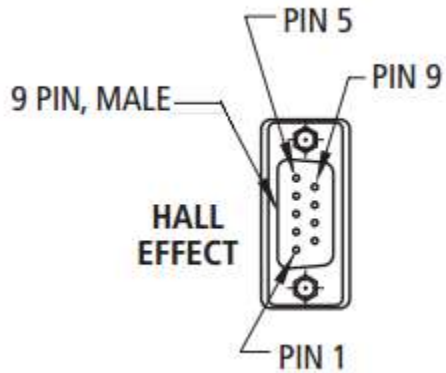
(1): Resolver with AKD2G-CON-SFA-R00 only, all other feedback devices with AKD2G-CON-SFA-E00 only

■ = DC Terminated, can be overridden with [DIO#.TERM](#)

■ = Optional

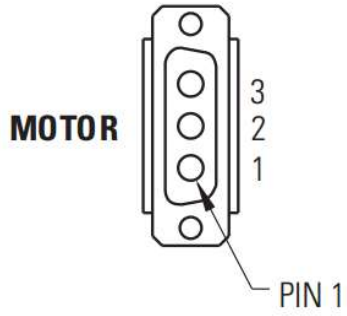
## 6. DDL Motor Hall Sensor Connections

### DDL Motor Hall Sensor Connections



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

## 7. DDL Motor Coil Connections



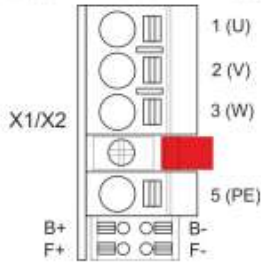
Motor Connector Pin Numbers	Motor Coil Wire Color	AKD2G Drive Connection Connector X1 or X2
1	Red	U
2	White	V
3	Black	W
Connector Shell	Grn/Yel	PE GND
Connector Shell	Violet	Shield

## 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

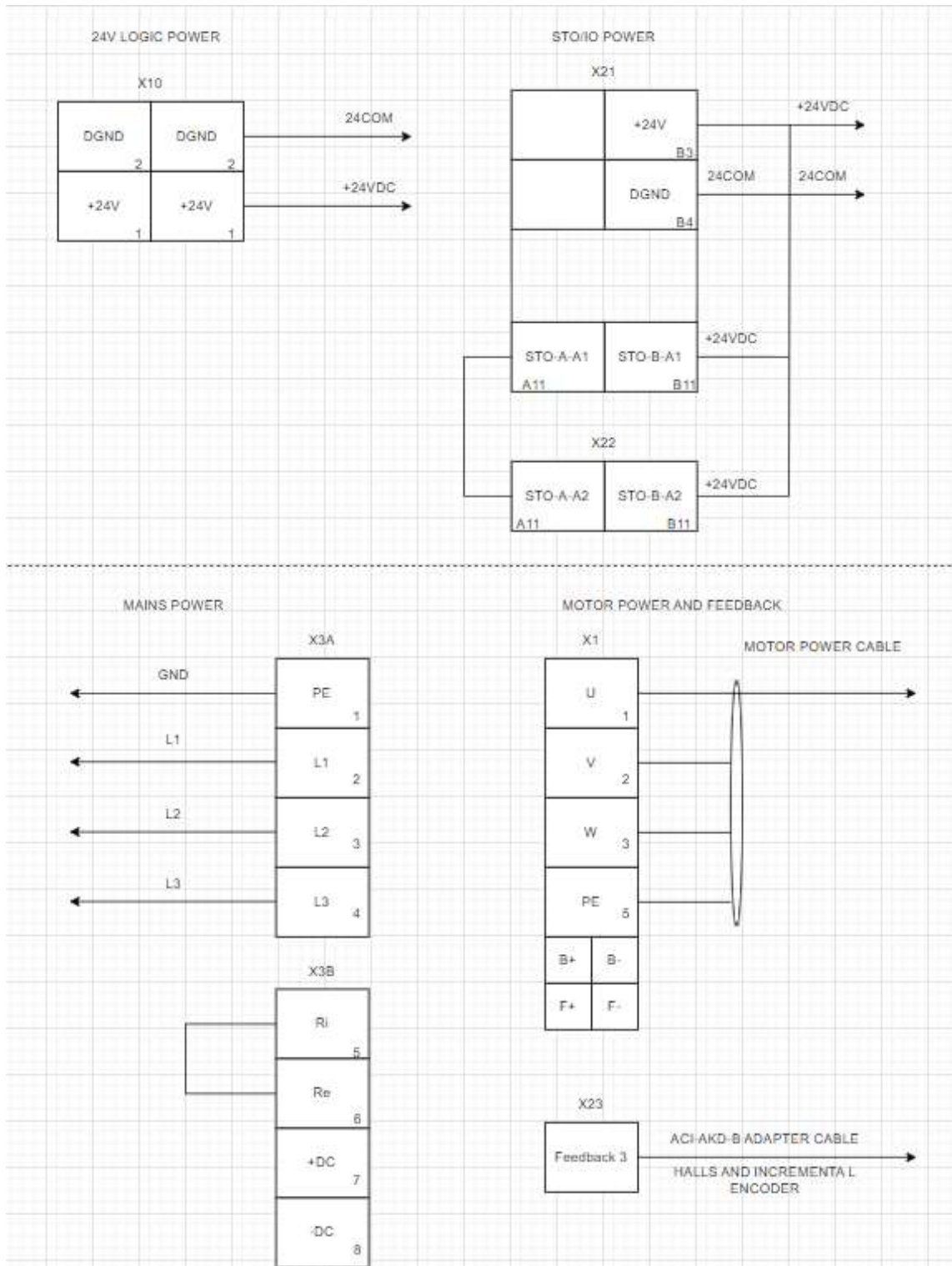


- 4 pin, pitch 7.62 mm plus 2x2 pin pitch 3.81 mm
- Spring clamps
- Locking screw, tightening torque 0.5 Nm (4.4 inlbs)
- Motor power, Motor brake (X1: axis 1, X2: axis 2)
- X1: Input for commutation feedback 1 (→ # 106)
- X2: Input for commutation feedback 2 (→ # 106)
- Wiring example:
  - DC Bus link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

Kollmorgen WorkBench

File Edit View Tools Help

Panic | Disable & Clear Faults | Save To Device | Disconnect | Axis 1 (1) Enable | Stop | 0 - Service | 0 - Torque | Axis 2 (2) Enable | Stop | 0 - Service | 0 - Torque

Device Topology

Motion

Project

no-name (Online)\*

Add New Device... Add New Group...

no-name (Online)\*

Scope

Parameter Load/Save

Terminal

Device Settings

Device Diagnostics

Axis 1 (1)

Settings

Feedback

Motor

Thermal Protection

Brake

Units

Limits

Home

Current Loop

Enable/Disable

Tuning

Performance Servo Tuner

Slider Tuning

Motion

Jog Motion

Service Motion

Motion Tasks

Axis 2 (2)

Settings

Feedback

Motor

Thermal Protection

Brake

Units

Limits

Home

Current Loop

Enable/Disable

### Limits

This page shows all the drive limits in one place.

**Current Limits**

Positive Peak Current:  Ams

Negative Peak Current:  Ams

Dynamic Brake Peak Current:  Ams

**Velocity Limits**

Positive Speed Limit:  rpm ⚠ Not used.

Negative Speed Limit:  rpm ⚠ Not used.

User Over-Speed Limit:  rpm

Overall Over-Speed Limit:  rpm ⓘ Min from user, motor mechanical and back EMF limits.

**Position Limits**

Maximum Position Error:  Counts16Bit

HW Positive Limit Switch:

HW Negative Limit Switch:

SW Limit Switch 0:   Counts16Bit

SW Limit Switch 1:   Counts16Bit

**Motor and Drive Limits**

These limits are set automatically through thermal protection:

Lower Current values to a safe level

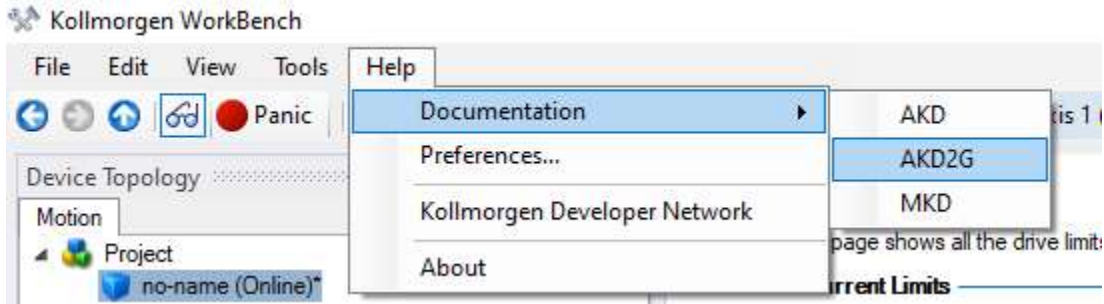
Axis 1 Limits

Axis 2 Limits

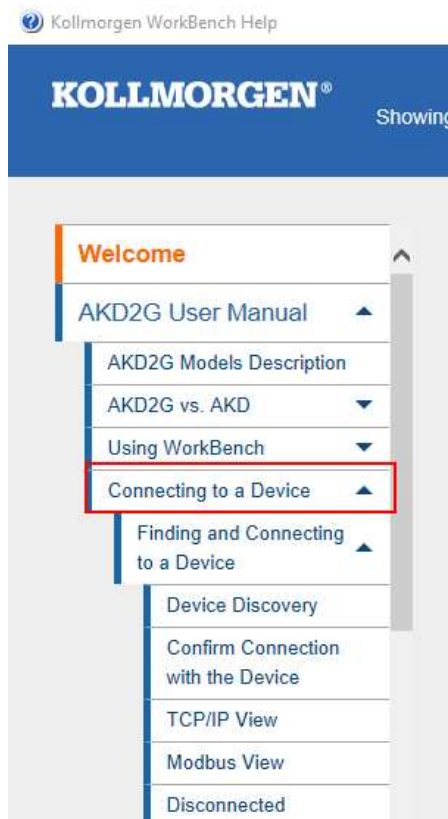
## 2. Connect to the AKD2G Drive

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

**Expand Settings under the Online Device tree**

**Click on Motor**

**Motor Properties**

Motor Name: empty  [Select Motor...](#)

Motor Type: 0 - Rotary, Permanent M:  [Create Motor...](#)

Field Weakening: 0 - Disabled  [More Information](#)

Motor Autoselect: 1 - On  [Configure...](#)

Commutation Source: 1 - Feedback 1  [Configure...](#)

Feedback Type: 0 - No Feedback Identified

Continuous Current:  1.000 Ams

Peak Current:  2.000 Ams

Coil Thermal Constant:  10.000 mHz

Inductance (quad, L4):  4.000 mH

Inductance (direct, L):  4.000 mH

Inductance Saturation:  9,000.000 Ams

Motor Poles:  6

Motor Phase:  0 deg

Inertia:  0.000 kg\*cm<sup>2</sup>

Torque Constant:  0.000 Nm/Ams

EMF Constant:  20.000 Vms/k-rpm

Motor Resistance (R):  10.000 Ohm

Maximum Voltage:  480 Vms

Maximum Speed:  3,000 rpm

This is disabled because:  
The Motor Autoselect value equal to 1.

# NOTE FOR THIS EXAMPLE AXIS 1 WILL BE SHOWN.

File Edit View Tools Help

Panic | Disable & Clear Faults | Save To Device | Disconnect | Axis 1 (1) Enable | Stop | 0 - Service | 0 - Torque | Axis 2 (2) Enable | Stop | 0 - Service

Device Topology

no-name (Online)\*

Scope

Parameter Load/Save

Terminal

Device Settings

Device Diagnostics

Axis 1 (1)

Settings

Feedback

Motor

Thermal Protection

Brake

Units

Limits

Home

Current Loop

Enable/Disable

Tuning

Performance Servo Tuner

Slider Tuning

Motion

Jog Motion

Service Motion

Motion Tasks

Axis 2 (2)

Settings

Feedback

Motor

Thermal Protection

**Expand Settings under the Online Device tree**

**Click on Motor**

## Motor

These parameters describe the motor attached to this drive.

Motor Properties

Motor Name: empty  [Select Motor...](#)

Motor Type: 0 - Rotary, Permanent M...  [Create Motor...](#)

Field Weakening: 0 - Disabled  [More Information](#)

Motor Autose: 1 - On  [Configure...](#)

Commutation Source: 1 - Feedback 1  [Configure...](#)

Feedback Type: 0 - No Feedback Identified

This is disabled because:  
The Motor Autose value equal to 1.

Continuous Current: 1.000 Ams

Peak Current: 2.000 Ams

Coil Thermal Constant: 10.000 mHz

Inductance (quad, L): 4.000 mH

Inductance (direct, L): 4.000 mH

Inductance Saturation: 9,000.000 Ams

Motor Poles: 6

Motor Phase: 0 deg

Inertia: 0.000 kg\*cm<sup>2</sup>

Torque Constant: 0.000 Nm/Ams

EMF Constant: 20.000 Vms/k-rpm

Motor Resistance (R): 10.000 Ohm

Maximum Voltage: 480 Vms

Maximum Speed: 3,000 rpm

## Selecting the Motor.

### STEP 1: SET MOTOR AUTOSET= "OFF".

Kollmorgen WorkBench

File Edit View Tools Help

Panic Disable & Clear Faults Save To Device Disconnect Axis 1 (1) Enable Stop 0 - Service 0 - Torque

Device Topology

Motion

- Project
  - no-name (Online)

Add New Device... Add New Group...

no-name (Online)\*

- Scope
- Parameter Load/Save
- Terminal
- Device Settings
  - Hardware Configuration
  - Communication
  - Power
  - Regen
  - Feedback Devices
    - Encoder Emulation
    - Analog Inputs
    - Analog Outputs
    - Digital I/O
  - Actions
    - Compare Engines
    - Capture
    - SD Card
  - Customization
- Device Diagnostics
  - Faults and Warnings
  - Safe I/O
- Axis 1 (1)
  - Settings
    - Feedback
    - Motor
    - Thermal Protection
    - Brake

**M Motor**

These parameters describe the motor attached to this drive.

