

AKD System Configuration with Kollmorgen

KBM Frameless Motors

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Rev. B

This document shows the wiring requirements for connecting the KBM frameless motor and the feedback of your choice to the AKD servo drive. It also describes the setup procedure for configuring the AKD drive in the Workbench software.

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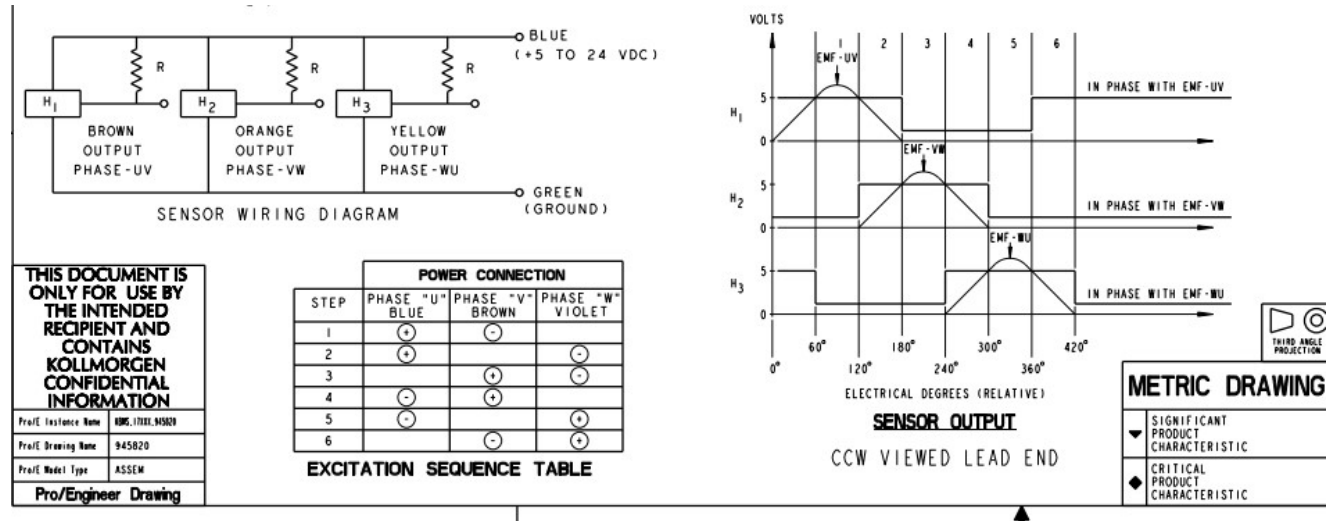
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CONVENTIONS

The preferred standard electrical connections between the AKD-drive to KBM(S) - frameless motor, unless specifically stated otherwise, are based upon a C.C.W. rotation of the rotor as viewed from the lead-exit end of the motor, for a positive count direction of the position-loop. In addition, to help clarify one motor phase or Hall feedback signal, to another, an underlined last letter is utilized under the point of electrical reference; hence, phase-UV, reads: phase-U, with respect to phase-V, leads V, by 120-degrees with a C.C.W. rotation of the rotor; or where a positive Hall-1 (H1) signal, also defined as Huv (drive-Hu for the defined convention), reads: hall signal: H1 (Huv) is positive, and in phase with motor's Bempf, phase-U, with respect to motor phase-V, with a C.C.W. rotation of the rotor.

This document shows color codes that are typical for the KBM(S) motors. Always check the outline drawing of your specific KBM(S) motor to verify the color coding of the motor power (for both KBM and KBMS motors and halls (KBMS)).

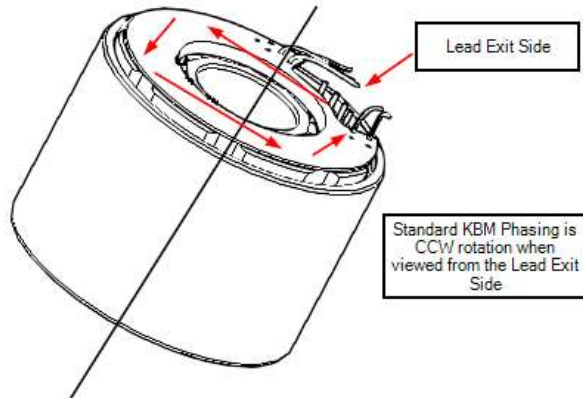
Here is an example of these details on a KBMS outline drawing.



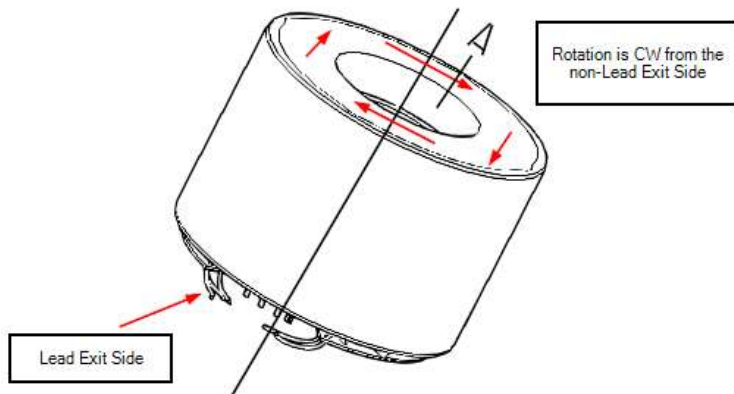
Orientation

As stated above the KBM motor uses the following convention.

If the motor is mounted upside down and you are viewing the lead exit side of the motor then the rotation for standard phasing will be CCW.



If the motor is mounted in an upright position and you are viewing the non-exit side of the motor then the rotation for standard phasing will be CW.



Feedback Wiring and Rotation Direction Conventions and Overview

Before proceeding to check feedback wiring and direction online in Workbench it is important to understand the concept and importance of motor power phasing in agreement with feedback direction based on orientation and rotation direction conventions stated above.

Concept:

FB1 is expected to count up in the orientations and directions given above.

This can be checked with the drive disabled and the primary feedback wired to X10.

Make sure Drive Direction "DRV.DIR = 0" is set to zero. This should be added where you referencing how feedback is counting

In this example BISS is used.

Feedback 1 (X10)
The primary position feedback fitted to your motor.

Feedback Selection: -1 - Auto Identify
Feedback Identified: BiSS

If you rotate the motor shaft you should see the dial move.

Motor Autoset: 1 - On
Position Feedback: 321,596,239.125 counts
Drive Direction: 0
Sine Cycles/Revolution: 2,048
Biss Sensor Bits: 32

[Goto Wake and Shake](#)