Motor Properties

Motor Name:	empty	Select Motor...
Motor Type:	0 - Rotary, Permanent M...	Create Motor...
Field Weakening:	0 - Disabled	More Information
Motor Autaset:	0 - Off	
Continuous Current:	1.000	Ams
Peak Current:	2.000	Ams
Coil Thermal Constant:	10.000	mHz
Inductance (quad, H):	4.000	mH
Inductance (direct, H):	4.000	mH
Inductance Saturation:	9.000.000	Ams
Motor Poles:	6	
Motor Phase:	0	deg
Inertia:	0.000	kg*cm <sup>2</sup>
Torque Constant:	0.000	Nm/Ams
EMF Constant:	20.000	Vms/k-rpm
Motor Resistance (H):	10.000	Ohm
Maximum Voltage:	480	Vms
Maximum Speed:	3.000	rpm

### STEP 2: Click on Select Motor

Kollmorgen WorkBench

File Edit View Tools Help

Panic Disable & Clear Faults Save To Device Disconnect Axis 1 (1) Enable Stop 0 - Service 0 - Torque

Device Topology

Motion

- Project
  - no-name (Online)

Add New Device... Add New Group...

no-name (Online)\*

- Scope
- Parameter Load/Save
- Terminal
- Device Settings
  - Hardware Configuration
  - Communication
  - Power
  - Regen
  - Feedback Devices
    - Encoder Emulation
    - Analog Inputs
    - Analog Outputs
    - Digital I/O
  - Actions
    - Compare Engines
    - Capture
    - SD Card
  - Customization
- Device Diagnostics
  - Faults and Warnings
  - Safe I/O
- Axis 1 (1)
  - Settings
    - Feedback
    - Motor
    - Thermal Protection
    - Brake
    - Units
    - Limits
    - Home
    - Current Loop
    - Enable/Disable

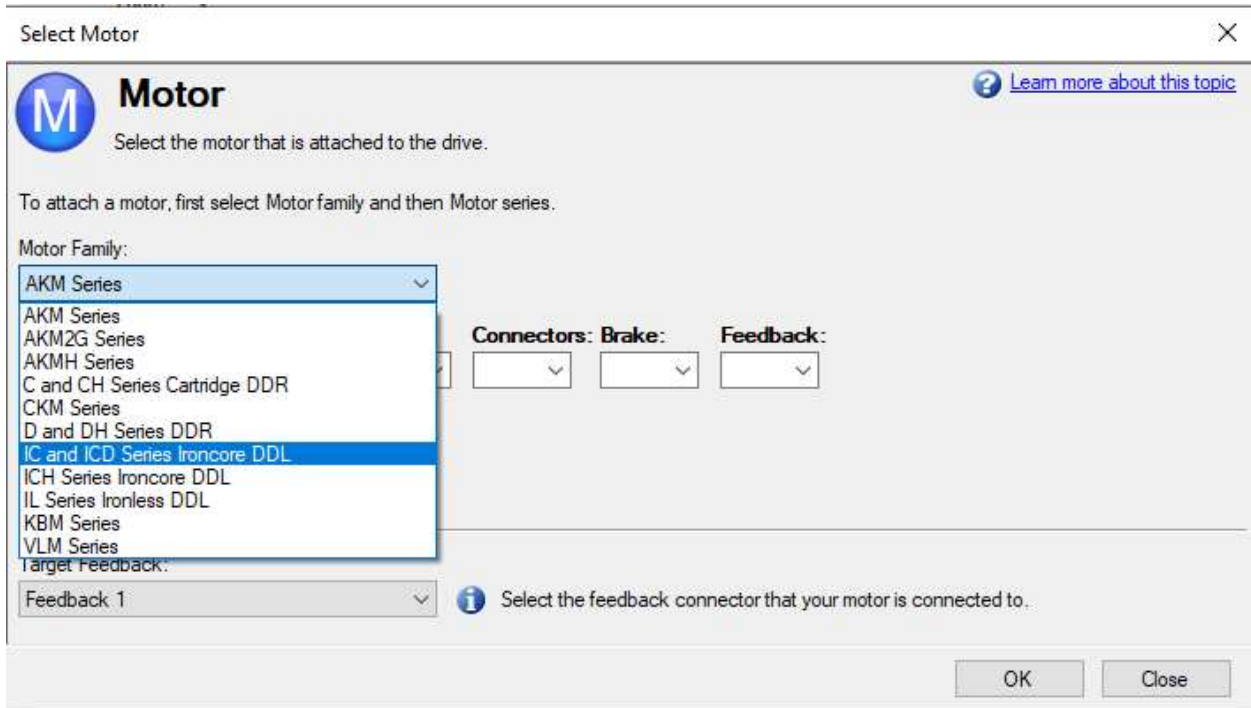
**M Motor**

These parameters describe the motor attached to this drive.

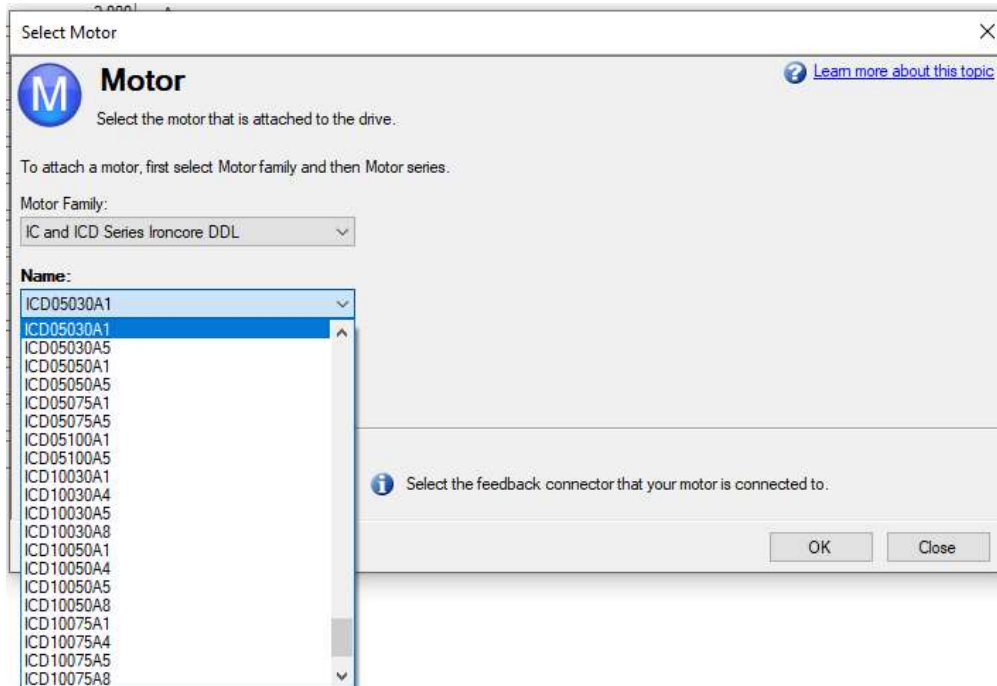
Motor Properties

Motor Name:	empty	Select Motor...
Motor Type:	0 - Rotary, Permanent M...	Create Motor...
Field Weakening:	0 - Disabled	More Information
Motor Autaset:	0 - Off	
Continuous Current:	1.000	Ams
Peak Current:	2.000	Ams
Coil Thermal Constant:	10.000	mHz
Inductance (quad, H):	4.000	mH
Inductance (direct, H):	4.000	mH
Inductance Saturation:	9.000.000	Ams
Motor Poles:	6	
Motor Phase:	0	deg
Inertia:	0.000	kg*cm <sup>2</sup>
Torque Constant:	0.000	Nm/Ams
EMF Constant:	20.000	Vms/k-rpm
Motor Resistance (H):	10.000	Ohm
Maximum Voltage:	480	Vms
Maximum Speed:	3.000	rpm

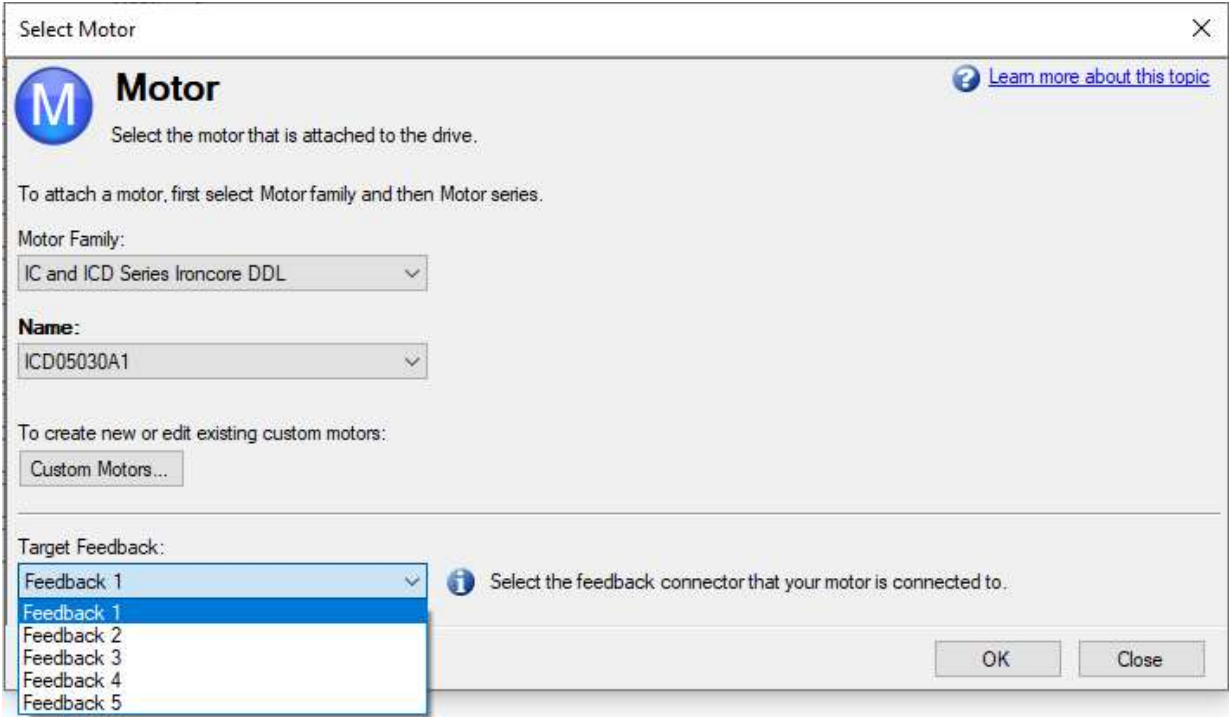
STEP 3: Change Motor Family to the correct motor type.  
In this example the blah blah is used.



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:



## Motor

These parameters describe the motor attached to this drive.

Motor Properties

Motor Name:	<input type="text" value="ICD05030A1"/>	<input type="button" value="Select Motor..."/>
Motor Type:	<input type="text" value="1 - Linear, Permanent Ma"/>	<input type="button" value="Create Motor..."/>
Motor Autoset:	<input type="text" value="0 - Off"/>	
Continuous Current:	<input type="text" value="2.100"/>	Ams
Peak Current:	<input type="text" value="7.900"/>	Ams
Coil Thermal Constant:	<input type="text" value="2.180"/>	mHz
Inductance (quad, H):	<input type="text" value="9.100"/>	mH
Inductance (direct, H):	<input type="text" value="9.100"/>	mH
Inductance Saturation:	<input type="text" value="9,000.000"/>	Ams
Motor Poles:	<input type="text" value="2"/>	
Motor Phase:	<input type="text" value="120"/>	deg
Mass:	<input type="text" value="0.620"/>	kg
Force Constant:	<input type="text" value="26.700"/>	N/Ams
EMF Constant:	<input type="text" value="21.800"/>	Vpeak/(m/s)
Motor Resistance (H):	<input type="text" value="3.200"/>	Ohm
Maximum Voltage:	<input type="text" value="230"/>	Vms
Maximum Speed:	<input type="text" value="8,000"/>	mm/s
Pole Pitch:	<input type="text" value="32.000"/>	mm

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 encoder 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	<code>AXIS#.MOTOR.PITCH</code> 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



### Terminal

A command line interface to the device. Type a command and press return.

```
-->AXIS1.MOTOR.PITCH
32.000 [mm]
-->
```



## 5. Select Motor Temperature Sensor

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

Kollmorgen WorkBench

File Edit View Tools Help

Panic | Disable & Clear Faults | Save To Device | Disconnect | Axis 1 (1) Enable | Stop | 0 - Service | 0 - Torque | Axis 2 (2) Enable | Stop | 0 - Service

Device Topology

Motion

Project

no-name (Online)

Add New Device... Add New Group...

no-name (Online)

- Scope
- Parameter Load/Save
- Terminal
- Device Settings
  - Hardware Configuration
  - Communication
  - Power
  - Regen
  - Feedback Devices
    - Encoder Emulation
    - Analog Inputs
    - Analog Outputs
    - Digital I/O
  - Actions
  - Compare Engines
  - Capture
  - SD Card
  - Customization
- Device Diagnostics
  - Axis 1 (1)
    - Settings
    - Feedback
      - Motor
        - Motor Temperature**
        - Wake and Shake
        - Thermal Protection
        - Brake
        - Units
        - Limits
        - Home
      - Current Loop
      - Enable/Disable

**Motor Temperature**

Monitor the motor temperature and configure faults/warnings.

Thermal Resistor Type: 0 - Single PTC Thermistor

Thermal Sensor Source: 0 - Direct Wired

Actual Thermistor Value: 4,294,967,295 Ohm

Fault Level: 1,300 Ohm

Warning Level: 0 Ohm

Temperature sensor connected via feedback cable.

0 means no fault

0 means no warning

Many motors have a thermistor embedded in their windings.

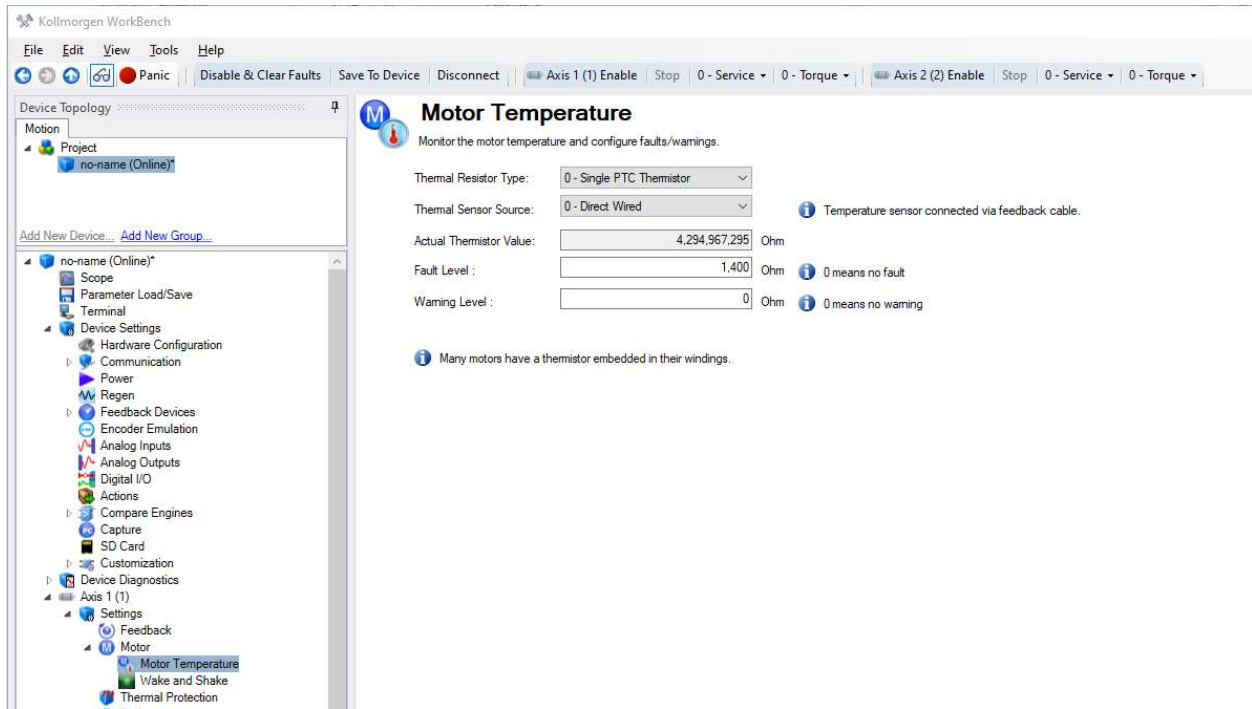
Expand Motor in the tree and click on "Motor Temperature"



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.

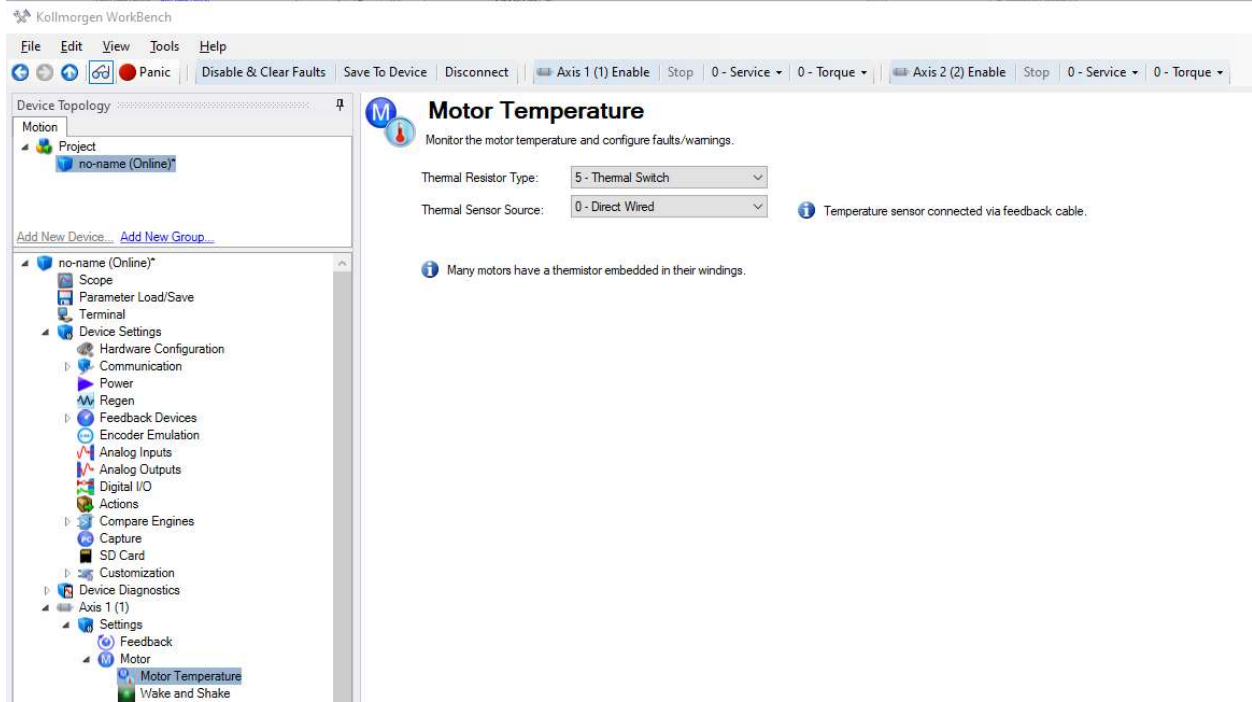
1. Thermostat Option type “TR”: PTC thermistor sensor

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. Thermostat Option type “TS”: Thermal switch

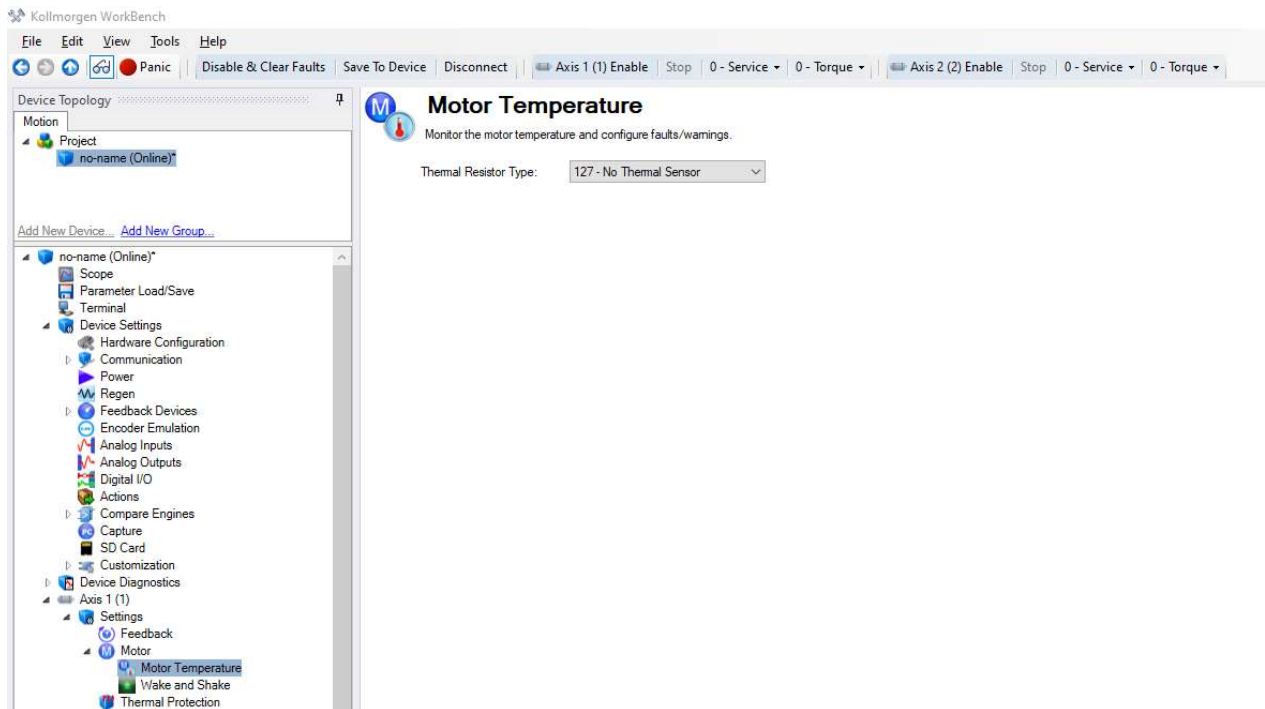
Kollmorgen DDL linear motors use a thermal switch if the Thermostat Option selected is TS Thermostat (MOTOR.RTYPE = 5, “Thermal Switch”)



### 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.

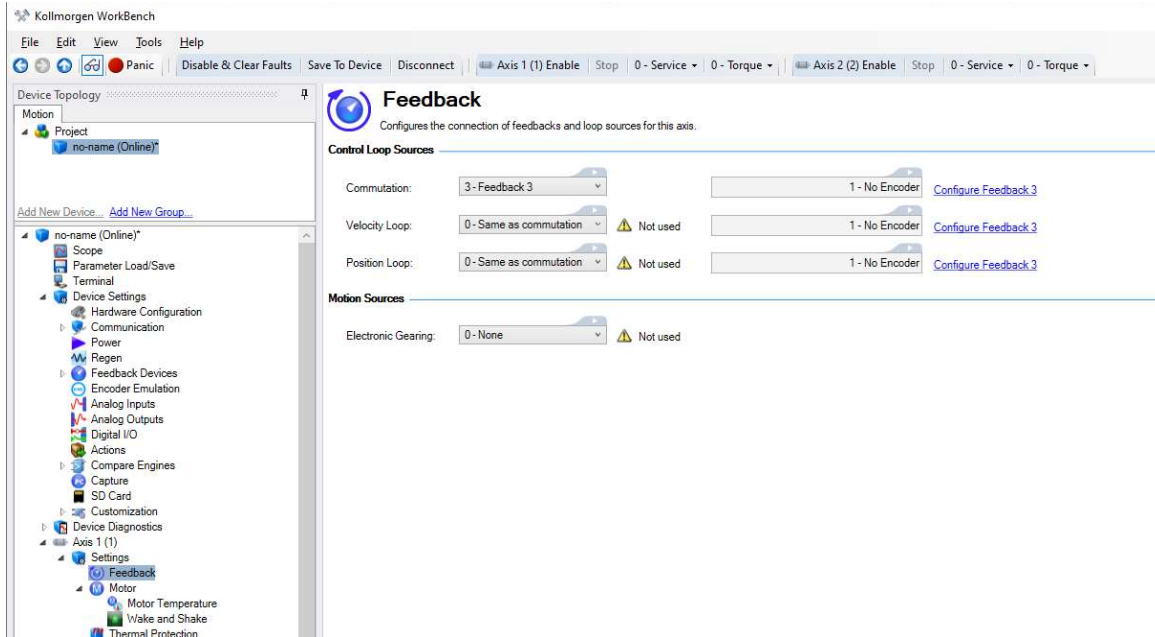
Note our demo setup used option 127-No Thermal Sensor



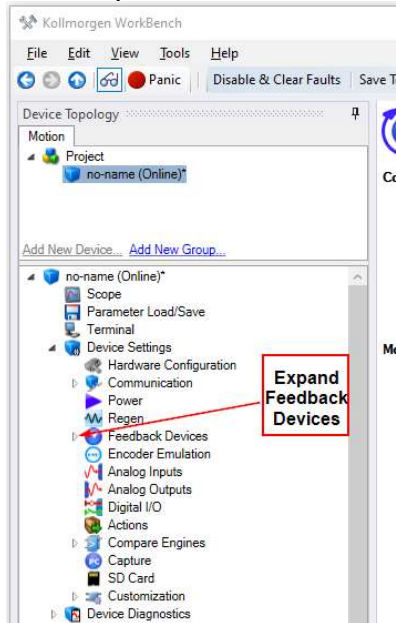
## 6. Select Feedback Type

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.

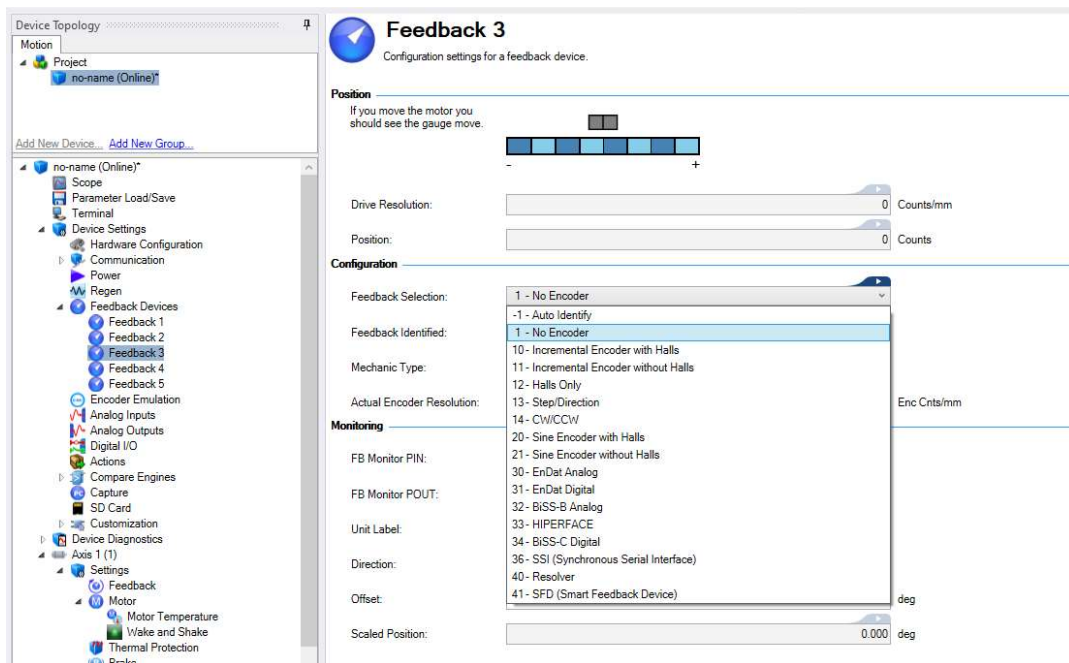
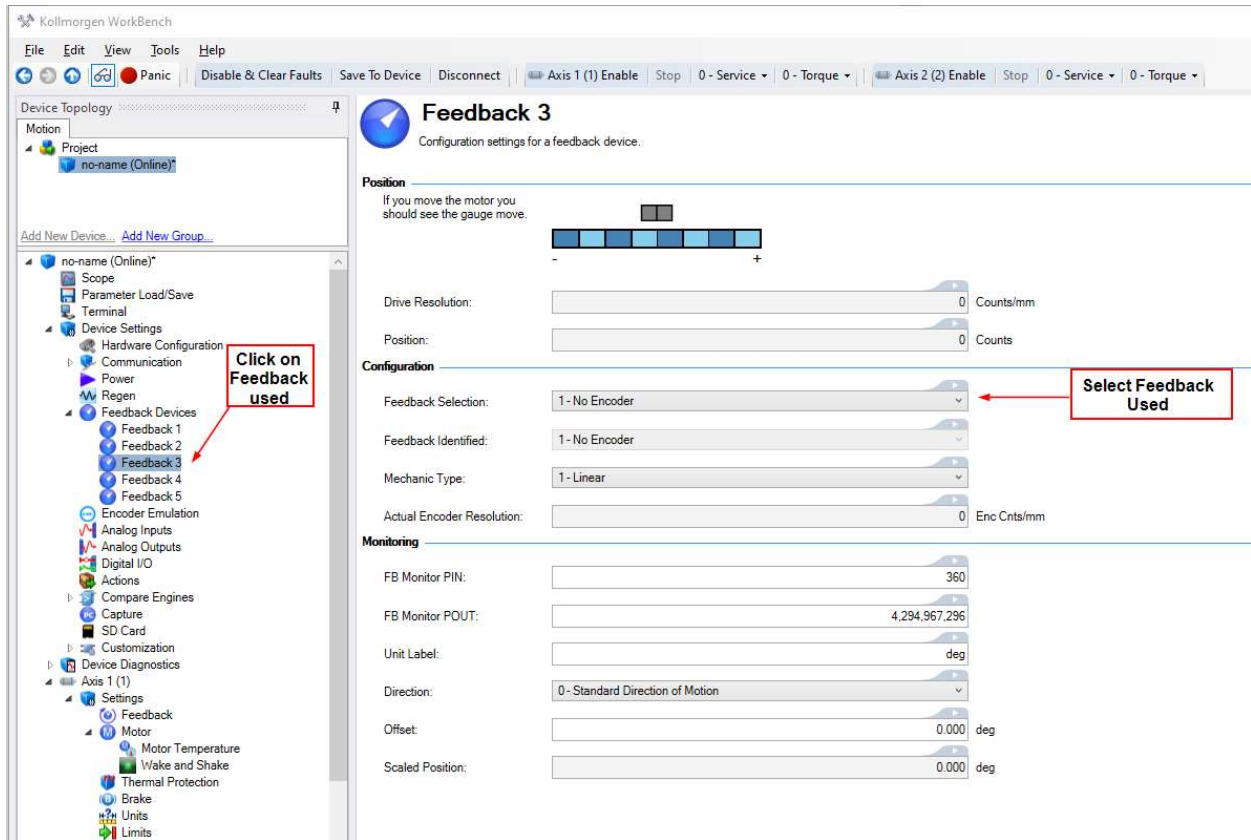


Next expand Feedback Devices under Device Settings->Feedback Devices



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.

The screenshot displays the 'Feedback 3' configuration window. On the left, the 'Device Topology' tree shows a project named 'no-name (Online)' with various sub-items including 'Feedback Devices' (Feedback 1-5), 'Encoder Emulation', 'Analog Inputs', 'Analog Outputs', 'Digital I/O', 'Actions', 'Compare Engines', 'Capture', 'SD Card', 'Customization', 'Device Diagnostics', 'Axis 1 (1)', 'Settings', 'Feedback', 'Motor', 'Motor Temperature', 'Wake and Shake', 'Thermal Protection', 'Brake', 'Units', 'Limits', and 'Home'.