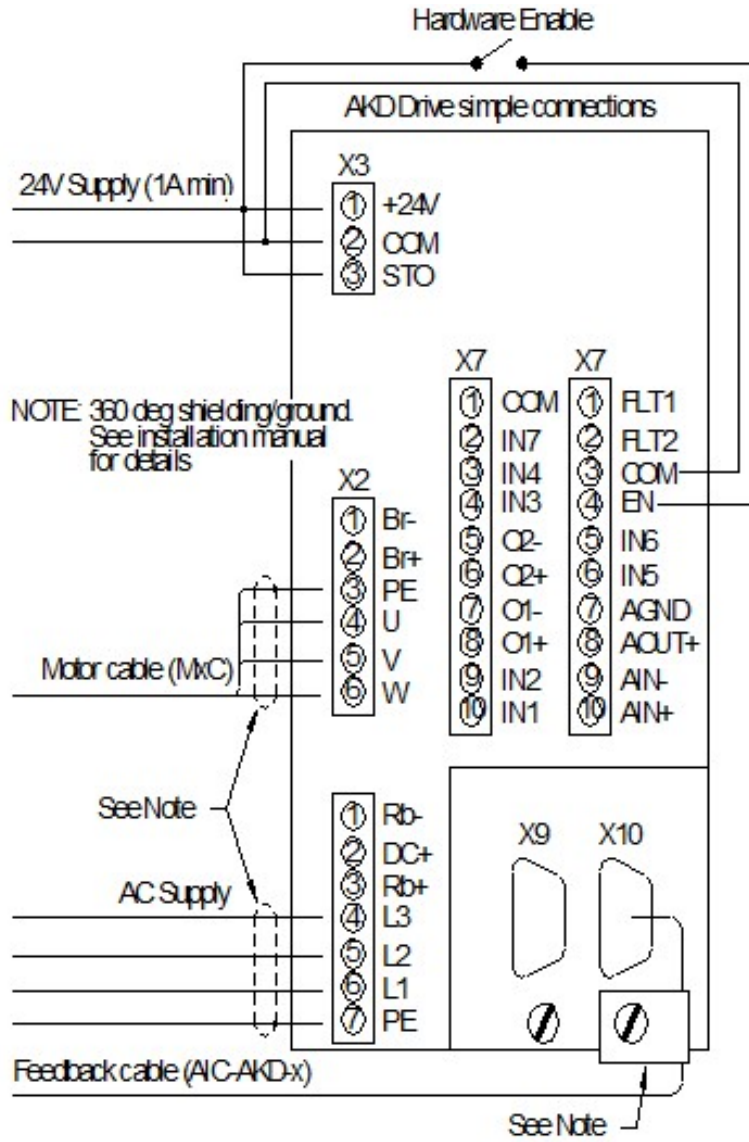
If the feedback counts DOWN when manually rotating the rotor in the orientations given above then the feedback type will determine how to remedy the conflict which may require either the motor and/or the feedback phasing to change. This will be covered in more detail later in this application guide.

Summary:

If feedback counts are negative in the direction of rotation for standard convention

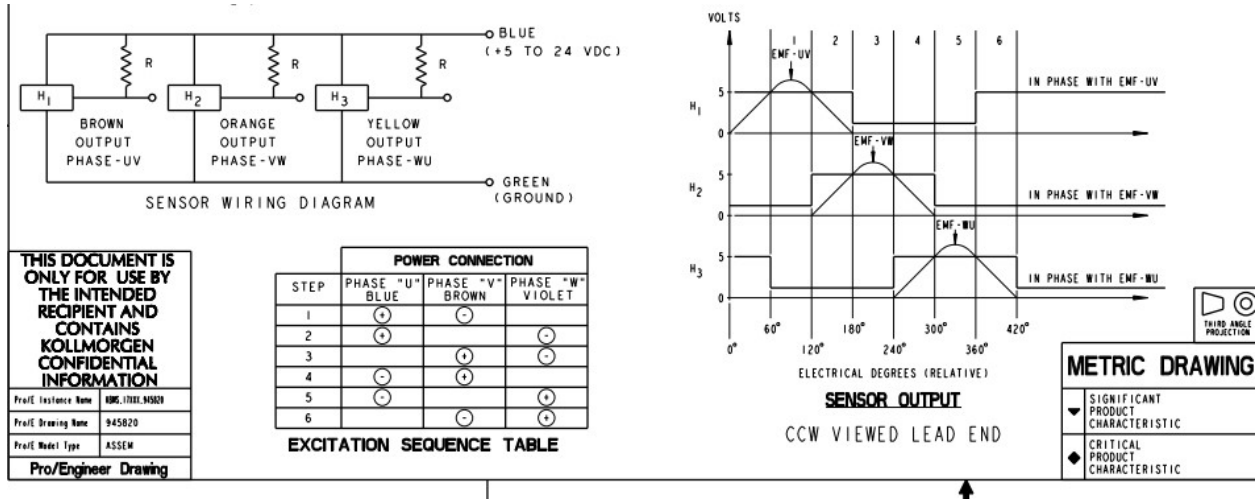
Feedback Type	Feedback Remedy	Motor Remedy	Wake and Shake Required?
Halls Only	This is beyond the scope of this application note; see the support documentation for AKD Halls Only operation.		
Resolver	Swap Sin + and Sin -	Not required	No
Incremental Encoder no halls	Swap A+ and A-	Not required	Yes
Incremental encoder with halls	Swap A+ and A- and Swap Halls U and V	Swap Motor U and W	No
Sine Encoder without Halls	Swap Sin+ and Sin-	Not required	Yes
Sine encoder with Halls	Swap A+ and A- and Swap Halls U and W	Swap Motor U and W	No
EnDat with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
EnDat digital only	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
BISS with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Renishaw BISS C (digital only)	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Hiperface with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Hiperface DSL (digital only)	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No

MINIMUM WIRING REQUIREMENT FOR THE AKD DRIVE



Motor and Halls Overview

Example Wiring (see outline drawing for your specific model to verify color codes):



Motor Power Standard Convention

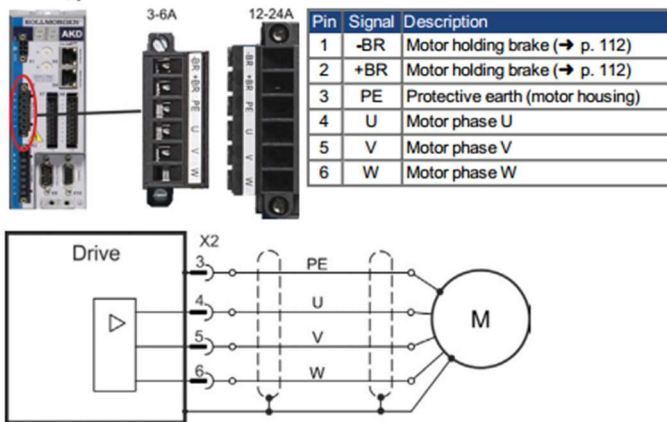
KBM Motor Connection	Typical KBM Motor Color	AKD Terminal X2
U	Blue	U
V	Brown	V
W	Violet	W
PE (motor case)	Green/Yellow Stripe	GND/PE
Shield		Drive Ground Bar/Clamp

Motor Power Non-Standard Convention (where motor phasing must change): **and shield?**

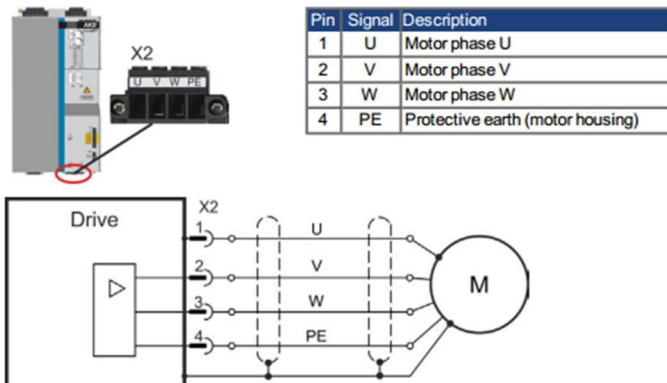
KBM Motor Connection	Typical KBM Motor Color	Typical Kollmorgen Cable Colors	AKD Terminal X2
U	Blue	Black	W
V	Brown	White	V
W	Violet	Blue	U
GND/PE	Green/Yellow Stripe	Green/Yellow Stripe	GND/PE

Important! In some cases the controls engineer is involved after the KBM has been assembled. Often the motor power lead color codes will change from the motor lead exit via the motor power extension cable or through-port connectorization, etc. It is extremely important to trace and label the wires at the drive end so the cable color code and phasing is known relative to the KBM's stator color code and phasing conventions.