The main configuration area is titled 'Feedback 3' and includes a 'Position' section with a gauge and a 'Halls' diagram. The 'Configuration' section contains the following settings:

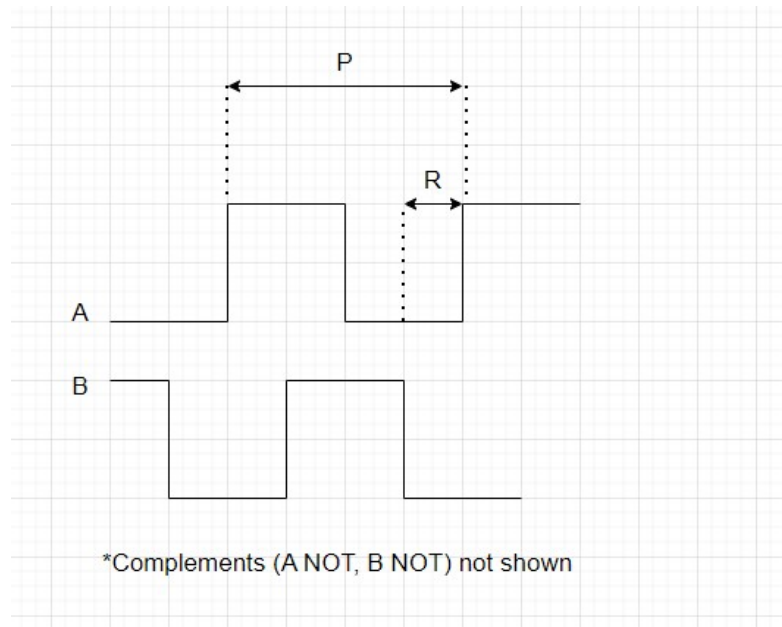
Parameter	Value	Unit
Drive Resolution	134,217,728	Counts/mm
Position	671,089	Counts
Feedback Selection	10 - Incremental Encoder with Halls	
Feedback Identified	10 - Incremental Encoder with Halls	
Mechanic Type	1 - Linear	
Encoder Pitch	20,000,000	nm/line
Actual Encoder Resolution	200	Enc Cnts/mm

The 'Encoder Pitch' field is highlighted with a red box. The 'Monitoring' section contains the following settings:

Parameter	Value	Unit
FB Monitor PIN	360	
FB Monitor POUT	4,294,967,296	
Unit Label	deg	
Direction	0 - Standard Direction of Motion	
Offset	0.000	deg
Scaled Position	0.056	deg

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 micron readhead	4	1	
5 micron readhead	20	5	
0.1 micron readhead	0.4	0.1	

$$\text{Encoder Resolution } (R) = R \text{ um}$$

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

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

$$\text{Actual Encoder Resolution } \left( \frac{\text{counts}}{\text{mm}} \right)$$

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

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)  $\frac{um}{line} = 1(um) * 4 = 4 um/line$

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

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

<b>Encoder Equivalent Resolution µm (1 count)</b>	<b>Encoder Pitch nm/line ( nm/period)</b>	<b>Actual Encoder Resolution Counts/mm (Read-only)</b>
50	20000	20
40	16000	25
25	10000	40
20	8000	50
10	4000	100
5	2000	200
2.5	1000	400
2	800	500
1	400	1000
0.5	200	2000
0.4	160	2500
0.2	80	5000
0.1	40	10000
0.05	20	20000
0.02	8	50000
0.01	4	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

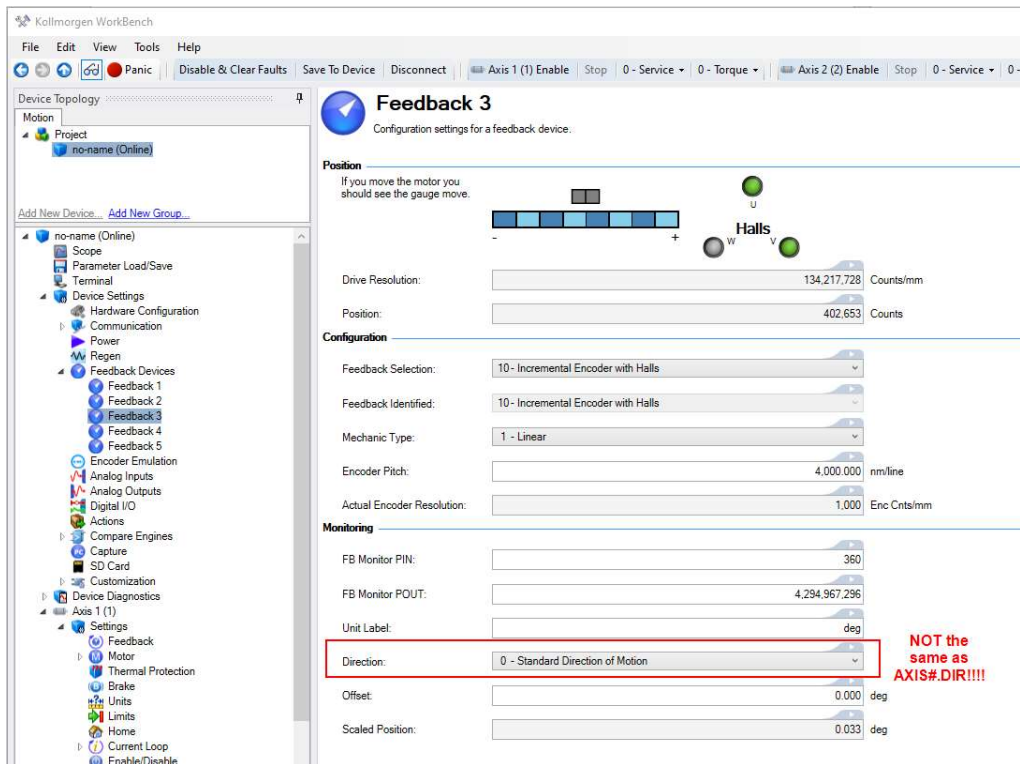
The screenshot shows the 'Feedback 3' configuration window. The 'Encoder Pitch' field is set to 4,000,000 nm/line. The 'Actual Encoder Resolution' field is set to 1,000 Enc Cnts/mm. The 'Mechanic Type' is set to 'T - Linear'. The 'Feedback Selection' and 'Feedback Identified' are both set to '10 - Incremental Encoder with Halls'. The 'Monitoring' section includes fields for 'FB Monitor PIV', 'FB Monitor POUT', 'Unit Label', 'Direction', 'Offset', and 'Scaled Position'.

## 8. Test Encoder Direction and Resolution

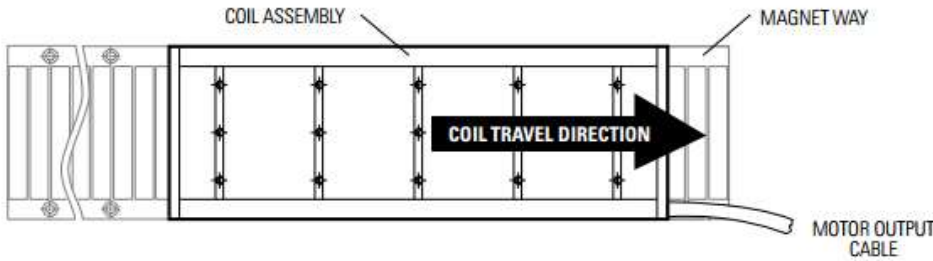
The direction of the encoder, the motor phase sequence, and hall sequence all need to match exactly. The hall phasing also needs to match the motor phasing exactly. This is very difficult to do by trial and error. **Axis Direction has to be set to zero** (“**AXIS1.DIR=0**” or “**AXIS2.DIR=0**”)



**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 ).

Parameter	Value	Units
Drive Resolution:	134,217,728	Counts/mm
Position:	-2,496,449,741	Counts
Feedback Selection:	10 - Incremental Encoder with Halls	
Feedback Identified:	10 - Incremental Encoder with Halls	
Mechanic Type:	1 - Linear	
Encoder Pitch:	4,000,000	nm/line
Actual Encoder Resolution:	1,000	Enc Cnts/mm
FB Monitor PIN:	360	
FB Monitor POUT:	4,294,967,296	
Unit Label:	deg	
Direction:	0 - Standard Direction of Motion	
Offset:	0.000	deg
Scaled Position:	-209.250	deg

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. 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.

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

STEP 2: Change the User Units to “mm”, “mm/s”, and “mm/s<sup>2</sup>”

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.

Kollmorgen WorkBench

File Edit View Tools Help

Axis 1 (1) Enable Stop 0 - Service 0 - Torque Axis 2 (2) Enable Stop 0 - Service 0 - Torque

Device Topology

Project

no-name (Online)

Add New Device... Add New Group...

no-name (Online)

Scope

Parameter Load/Save

Terminal

Device Settings

Hardware Configuration

Communication

Power

Regen

Feedback Devices

Feedback 1

Feedback 2

Feedback 3

Feedback 4

Feedback 5

Encoder Emulation

Analog Inputs

Analog Outputs

Digital I/O

Actions

Compare Engines

Capture

SD Card

Customization

Device Diagnostics

Axis 1 (1)

Settings

Feedback

Motor

Thermal Protection

Brake

Units

Limits

Home

Current Loop

Enable/Disable

**Click on Units**

**Units**

You can select the units used for positions, velocities and accelerations.

Select Type of Mechanics: Motor Only

Pole-Pair Pitch: 32.000 mm

Position Unit: 1 - mm

Velocity Unit: 1 - mm/s

Acceleration Unit: 1 - mm/s<sup>2</sup>

Modbus Unit: Goto Modbus

Less <<

Position: 0.000 mm

**Set all 3 Units as mm, mm/s, and mm/s<sup>2</sup> respectively**

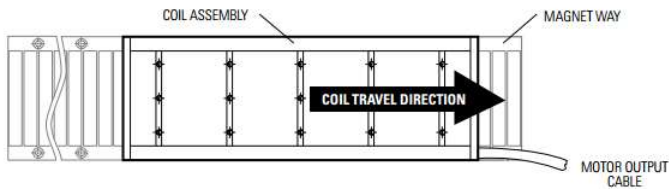
**Move the motor from one line to the other and see if the position counter changes the correct amount in the correct direction**

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.

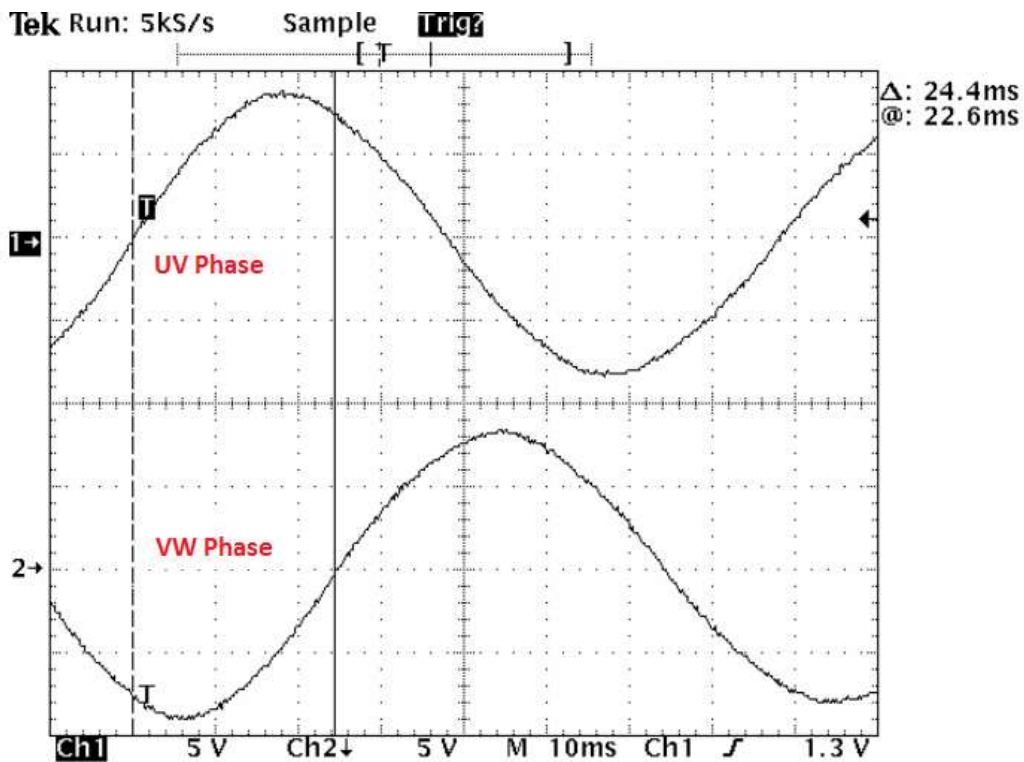
## 10. Check Motor Phasing of Any Servo Motor

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.

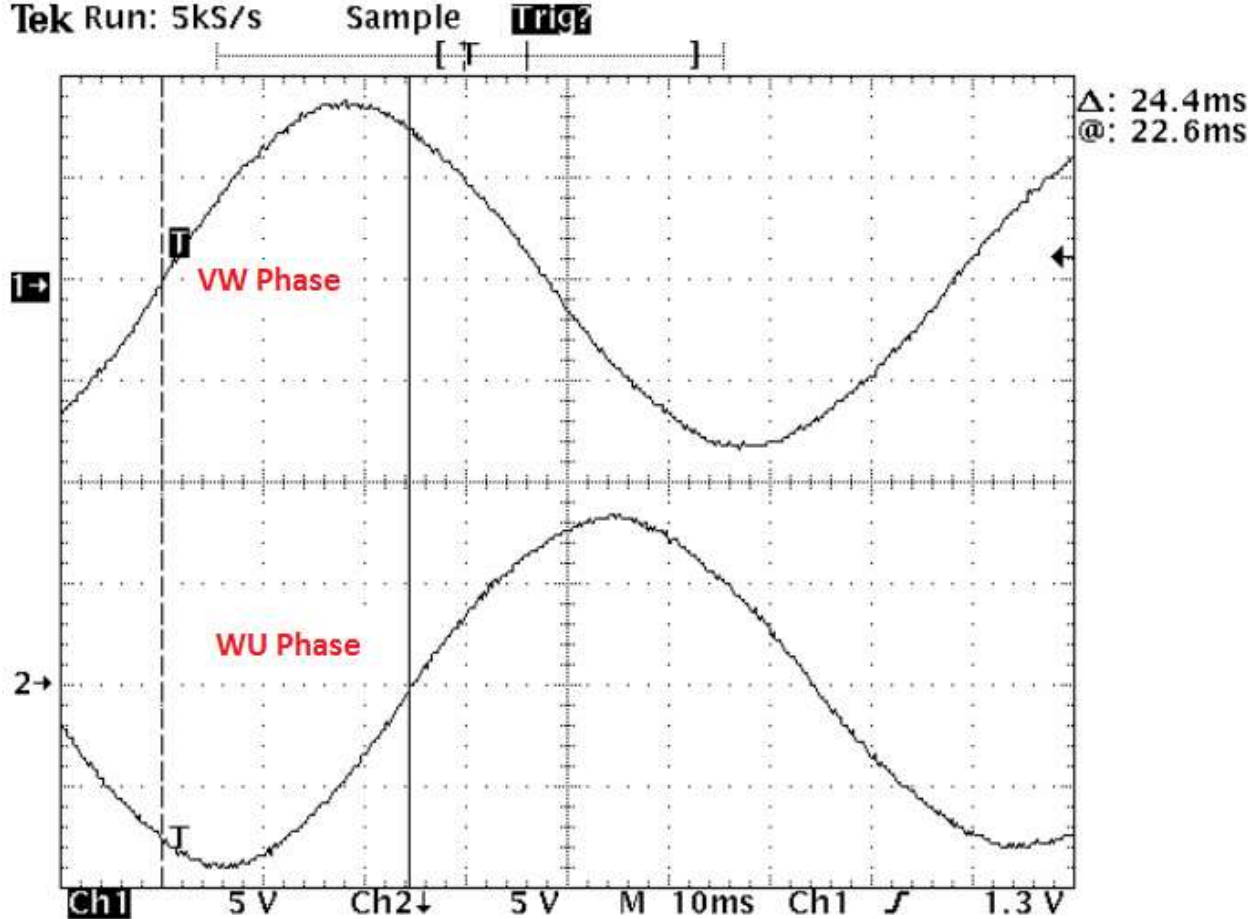


When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by  $120^\circ$  of the V phase (V phase with reference to W phase).





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 checked 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

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

What does this mean?



## 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

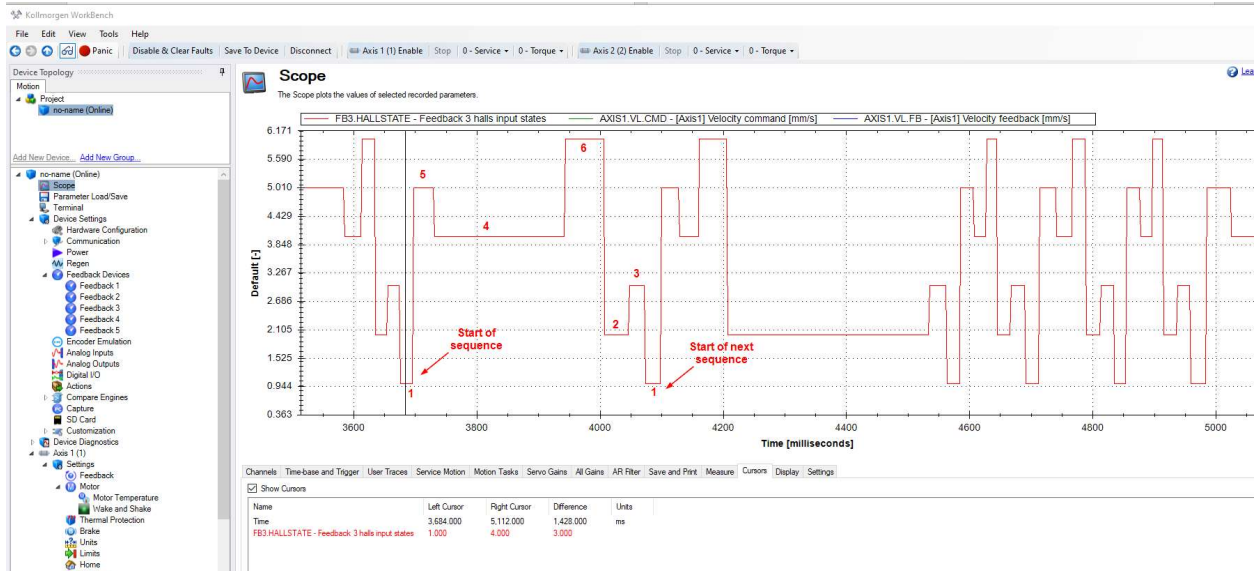
Action	Version	Notes
Implemented	02-10-00-000	

### 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

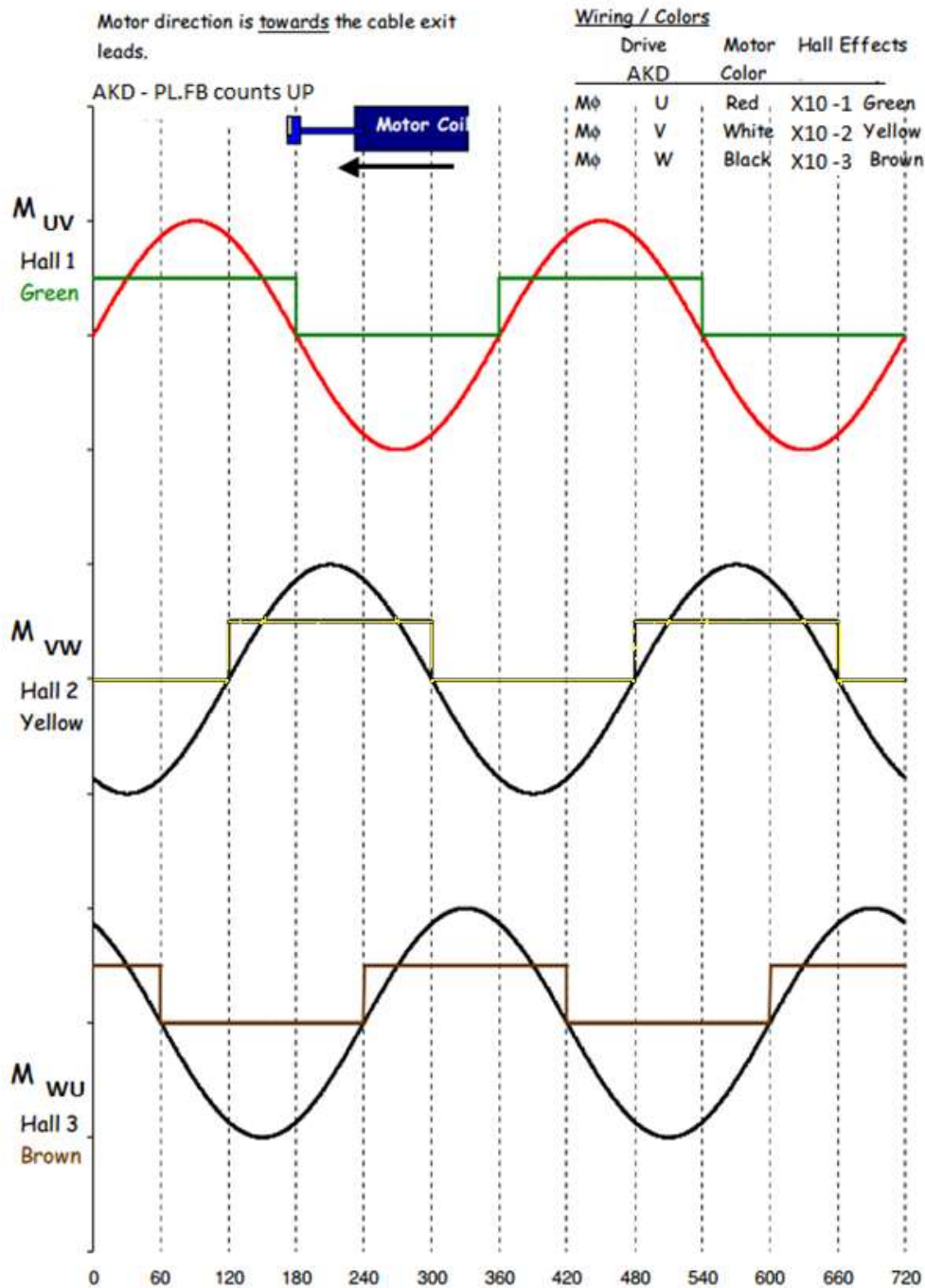


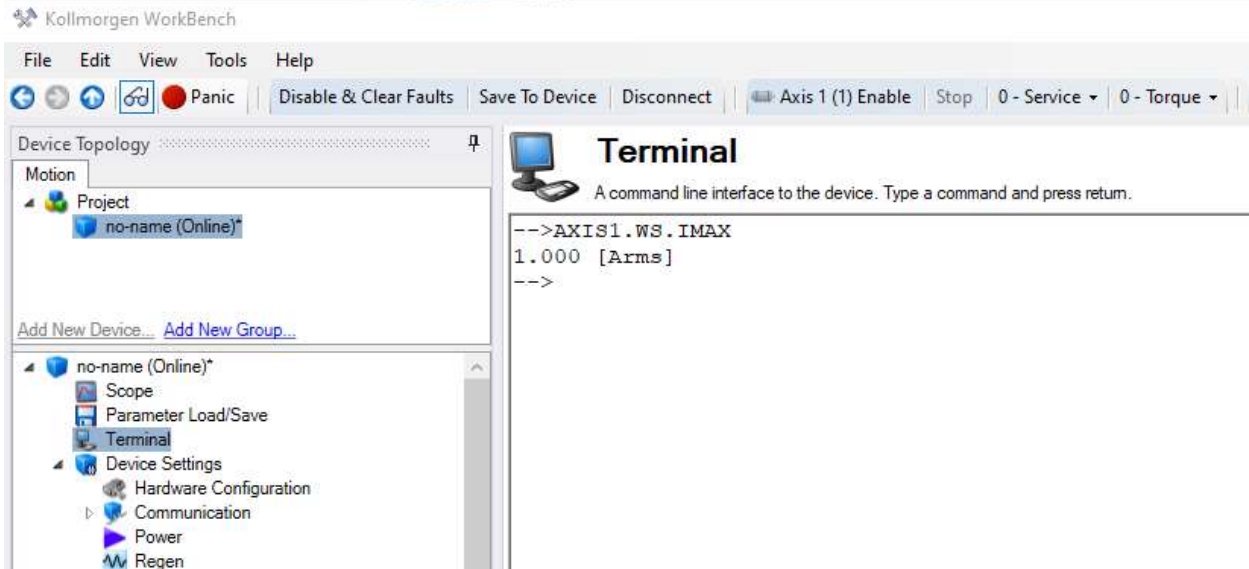
Figure 2

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 alignment and motor phasing match exactly as shown in Figure 2.

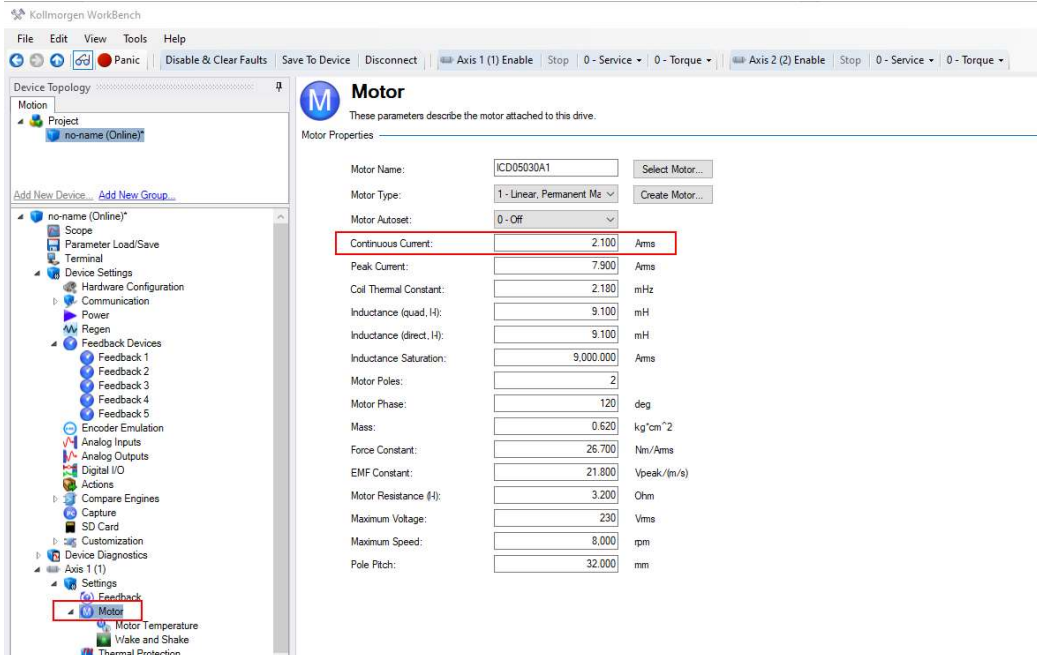
### 13. How to Verify the Motor's Commutation Alignment Angle (MOTOR.PHASE)

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.

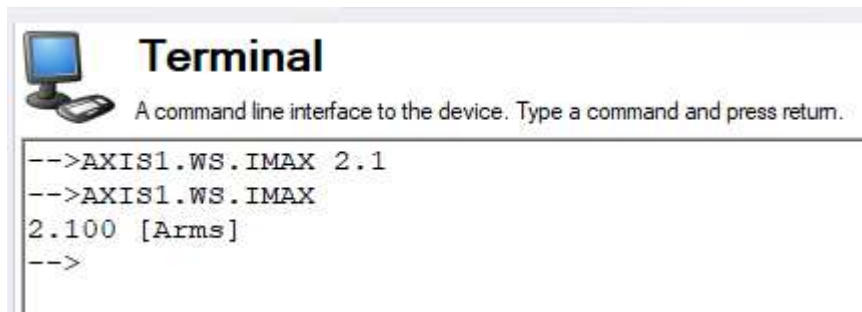
The keyword is AXIS#.WS.IMAX where # is 1 or 2 for the axis number.



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

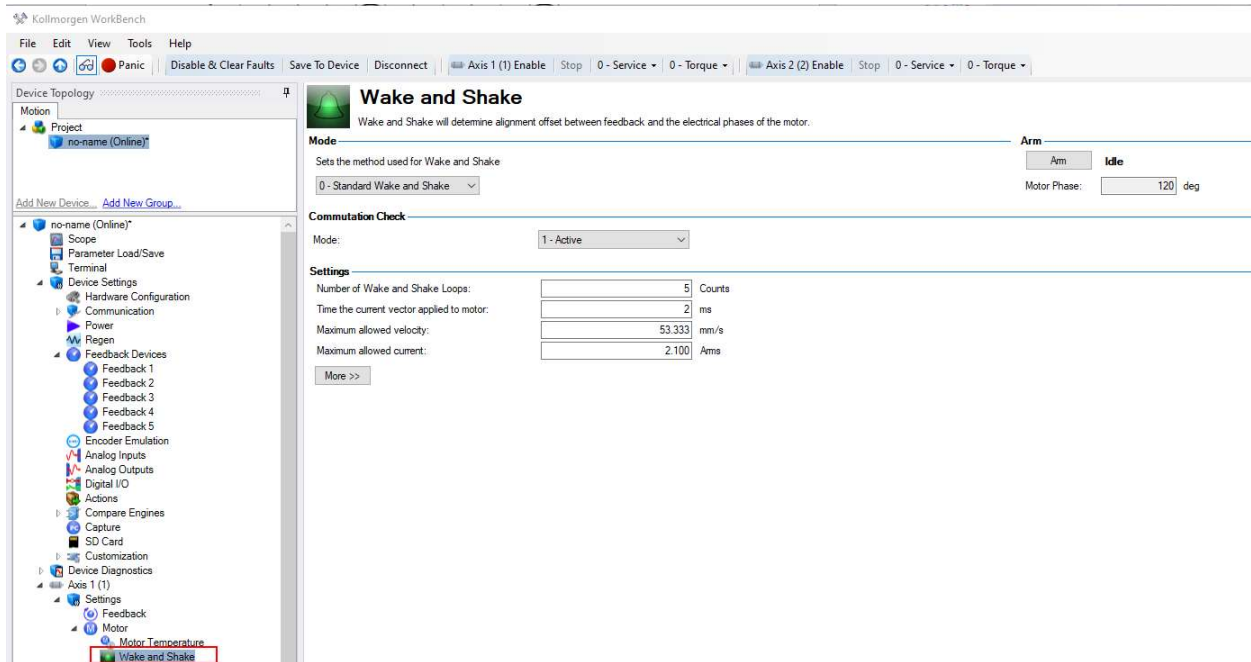


Returning to the Terminal set the AXIS#.WS.IMAX to the continuous current rating from the Motor screen.