AKD-x003 to 024, power connector X2



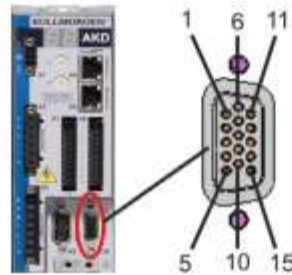
AKD-x048, power connector X2



AKD Feedback X10

AKD Feedback X10

Feedback connector (X10)



PIN	SFD	SFD3/DSL	Resolver	BiSS B (analog)	BiSS C (digital)	EnDAT 2.1	EnDAT 2.2	Hiperface	Sine Enc. +Hall	Tamagawa Smart Abs*	Incr. Enc. +Hall
1	-	-	-	-	-	-	-	-	Hall U	-	Hall U
2	-	-	-	CLK+	CLK+	CLK+	CLK+	-	Hall V	-	Hall V
3	-	-	-	CLK-	CLK-	CLK-	CLK-	-	Hall W	-	Hall W
4	SEN+	-	-	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+
5	SEN-	-	-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-
6	COM+	COM+	R1 Ref+	DAT+	DAT+	DAT+	DAT+	DAT+	Zero+	SD+	Zero+
7	COM-	COM-	R2 Ref-	DAT-	DAT-	DAT-	DAT-	DAT-	Zero-	SD-	Zero-
8	-	-	Thermal control (+)								
9	-	-	Thermal control (-)								
10	+5 V	+5 V	-	+5 V	+5 V	+5 V	+5 V	+8 to +9 V	+5 V	+5 V	+5 V
11	0V	0V	-	0V	0V	0V	0V	0V	0V	0V	0V
12	-	-	S1 SIN+	A+	-	A+	-	SIN+	A+	-	A+
13	-	-	S3 SIN-	A-	-	A-	-	SIN-	A-	-	A-
14	-	-	S2 COS+	B+	-	B+	-	COS+	B+	-	B+
15	-	-	S4 COS-	B-	-	B-	-	COS-	B-	-	B-

CLK = CLOCK, DAT = DATA, SEN = SENSE, * = for AKD with "NB" (rev 8+) only

Halls

The 2 feedback types covered in this application note where halls would be used (with the KBMS) is for either 1) Comcoder (incremental encoder with halls) or 2) Sine Encoder with Halls

Standard

KBM Hall Channel	KBM Color	AKD Motor Terminal Connection	AKM X10 Terminal
Hall U (H1)	Brown	Hall U (H1)	Pin 1
Hall V (H2)	Orange	Hall V (H2)	Pin 2
Hall W (H3)	Yellow	Hall W (H3)	Pin 3
Common	Green/Common	Common (0 V)	Pin 11
Shield			Shell

Non-Standard

In this case Halls U (H1) and V (H2) are swapped at the drive side X10 connection

KBM Hall Channel	KBM Color	AKD Motor Terminal Connection	AKM X10 Terminal Pin
Hall U (H1)	Yellow	Hall V (H2)	Pin 2
Hall V (H2)	Orange	Hall U (H1)	Pin 1
Hall W (H3)	Brown	Hall W (H3)	Pin 3
Common	Green/Common	Common (0 V)	Pin 11
Shield			Shell

MOTOR BACK EMF AND HALL SENSOR SIGNAL ALIGNMENT (STANDARD)

I. HALL SIGNALS –versus- MOTOR PHASES (of a presentment as an oscilloscope plot):

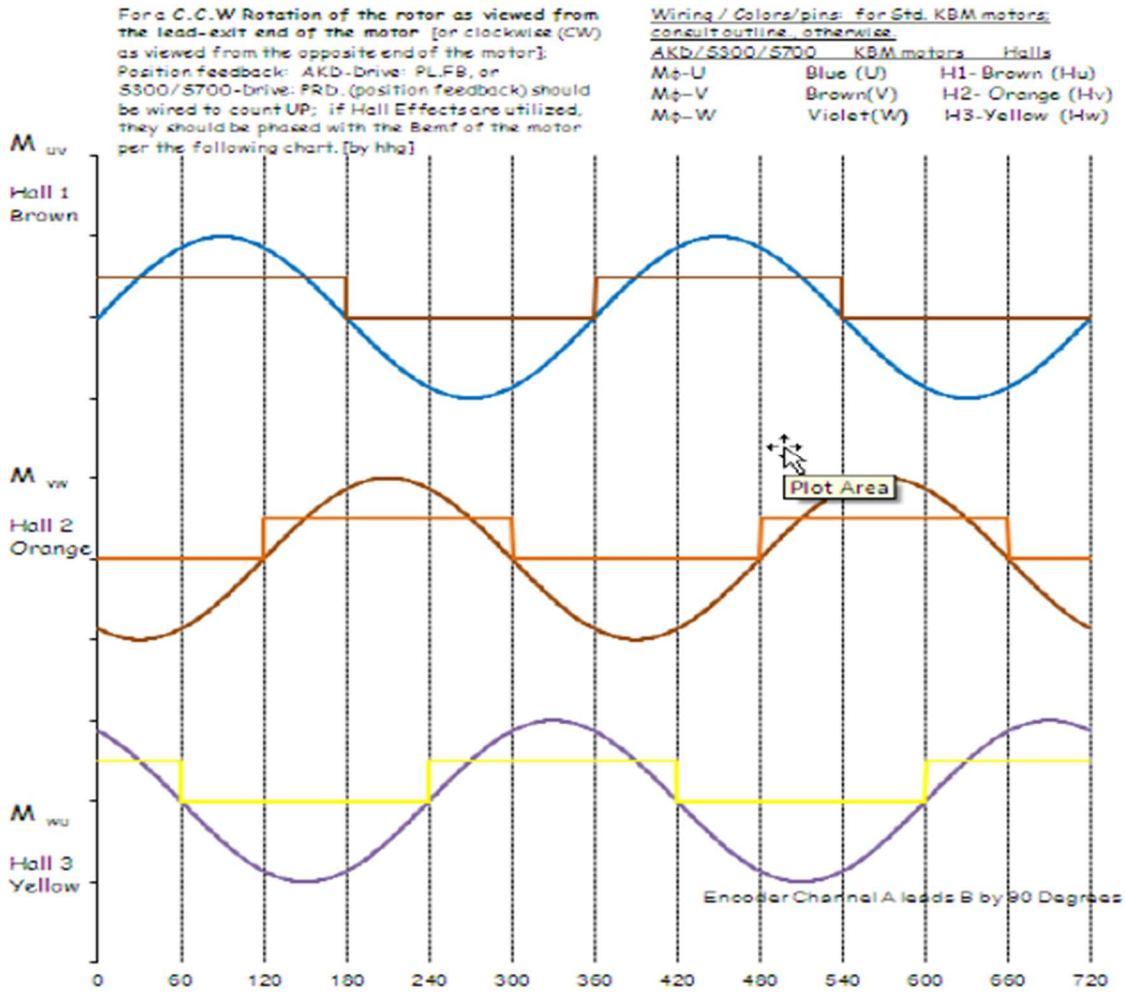


Figure 3

When using a Kollmorgen KBM motor and 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) rotated in a CCW direction when viewing from the lead exit end or CW from the opposite end of the motor then the hall alignment and motor phasing will match exactly as shown in Figure 3.

Incremental Encoder With Halls

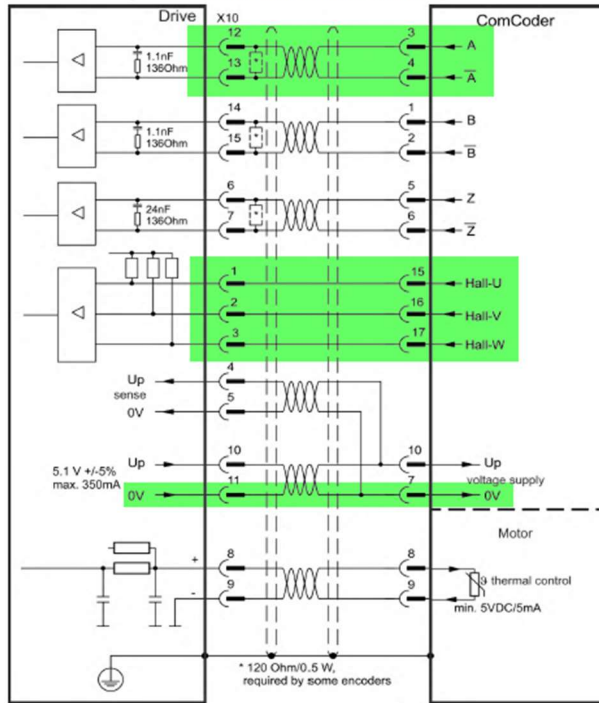
With the normal convention the wiring is shown. If the counts go DOWN with that convention then swap A+ and A- and swap halls U and V. The motor phasing must change where phases U and W must change at the drive end (Non-Standard Convention; see overview section).

9.12.13 Incremental Encoder

Feedback devices, which do not deliver absolute information for commutation, can either work with wake&shake commutation (see *WorkBench Online Help*) or can be used as a complete feedback system when combined with an additional Hall encoder. All signals are connected using a pre-assembled comcoder connection cable. The thermal control in the motor is connected via the encoder cable and evaluated in the drive. If cable lengths of more than 25 m are planned, please consult customer support.

Type	FBTYPE	Frequency Limit
Incremental Encoder&Hall Switches (Comcoder)	10	2.5 MHz
Incremental Encoder (Wake&Shake)	11	2.5 MHz

The pin assignment shown on the encoder end relates to Kollmorgen AKM motors.



Non-Standard Convention: In this case Halls U (H1) and V (H2) are swapped at the drive side X10 connection

KBM Hall Channel	KBM Color	AKD Motor Terminal Connection	AKM X10 Terminal Pin
Hall U (H1)	Brown	Hall V (H2)	Pin 2
Hall V (H2)	Orange	Hall U (H1)	Pin 1
Hall W (H3)	Violet	Hall W (H3)	Pin 3
Common	Green/Common	Common (0 V)	Pin 11

Incremental Encoder without Halls

With the normal convention the wiring is shown. If the counts go DOWN with that convention then swap A+ and A-. Motor Phasing does not change from the Standard Convention.

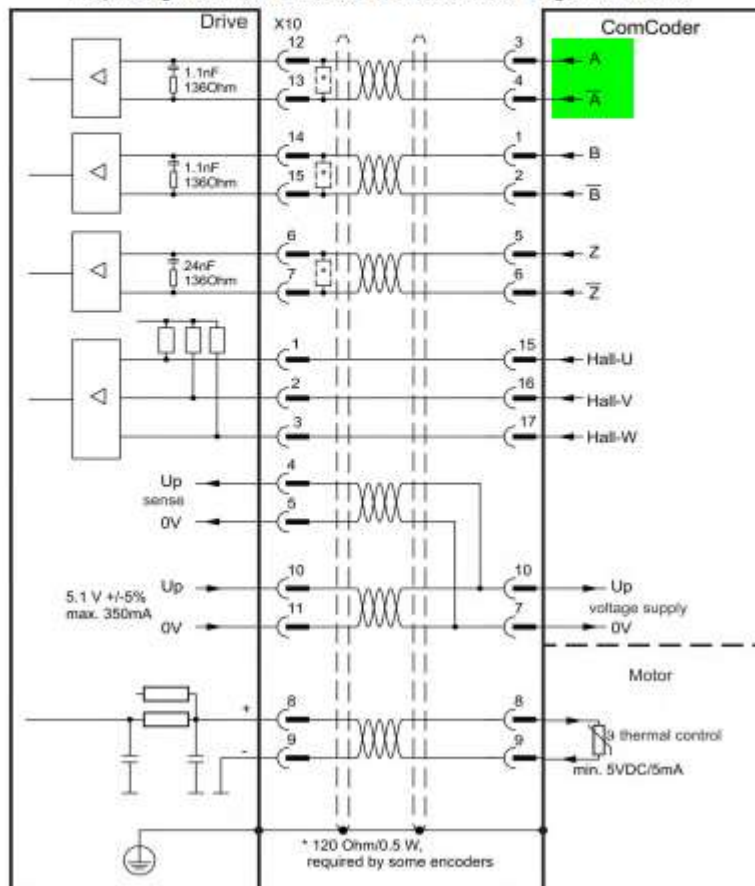
9.12.13 Incremental Encoder

Feedback devices, which do not deliver absolute information for commutation, can either work with wake&shake commutation (see *WorkBench Online Help*) or can be used as a complete feedback system when combined with an additional Hall encoder. All signals are connected using a pre-assembled comcoder connection cable. The thermal control in the motor is connected via the encoder cable and evaluated in the drive.

If cable lengths of more than 25 m are planned, please consult customer support.

Type	FBTYPE	Frequency Limit
Incremental Encoder&Hall Switches (Comcoder)	10	2.5 MHz
Incremental Encoder (Wake&Shake)	11	2.5 MHz

The pin assignment shown on the encoder end relates to Kollmorgen AKM motors.



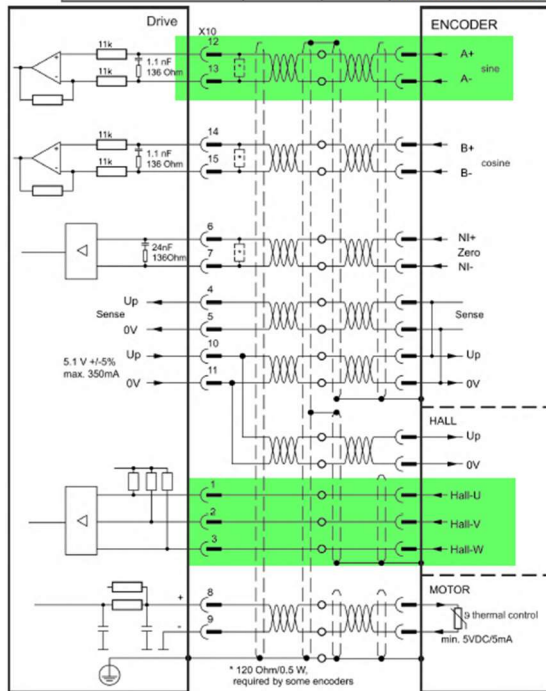
Sine Encoder with Halls

With the normal convention the wiring is shown. If the counts go DOWN with that convention then swap A+ and A- and swap halls U and V. The motor phasing must change where phases U and W must change at the drive end (Non-Standard Convention; see overview section).

9.12.12 Sine Encoder

Feedback devices, which do not deliver absolute information for commutation, can either work with wake&shake commutation (*WorkBench Online Help*) or can be used as a complete feedback system when combined with an additional Hall encoder. All signals are connected to X10 and evaluated there. If cable lengths of more than 25 m are planned, please consult customer support.