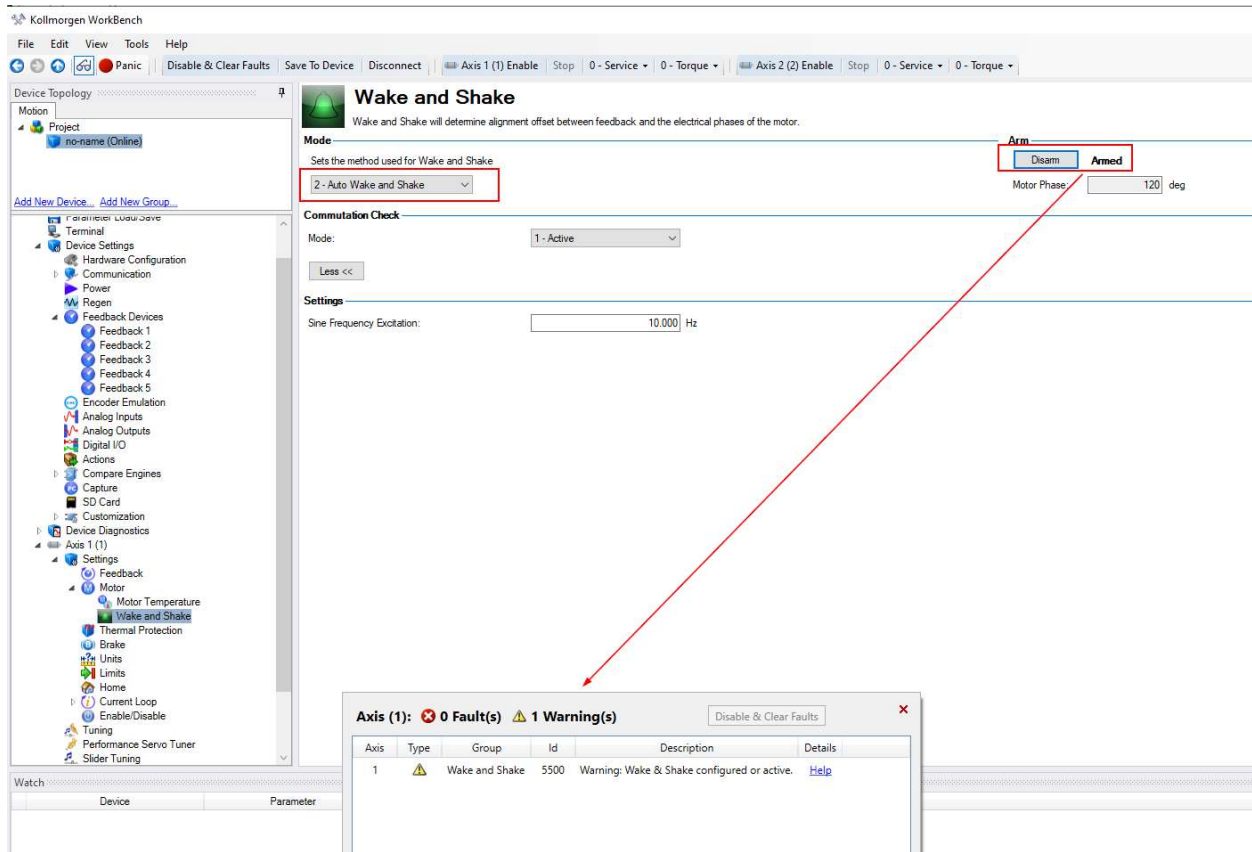


STEP 2: Setup the Wake and Shake Routine.

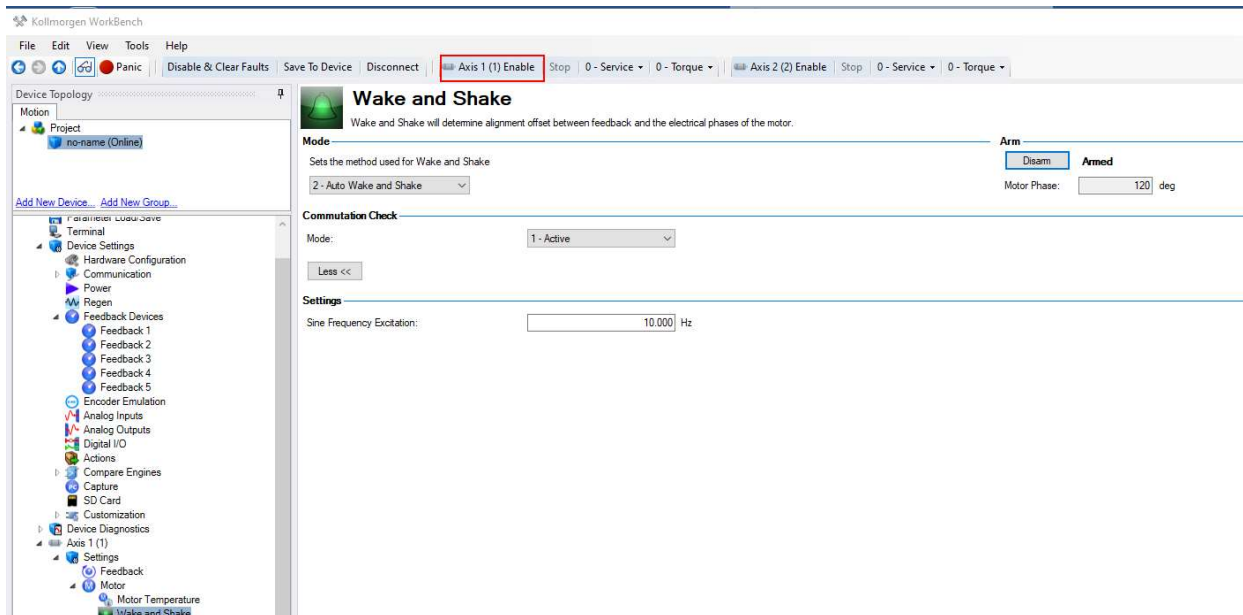
Navigate to the Wake and Shake screen under the Axis#->Settings->Motor->Wake and Shake.



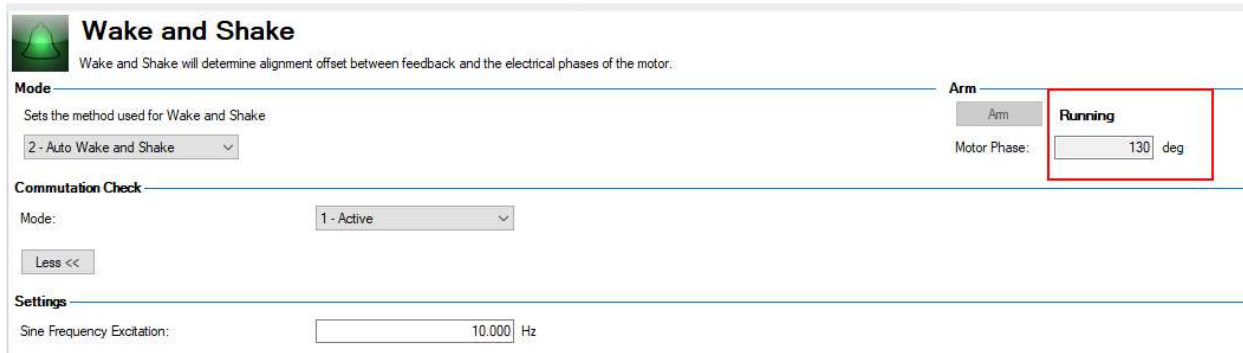
Change the Wake and Shake mode to 2-Auto Wake and Shake and click on the “Arm” button to arm the Wake and Shake routine. The status to the right of the Arm button should change from Idle to Armed. Note you cannot arm the W&S if the axis is already enabled ( disable prior to arming ). Also note a warning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



Start the W&S Routing by enabling the Axis.

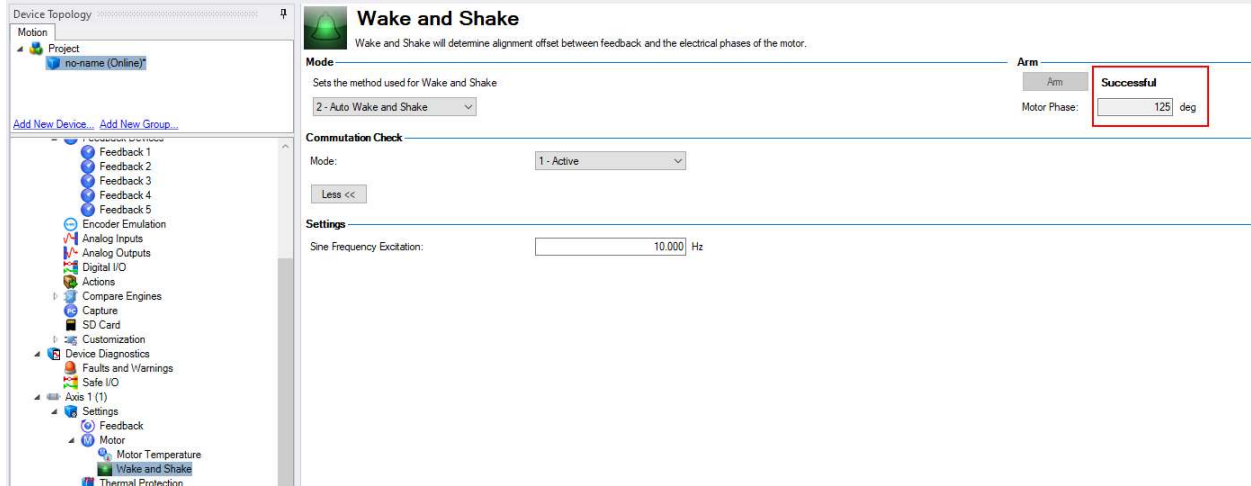


The status to the right of the Arm button should change to “Running” while the W&S is executing. Monitor the Motor Phase read-only on the W&S screen while the W&S runs. This indicates the W&S algorithm is searching for the correct commutation angle in deg.



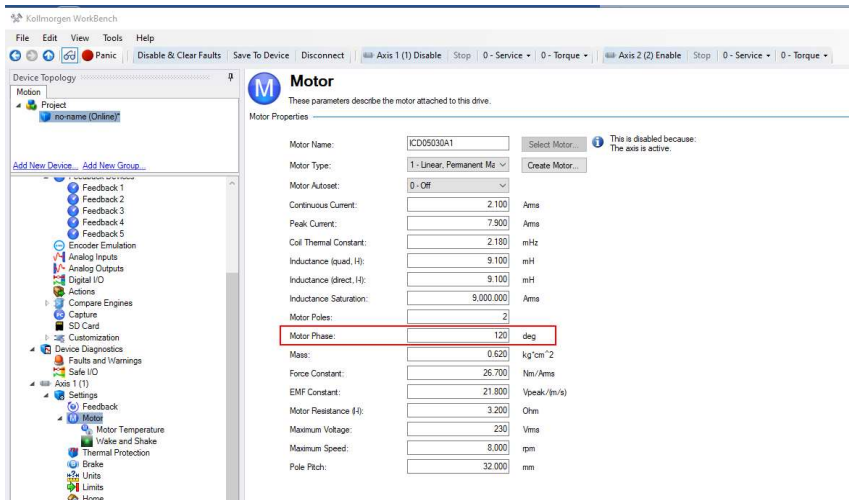
The W&S will either finish and indicate “Successful” if it was able to determine the Motor Phase or “Error” if the W&S algorithm failed.

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.

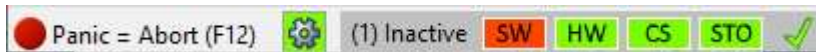


## 14. Verify the Motor is Setup Correctly by Jogging it in Both Directions



**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.**

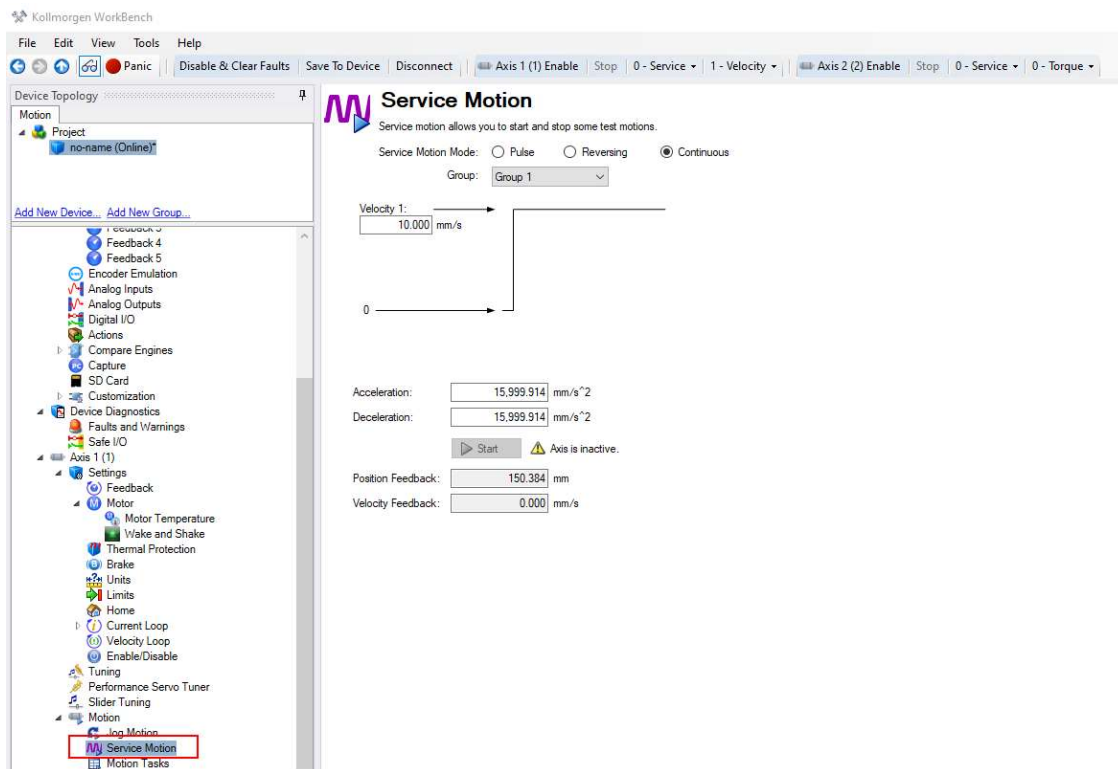
STEP 1: Start with the Axis disabled.



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

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

Velocity 1: 10.000 mm/s

0

Time 1: 500 ms

Acceleration: 15,999.914 mm/s<sup>2</sup>

Deceleration: 15,999.914 mm/s<sup>2</sup>

▶ Start ⚠ Axis is inactive.