Type	FBTYPE	Up	Frequency Limit
SinCos 1 V p-p with Hall	20	5.1 V +/-5%	1 MHz, 250 kHz for encoders that require termination resistors
SinCos 1 V p-p (Wake&Shake)	21	5.1 V +/-5%	



Non-Standard Convention: In this case Halls U (H1) and V (H2) are swapped at the drive side X10 connection

KBM Hall Channel	KBM Color	AKD Motor Terminal Connection	AKM X10 Terminal Pin
Hall U (H1)	Brown	Hall V (H2)	Pin 2
Hall V (H2)	Orange	Hall U (H1)	Pin 1
Hall W (H3)	Violet	Hall W (H3)	Pin 3
Common	Green/Common	Common (0 V)	Pin 11

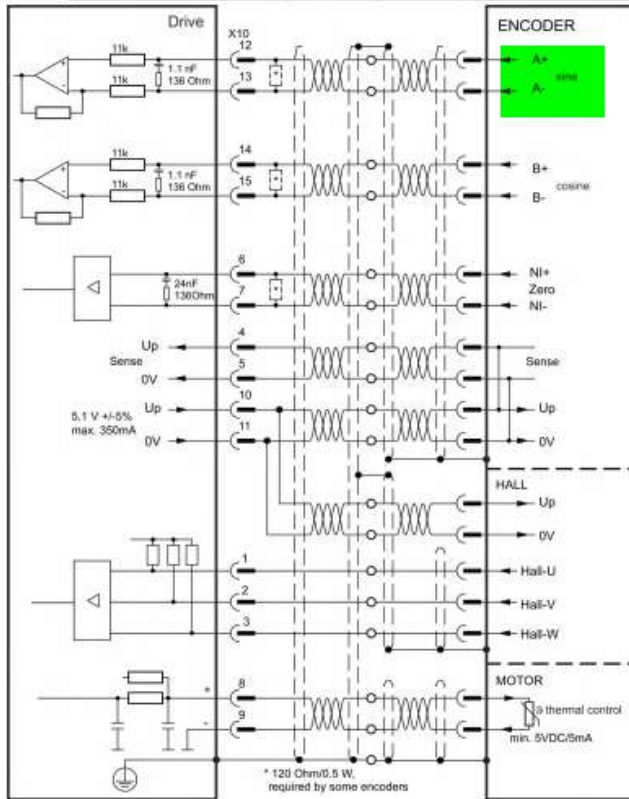
Sine Encoder Without Halls

With the normal convention the wiring is shown. If the counts go DOWN with that convention then swap A+ and A-. Motor Phasing does not change from the Standard Convention.

9.12.12 Sine Encoder

Feedback devices, which do not deliver absolute information for commutation, can either work with wake&shake commutation (*WorkBench Online Help*) or can be used as a complete feedback system when combined with an additional Hall encoder. All signals are connected to X10 and evaluated there. If cable lengths of more than 25 m are planned, please consult customer support.

Type	FBTYPE	Up	Frequency Limit
SinCos 1 V p-p with Hall	20	5.1 V +/-5%	1 MHz,
SinCos 1 V p-p (Wake&Shake)	21	5.1 V +/-5%	250 kHz for encoders that require termination resistors



Resolver

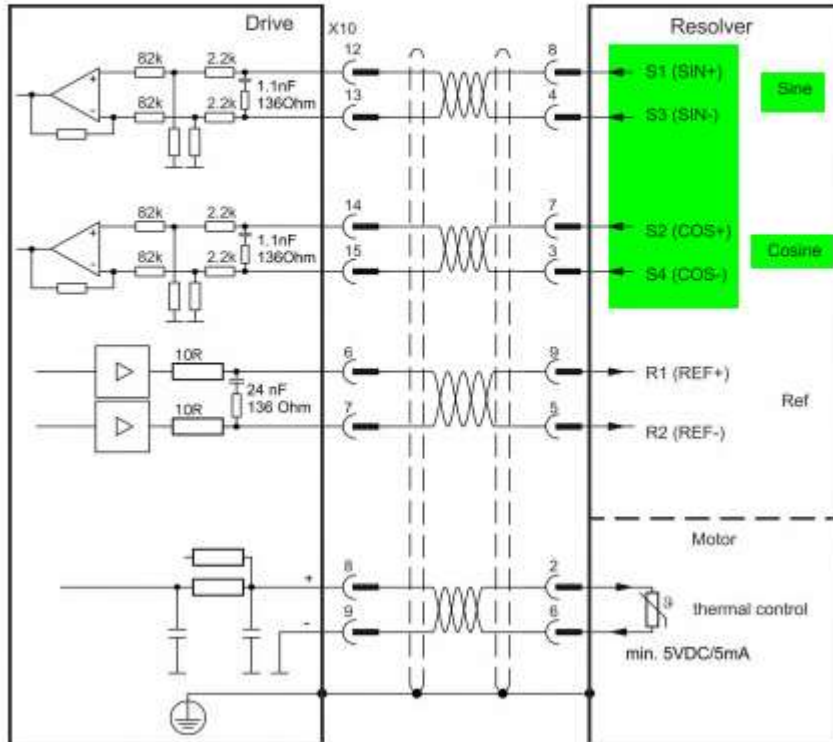
With the normal convention the wiring is shown. If feedback counts DOWN, swap SIN+ with COS+ and SIN- with COS-. Motor Phasing does not change from the Standard Convention.

9.12.4 Resolver

The diagram below shows the connection of a resolver (2 to 36-poles) as a feedback system. The thermal control in the motor is connected via the Resolver cable and evaluated in the drive. If no thermal control is in the motor, the cable must short pins 8 and 9. If cable lengths of more than 100 m are planned, please contact customer support.

Type	FATYPE	Description
Resolver	40	Accuracy: 14 bit (0.022°), resolution: 16 bit (0.006°)

The pin assignment shown on the Resolver end relates to Kollmorgen motors.



Feedback Devices with Serial Communications (without or without analog/all digital):

With the given convention, the feedback connections are shown below. If your counts go DOWN because of the mechanical orientation of the installed feedback device then the feedback direction for commutation cannot be changed by wiring. The motor phasing is the only wiring that can change to correct for this.

Feedback Devices this applies to:

EnDat 2.1 with analog

EnDat 2.2 all digital

BISS with analog

BISS (Renishaw BISS C all digital)

Hiperface with analog

Hiperface DSL (all digital)

See the AKD Installation manual for wiring connections. The KDN has application notes regarding Renishaw BISS C wiring conventions and setup of the feedback device in Workbench.

Thermal Device

The KBM has a 155°C motor winding temperature rating with integral thermistor

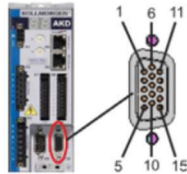
Before proceeding keep in mind the KBM frameless motor is available in high customized models and part numbers. The following is general information and to ensure the proper setup of the motor thermal settings and protection in the AKD drive it is important to acquire the data such as thermal switching resistance, etc. for your exact model number from Kollmorgen.

The KBM motor frame size 10,14,17,25,35, and 45 all use a single PTC thermistor for -X00 or X01 models. X03 models use a KTY

The KBM 43 has a Triplex configuration (three PTC's in series and all located in different sections of the stator)

The same trip point should be at or near the same resistance on this Triplex configuration as was on the single PTC device. The triplex configuration has the same resistance point on the upper end of the curve. The motor winding "critical temperature" is 155 deg C. The single PTC and the Triplex PTC show a resistance of 1330 ohms @ approx 155 degs C. **So use a trip point of 1300?**

Feedback connector (X10)



PIN	SFD	SFD3/DSL	Resolver	BiSS B (analog)	BiSS C (digital)	EnDAT 2.1	EnDAT 2.2	Hiper-face	Sine Enc +Hall	Tamagawa Smart Abs*	Incr. Enc +Hall
1	-	-	-	-	-	-	-	-	Hall U	-	Hall U
2	-	-	-	CLK+	CLK+	CLK+	CLK+	-	Hall V	-	Hall V
3	-	-	-	CLK-	CLK-	CLK-	CLK-	-	Hall W	-	Hall W
4	SEN+	-	-	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+
5	SEN-	-	-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-
6	COM+	COM+	R1 Ref+	DAT+	DAT+	DAT+	DAT+	DAT+	Zero+	SD+	Zero+
7	COM-	COM-	R2 Ref-	DAT-	DAT-	DAT-	DAT-	DAT-	Zero-	SD-	Zero-
8	-	-	Thermal control (+)								
9	-	-	Thermal control (-)								
10	+5V	+5V	-	+5V	+5V	+5V	+5V	+8 to +9V	+5V	+5V	+5V
11	0V	0V	-	0V	0V	0V	0V	0V	0V	0V	0V
12	-	-	S1 SIN+	A+	-	A+	-	SIN+	A+	-	A+
13	-	-	S3 SIN-	A-	-	A-	-	SIN-	A-	-	A-
14	-	-	S2 COS+	B+	-	B+	-	COS+	B+	-	B+
15	-	-	S4 COS-	B-	-	B-	-	COS-	B-	-	B-

CLK = CLOCK, DAT = DATA, SEN = SENSE, * = for AKD with "NB" (rev 8+) only

KBM Thermistor	KBM Color	AKD X10 Connection	AKM X10 Terminal Pin
+	Black?	Thermal Control +	Pin 8
-	Blue?	Thermal Control -	Pin 9

Configure the AKD Drive Using the Workbench Software

Install AKD Workbench. The software program can be found on the website (<http://www.kollmorgen.com/en-us/products/drives/servo/akd/>), (<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.

The screenshot shows the Kollmorgen WorkBench software interface. The main window displays the 'Limits' configuration page. The interface includes a menu bar (File, Edit, View, Tools, Help), a toolbar with buttons for Enable, Stop, and Service, and a Device Topology tree on the left. The main area displays the Limits configuration page with sections for Current Limits, Velocity Limits, Position Limits, Acceleration Limits, and Motor Limits. Annotations include a green arrow pointing to the 'Limits' icon in the Device Topology tree, a box labeled '1: Click on the "LIMITS"' pointing to the 'Limits' icon, and a box labeled '2: Lower the Peak Current values to a safe level' pointing to the current limit input fields.

Section	Parameter	Value	Unit
Current Limits	Positive Peak Current:	9.000	Ams
	Negative Peak Current:	-9.000	Ams
	Dynamic Break Peak Current:	1.000	Ams
Velocity Limits	Positive Speed Limit:	3,000.000	rpm
	Negative Speed Limit:	-3,000.000	rpm
	User Over-Speed Limit:	9,599.894	rpm
	Overall Over-Speed Limit:	9,599.894	rpm
Position Limits	Maximum Position Error:	655,360	Counts16Bit
	Position Limit 0:	0	Counts16Bit
	Position Limit 1:	1,048,576	Counts16Bit
Acceleration Limits	Acceleration:	59.903	rpm/s
	Deceleration:	59.903	rpm/s
Motor Limits	Motor limits are set through the Motor Foldback Screen: Goto Foldback		

2. Connect to the AKD Drive

Follow the instruction from the WorkBench help file.

The screenshot displays the Kollmorgen WorkBench software interface. The top menu bar includes 'File', 'Edit', 'View', 'Tools', and 'Help'. Below the menu bar, there are buttons for 'Connect' and 'Panic'. The 'Device Topology' pane on the left shows a 'Start Page' and a 'Kollmorgen Device (169.254.250.201)'. The main window displays the 'Kollmorgen WorkBench Help' content, with a breadcrumb trail 'User Manual > Connecting the Drive'. The 'Contents' pane on the left lists various topics, with 'Connecting the AKD' highlighted. A callout box with the text '1: Click on the Help then on "Documentation -> AKD"' points to the 'Help' menu item. Another callout box with the text '2: Expand "AKD User Manual" and then "connect to the AKD"' points to the 'Connecting the AKD' item in the 'Contents' pane. The main content area shows the 'Connecting the Drive' page with a list of sub-topics: 'Connected and Disconnected States', 'Disconnected', 'Confirm Connection with the Device', 'Connect To Another Device', 'TwinCAT and Workbench Connection', and 'Troubleshooting Connection and Communication Problems'. The bottom of the interface shows a 'Watch' area with 'Enab...' and 'Device' tabs, and a 'Parameter' tab.

1: Click on the Help then on "Documentation -> AKD"

2: Expand "AKD User Manual" and then "connect to the AKD"

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Because Motion Matters

3. EXPAND "SETTINGS" AND SELECT THE MOTOR SETUP SCREEN

The screenshot displays the Kollmorgen WorkBench software interface. The top menu bar includes File, Edit, View, Tools, and Help. Below the menu is a toolbar with navigation icons and status indicators: Enable, Stop, 3 - Analog, 1 - Velocity Mode, Disable & Clear Faults, and Save T. The main window is divided into two panes. The left pane, titled "Device Topology", shows a tree structure under "no-name (Online)". The "Settings" folder is expanded, revealing a list of sub-items: Communication, Power, Regen, Motor, Feedback, Feedback 2, Foldback, Brake, Units, Modulo, Limits, Current Loop, Velocity Loop, Encoder Emulation (X9 Cfg), Analog Input, Analog Output, Digital I/O, Programmable Limit Switches, Compare Engines, Enable/Disable, Position Capture, and Performance Servo Tuner. The right pane, titled "Motor", displays configuration parameters for the selected motor. A blue circle with a white "M" icon is positioned above the "Motor" title. The text "These parameters describe the motor attached to" is followed by a list of parameters and their values:

- Motor Name: AKM31E-ANKI
- Motor Type: 0 - Rotary, Per
- Motor Autoset: 0 - Off
- Continuous Current: [input field]
- Peak Current: [input field]
- Instant: [input field]
- Inductance (quad, I4): [input field]
- Inductance Saturation: [input field]
- Motor Poles: [input field]
- Motor Phase: [input field]
- Inertia: [input field]
- Torque Constant: [input field]
- EMF Constant: [input field]
- Motor Resistance (I4): [input field]

Two callout boxes with arrows point to the "Settings" folder and the "Motor" item in the tree. The first callout box contains the text "1: Click here to expand the tree" and points to the "Settings" folder. The second callout box contains the text "2: Click on 'Motor'" and points to the "Motor" item.

4. Select Motor from Pull Down List

Kollmorgen WorkBench

File Edit View Tools Help

Enable Stop 0 - Service 2 - Position Mode Disable & Clear Faults Save To Device Disconnect Panic

Device Topology

- Start Page
- AKD-PN (Online)*
 - Settings
 - Communication
 - Power
 - Regen
 - Motor**
 - Feedback 1
 - Feedback 2
 - Foldback
 - Brake
 - Units
 - Modulo
 - Limits
 - Home
 - Current Loop
 - Velocity Loop
 - Position Loop
 - Service Motion
 - Encoder Emulation (X9 Cfg)
 - Analog Input
 - Analog Output
 - Digital I/O
 - Programmable Limit Switches
 - Compare Engines
 - Enable/Disable
 - Position Capture
 - Motion Profile Table
 - Performance Servo Tuner
 - Slider Tuning
 - Motion Tasks
 - Drive Motion Status
 - Faults and Warnings
 - Scope
 - Parameter Load/Save

Motor

These parameters describe the motor attached to this drive.

Motor Name: AKM21C-ANBNAB00 **Select Motor...** 2. Click on "Select Motor"

Motor Type: 0 - Rotary, Permanent Mt Create Motor...

Field Weakening: 0 - Disabled

Motor Autoselect: 0 - Off 1. Turn off

Continuous Current: 1.578 Arms

Select Motor

Motor

Select the motor that is attached to the drive.

To attach a motor, first select Motor family and then Motor series.

Motor Family: KBM Series 3. Change Motor Family to correct motor type

Name: KBM-17H01-A 4. Select motor part number then click ok

To create new or edit existing custom motors:

Custom Motors...

Target Feedback: Feedback 1 Select the feedback connector that your motor is connected to.

OK Close



NOTE

If the motor cannot be found in the database, Custom motors can be setup using the "Edit Custom Motors" tools under "Edit" on the tool bar. Instructions for use can be found in the WorkBench help file.