Position Feedback: 150.384 mm

Velocity Feedback: 0.000 mm/s

The screenshot shows a control interface for 'Service Motion'. At the top, there's a title and a brief description. Below that, three radio buttons allow selecting a mode: 'Pulse' (selected), 'Reversing', and 'Continuous'. A dropdown menu shows 'Group 1'. A velocity profile graph shows a pulse starting at 0, rising to 10.000 mm/s, staying constant for 500 ms, and then falling back to 0. Below the graph, numerical fields for acceleration and deceleration are both set to 15,999.914 mm/s<sup>2</sup>. A 'Start' button is disabled with a warning 'Axis is inactive'. At the bottom, position feedback is 150.384 mm and velocity feedback is 0.000 mm/s.

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

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

Velocity 1: 10.000 mm/s

0

Time 1: 500 ms

Acceleration: 15,999.914 mm/s<sup>2</sup>

Deceleration: 15,999.914 mm/s<sup>2</sup>

▶ Start ⚠ Axis is inactive.

Position Feedback: 150.384 mm

Velocity Feedback: 0.000 mm/s

This screenshot is identical to the previous one, but the 'Velocity 1: 10.000 mm/s' input field is highlighted with a red rectangular box to emphasize the value entered.

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.

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

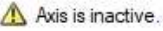
Velocity 1: 10.000 mm/s

0

Time 1: 1,000 ms

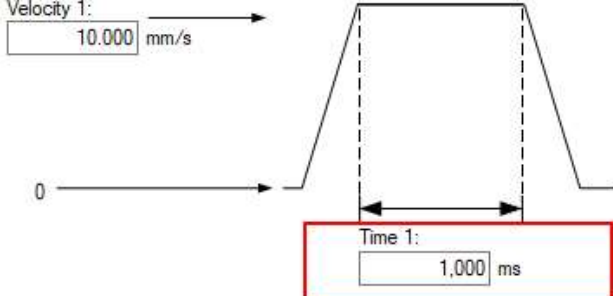
Acceleration: 15,999.914 mm/s<sup>2</sup>

Deceleration: 15,999.914 mm/s<sup>2</sup>

Start 

Position Feedback: 150.384 mm

Velocity Feedback: 0.000 mm/s



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

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

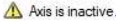
Velocity 1: 10.000 mm/s

0

Time 1: 1,000 ms

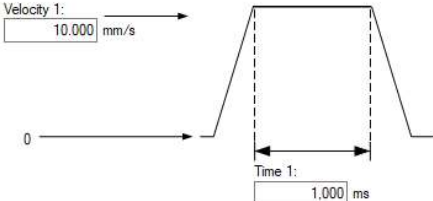
Acceleration: 15,999.914 mm/s<sup>2</sup>

Deceleration: 15,999.914 mm/s<sup>2</sup>

Start 

Position Feedback: 150.384 mm

Velocity Feedback: 0.000 mm/s



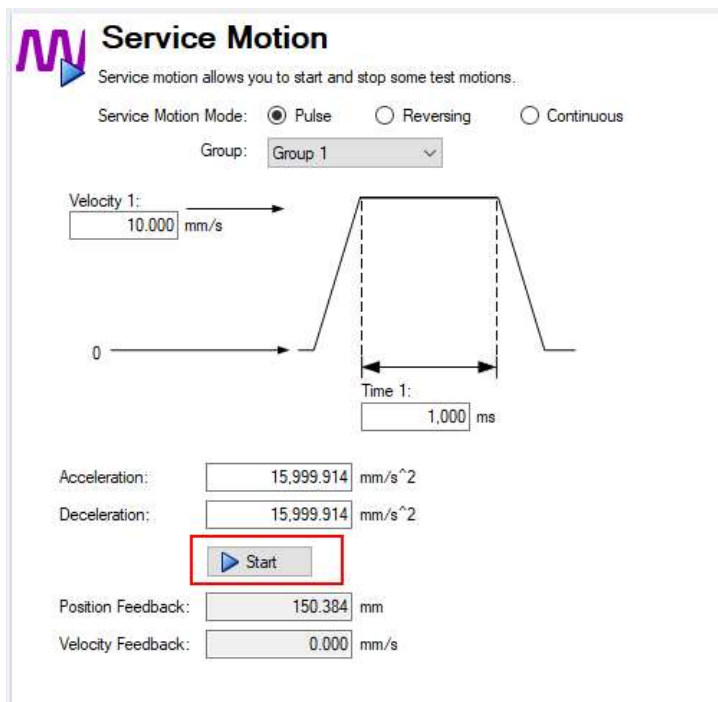
## STEP 10: Enable the Axis.



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.

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

Velocity 1:  mm/s

Time 1:  ms

Acceleration:  mm/s<sup>2</sup>

Deceleration:  mm/s<sup>2</sup>

Position Feedback:  mm

Velocity Feedback:  mm/s

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.

**Service Motion**  
Service motion allows you to start and stop some test motions.

Service Motion Mode:  Pulse  Reversing  Continuous

Group: Group 1

Velocity 1:  mm/s

Acceleration:  mm/s<sup>2</sup>

Deceleration:  mm/s<sup>2</sup>

Position Feedback:  mm

Velocity Feedback:  mm/s

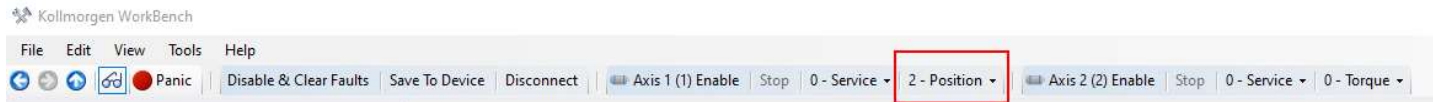
## 15. Home Axis and Use Motion Tasking to Extend and Retract

STEP 1: Disable the axis.

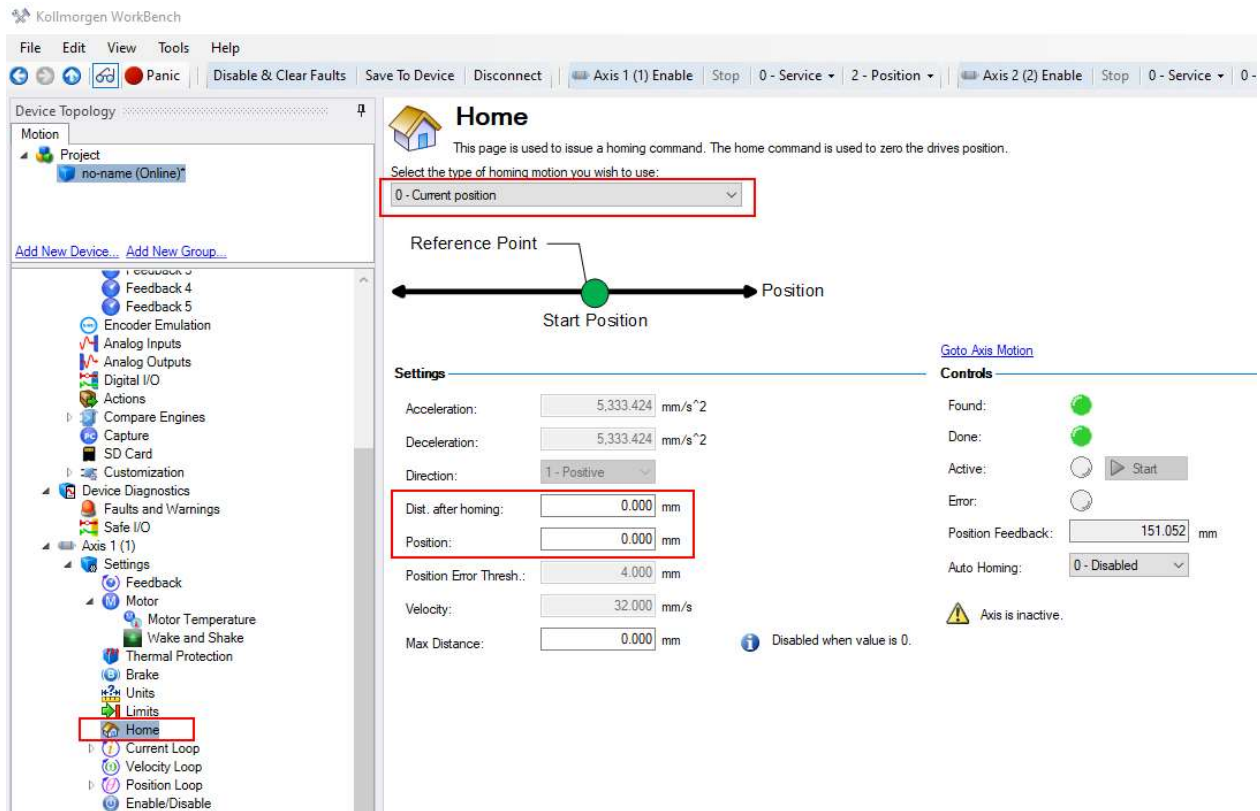


STEP 2: Safely move the motor to the desired home position.

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.

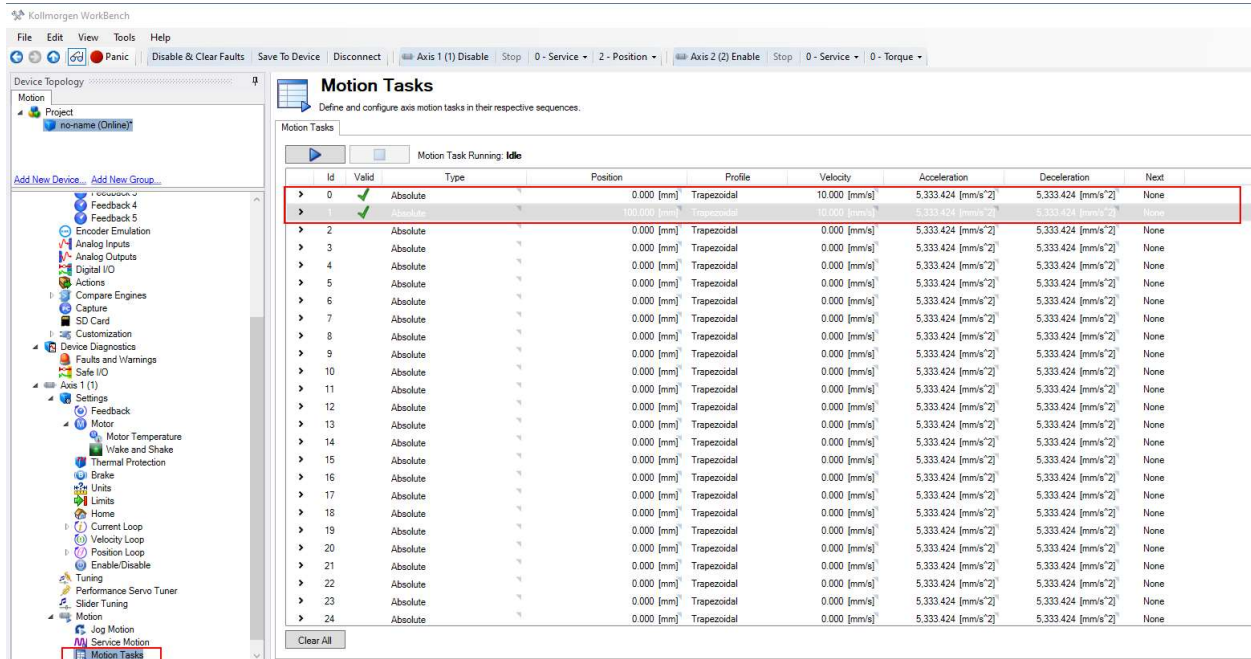


Enable the axis and press the Start button on the Home screen. Note the Position Feedback read-only on the Home screen should read 0.000 mm after homing.

The screenshot shows the Kollmorgen WorkBench software interface. The main window is titled "Home" and contains the following elements:

- Toolbar:** Includes buttons for "Panic", "Disable & Clear Faults", "Save To Device", "Disconnect", "Axis 1 (1) Disable", "Stop", "0 - Service", "2 - Position", "Axis 2 (2) Enable", "Stop", "0 - Service", and "0 - Tor".
- Device Topology:** A tree view on the left showing the project structure, including "Motion", "Project", "no-name (Online)", and various hardware components like "Feedback 4", "Encoder Emulation", "Analog Inputs", "Analog Outputs", "Digital I/O", "Actions", "Compare Engines", "Capture", "SD Card", "Customization", "Device Diagnostics", "Faults and Warnings", "Safe I/O", "Axis 1 (1)", "Settings", "Feedback", "Motor", "Motor Temperature", "Wake and Shake", "Thermal Protection", "Brake", "Units", "Limits", "Home", "Current Loop", "Velocity Loop", "Position Loop", and "Enable/Disable".
- Home Screen:**
  - Header:** "Home" with a house icon and the text: "This page is used to issue a homing command. The home command is used to zero the drives position." Below this is a dropdown menu set to "0 - Current position".
  - Diagram:** A horizontal axis labeled "Position" with a green dot at the "Start Position" and a line pointing to the left labeled "Reference Point".
  - Settings:** A list of parameters for homing:
    - Acceleration: 5,333.424 mm/s<sup>2</sup>
    - Deceleration: 5,333.424 mm/s<sup>2</sup>
    - Direction: 1 - Positive
    - Dist. after homing: 0.000 mm
    - Position: 0.000 mm
    - Position Error Thresh.: 4.000 mm
    - Velocity: 32.000 mm/s
    - Max Distance: 0.000 mm
  - Controls:** A section with status indicators and a "Start" button:
    - Found: Green dot
    - Done: Green dot
    - Active: Radio button selected, "Start" button highlighted with a red box.
    - Error: Radio button selected
    - Position Feedback: Input field showing "0.000 mm", highlighted with a red box.
    - Auto Homing: 0 - Disabled

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.

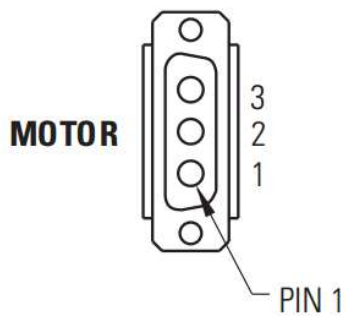


**The linear motor initial commissioning is now complete!**

## Appendix A

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

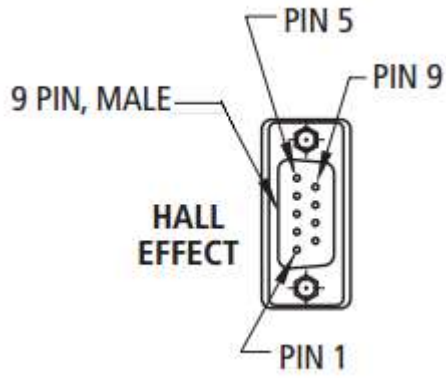
#### 1. DDL Motor Coil Connections



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”.

Kollmorgen WorkBench

File Edit View Tools Help

Enable Stop 0 - Service 0 - Torque Mode Disable & Clear Faults Save To Device Connect Panic

Device Topology

- Start Page
- no\_name (Offline)
  - Settings
    - Communication
    - Power
    - Regen
    - Motor
      - Motor Temperature
      - Feedback 1
      - Feedback 2
      - Foldback
      - Brake
      - Units
      - Modulo
      - Limits
      - Home
      - Current Loop
      - Service Motion
      - Encoder Emulation (X9 Cfg)
      - Analog Input
      - Analog Output

Units

You can select the units used for positions, velocities and accelerations.

Select Type of Mechanics: Motor Only

1: Click on "Units"

2: Setup all three Units as mm.