5. SELECT MOTOR TEMPERATURE SENSOR

Per the following nomenclature, standard KBM(S) motors have PTC avalanche type thermistors embedded in the stator for motor thermal protection. Other sensors are available:

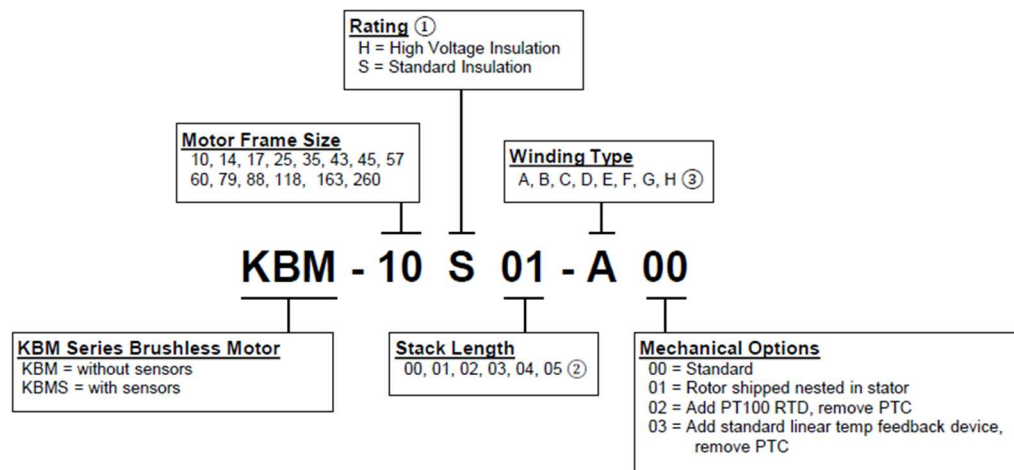
Mechanical Options

00=PTC Single Thermistor?

01=PTC Single Thermistor?

02=PT100 RTD?

03= KTY84/130?



① S rating not available on frame sizes 10, 14, 17, 25, 35, and 45.

The KBM has a 155°C motor winding temperature rating with integral thermistor

Before proceeding keep in mind the KBM frameless motor is available in high customized models and part numbers. The following is general information and to ensure the proper setup of the motor thermal settings and protection in the AKD drive it is important to acquire the data such as thermal switching resistance, etc. for your exact model number from Kollmorgen.

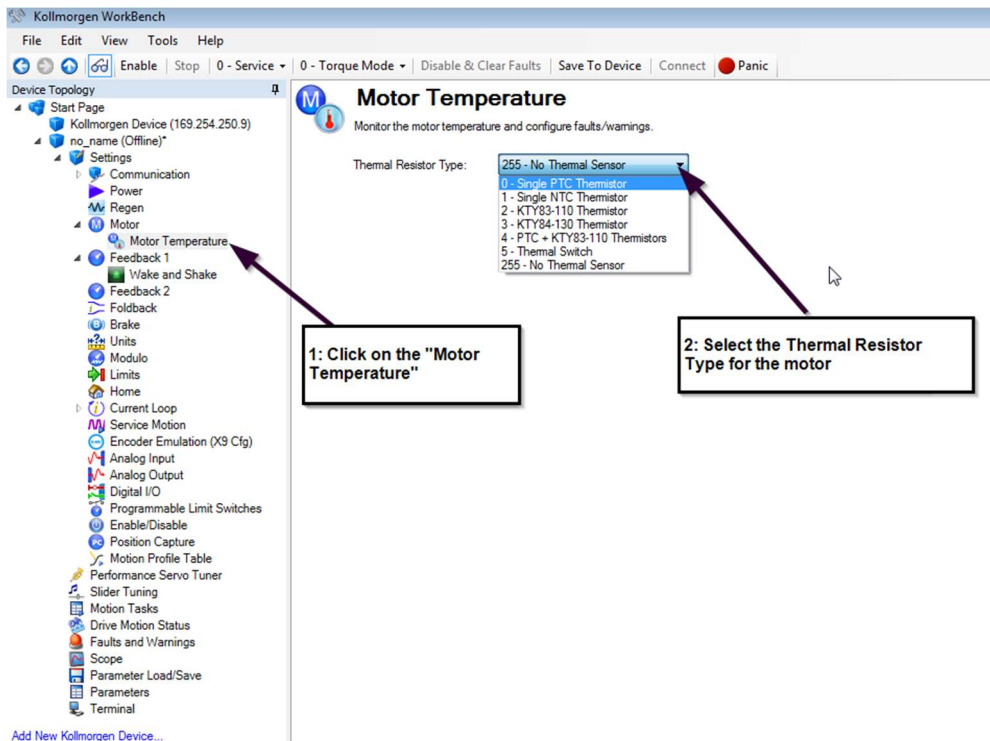
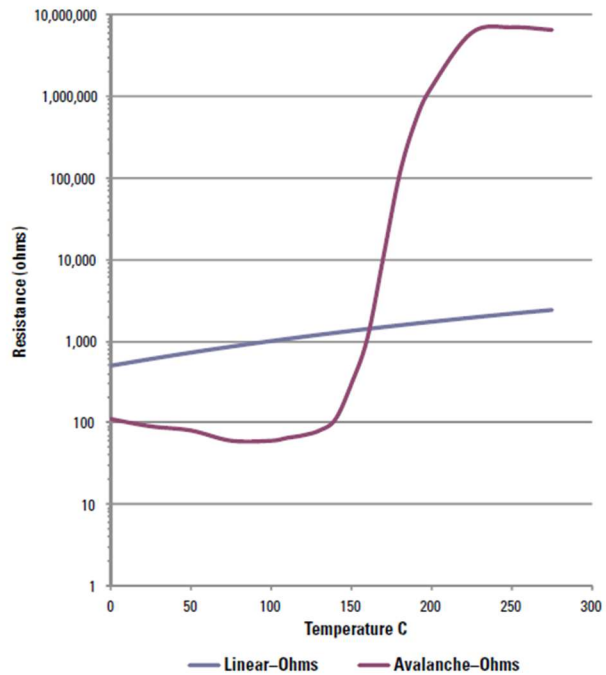
The KBM motor frame size 10,14,17,25,35, and 45 all use a single PTC thermistor for -X00 or X01 models. X03 models use a KTY

The KBM 43 has a Triplex configuration (three PTC's in series and all located in different sections of the stator)

The same trip point should be at or near the same resistance on this Triplex configuration as was on the single PTC device. The triplex configuration has the same resistance point on the upper end of the curve. The motor winding "critical temperature" is 155 deg C. The single PTC and the Triplex PTC show a resistance of 1330 ohms @ approx 155 degs C. **So use a trip point of 1300?**

Thermistors

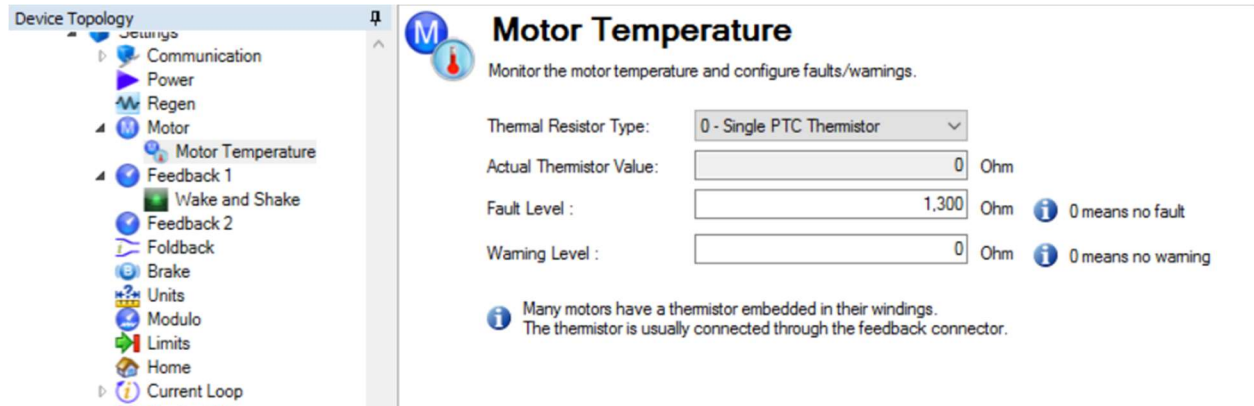
To provide for continuous safe operation of KBM(S) series motors in demanding applications, integral thermistors are mounted in the stator. These passive devices provide an output characteristic [Avalanche type] as shown in the side table for use in typical control safety circuits as the temperature goes beyond the rating of the motor windings [155C]. The KBM(S)-10XXX through KBM(S)-35XXX and KBM(S)-45XXX motors all have a single avalanche type thermistor while the balance of the KBM(S) family motors have two or three wired in series or independently depending on the model number. Linear thermistors are optionally available for use in winding temperature data acquisition and exhibit a basically linear resistance characteristic over the operating range of the motor.