3: Click on the "More" button to show the position feedback counter

4: Move the motor from one line to the other and see if the position counter changes the correct amount in the correct direction

Pole-Pair Pitch: 32.000 mm

Position Unit: 1 - mm

Velocity Unit: 1 - mm/s

Acceleration Unit: 1 - mm/s<sup>2</sup>

Modbus Unit: [Goto Modbus](#)

Less <<

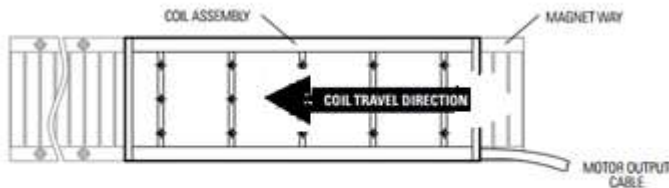
Position: 0.000 mm

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.

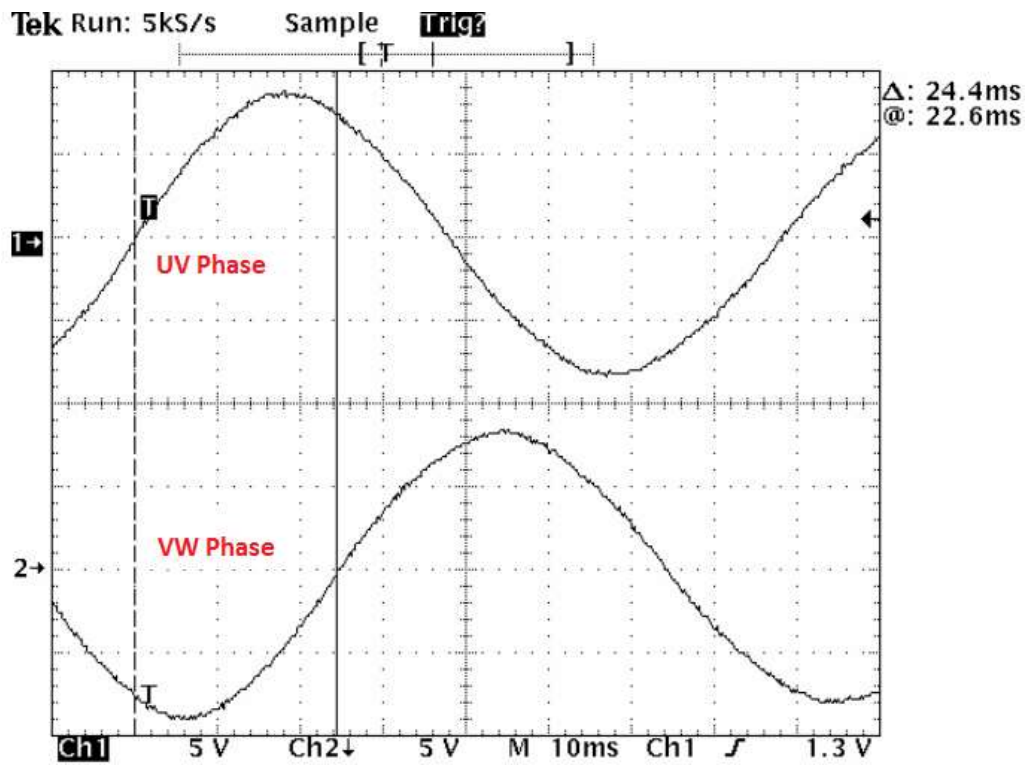
#### 4. Check Motor Phasing of Any Servo Motor

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.

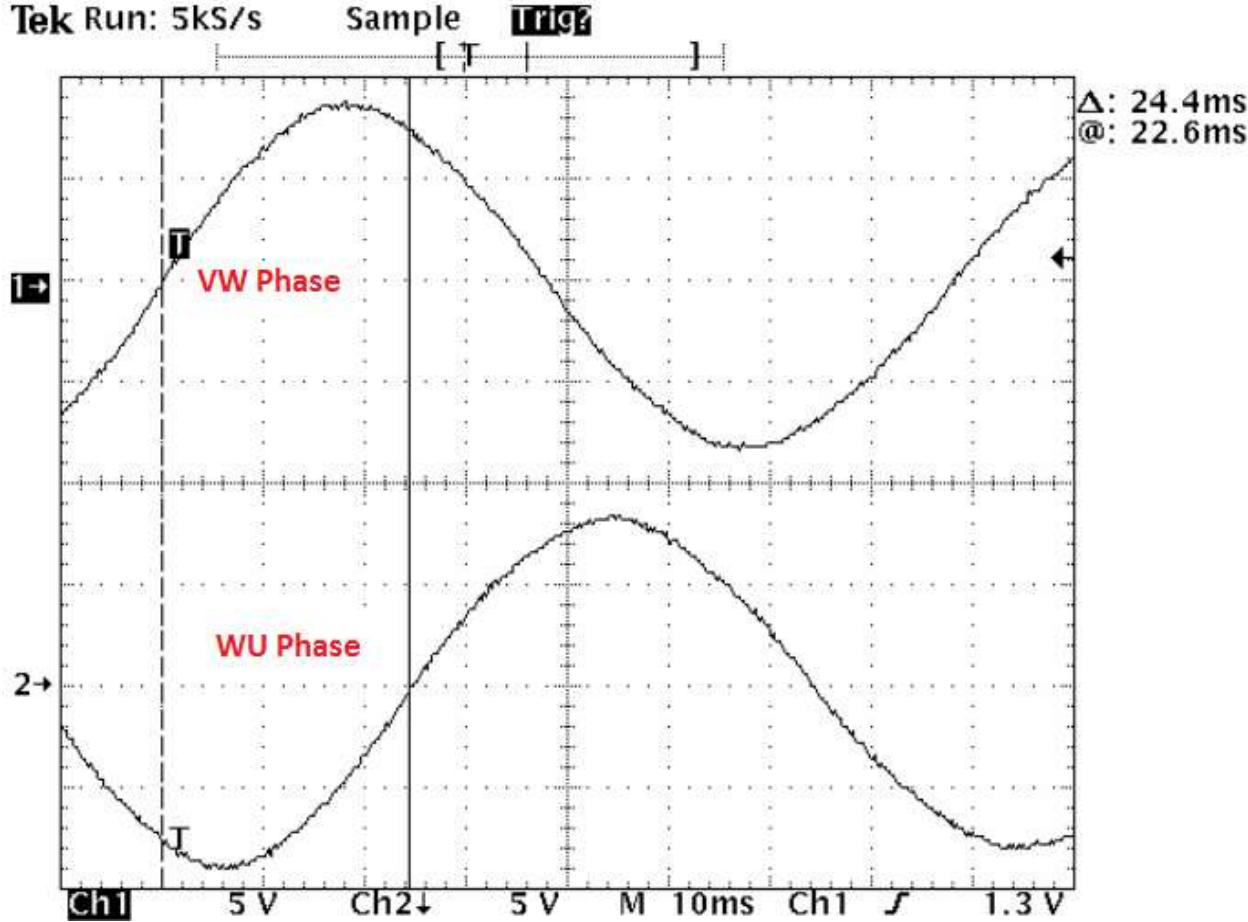
This part of the setup will require a two channel oscilloscope with isolated channels. Move the motor in the positive direction based on the motor manufactures specification. The AKD2G commutates a motor in the phase sequence of U V W in the positive direction.



When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by  $120^\circ$  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

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

What does this mean?

### 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.



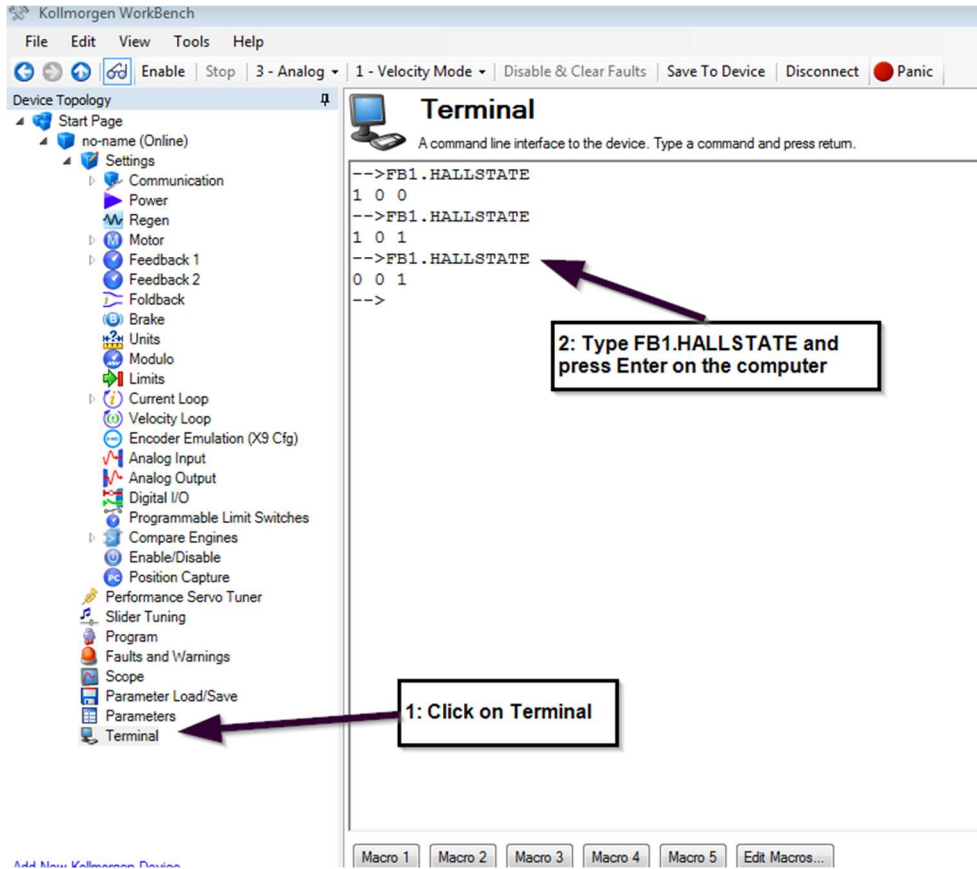
## Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

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.

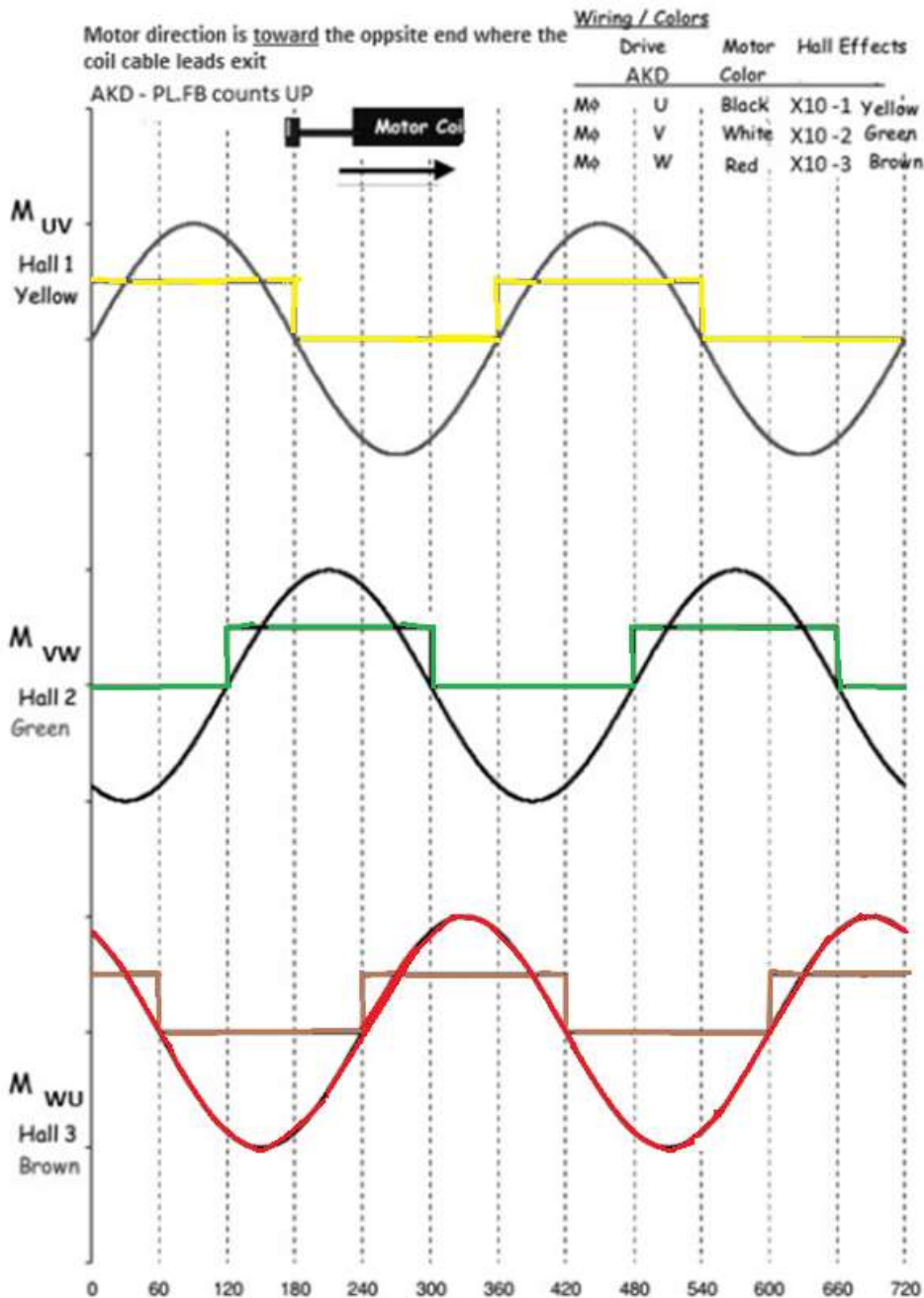
Step(CW)	FB#.HALLSTATE
1	1
2	5
3	4
4	6
5	2
6	3
1	1

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**

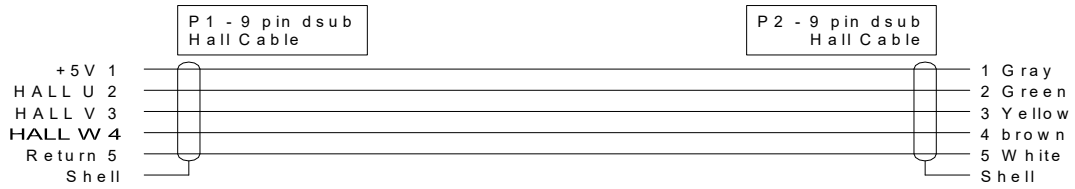
When using a Kollmorgen DDL motor, **MOTOR.PHASE = 120** when the feedback direction is positive toward the “Lead Exit End” of motor (that is, the end of the motor where the leads come out), and when the hall alignment and motor phasing match exactly as shown in Figure 3.

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

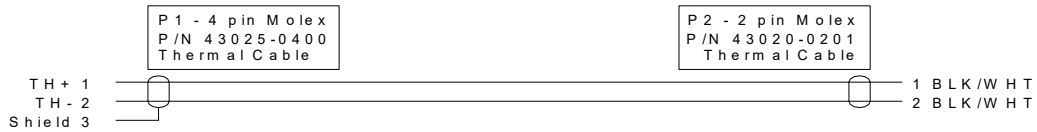


# Appendix B

## 1. Hall Effect Cable



## 2. Thermal Sensor Cable



## 3. Motor Power Cable