Note to double-click on "Motor" to expand the project tree if "Motor Temperature" is not visible.

1. Thermistor Option type “00 or 01” Single 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”). **When the KBM motor is selected in Workbench on the Motor screen,**

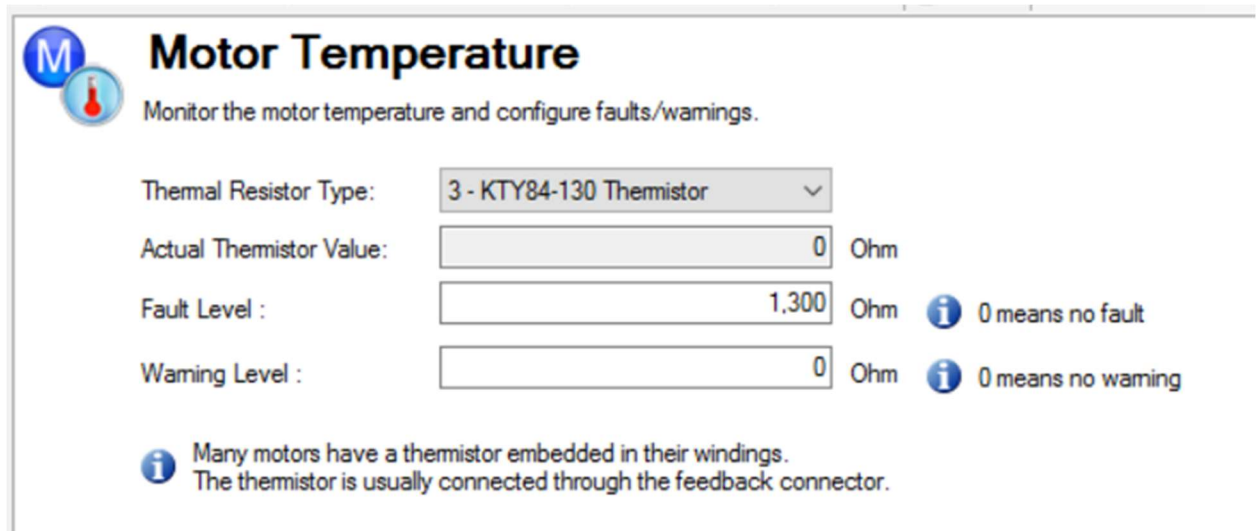


2. Thermostat Option type “02” PT100 RTD

Not applicable for the AKD?

3. Thermostat Option type “03”

KTY84-130...what values need to be set here?



6. SELECT FEEDBACK TYPE

Notes on the resolution setting are explained below.

The screenshot displays the 'Feedback 1 (X10)' configuration window. On the left, the 'Device Topology' tree shows the 'Feedback 1' component selected. A callout box labeled '1. Click on "Feedback 1"' points to this component. The main panel shows the 'Feedback Selection' dropdown menu open, with '40 - Resolver' selected. A callout box labeled '2. Select Feedback Type' points to this dropdown. Below the dropdown, various parameters are visible, including 'Rotary Encoder Resolution' (65,536), 'Phase Lag' (-2.000 deg), 'Nominal Transformation Ratio' (0.500), and 'Position Feedback Poles' (2). A 'Goto Wake and Shake' link is located at the bottom right.

1. Click on "Feedback 1"

2. Select Feedback Type

Feedback 1 (X10)
The primary position feedback fitted to your motor.

Feedback Selection: 40 - Resolver

- 1 - Auto Identify
- 1 - None
- 10 - Incremental Encoder with Halls
- 11 - Incremental Encoder without Halls
- 12 - Halls Only
- 20 - Sine Encoder with Halls
- 21 - Sine Encoder without Halls
- 30 - Endat 2.1
- 31 - Endat 2.2
- 32 - BiSS Analog
- 33 - Hiperface
- 34 - BiSS Mode C Renishaw
- 40 - Resolver**
- 41 - SFD (Smart Feedback Device)
- 42 - Tamagawa Serial
- 43 - Network Cyclic Feedback
- 45 - SFD3 (Smart Feedback Device Gen3)
- 46 - Hiperface DSL
- 50 - Reserved (do not use)

If you rotate the motor shaft you should see the dial move.

Motor Autoset: _____

Position Feedback: _____

Drive Direction: _____

Rotary Encoder Resolution: 65,536

Phase Lag: -2.000 deg

Nominal Transformation Ratio: 0.500

Position Feedback Poles: 2

[Goto Wake and Shake](#)

7. CONFIGURING ENCODER FEEDBACK RESOLUTION

Depending on your feedback selection the Feedback 1 screen will change graphically and also change in regards to feedback 1 related parameters.

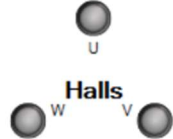
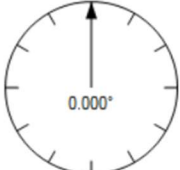
For example a Sine Encoder with Halls show the Halls graphically and the configuration requires the sine cycles/revolution be entered that match the specifications of your feedback device.

Feedback 1 (X10)

The primary position feedback fitted to your motor.

Feedback Selection:

If you rotate the motor shaft you should see the dial move.



Motor Autaset:

Position Feedback: Counts16Bit

Drive Direction:

Sine Cycles/Revolution:

[Goto Wake and Shake](#)

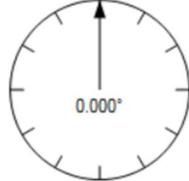
Compare with a BISS Mode C Renishaw where no halls are shown and there are 2 parameters that must be entered: 1) Rotary Encoder Resolution and BISS Sensor Bits. Please use the KDN articles for wiring conventions and also how to configure the BISS C Renishaw encoder for a rotary application.

Feedback 1 (X10)

The primary position feedback fitted to your motor.

Feedback Selection:

If you rotate the motor shaft you should see the dial move.



Motor Autaset:

Position Feedback: Counts16Bit

Drive Direction:

Rotary Encoder Resolution:

BISS Sensor Bits:

[Goto Wake and Shake](#)

8. TEST ENCODER DIRECTION AND RESOLUTION

Note: It is very important the Drive Direction parameter on the Feedback 1 screen is set to 0 until correct commutation is established. Once the motor is running with correct commutation, if the direction of rotation is reverse of what is required in the application then the Drive Direction can be changed at that point to a 1.

The Feedback test available is the movement of the indicator on the motor feedback screen.

The screenshot displays the 'Feedback 1 (X10)' configuration screen. On the left, a 'Device Topology' tree shows the project structure, with 'Feedback 1' selected. The main panel contains the following settings:

- Feedback Selection:** -1 - Auto Identify
- Feedback Identified:** BiSS
- Motor Autoset:** 1 - On
- Position Feedback:** 321,596,239.125 counts
- Drive Direction:** 0
- Sine Cycles/Revolution:** 2,048
- Biss Sensor Bits:** 32

A central dial indicator shows a reading of 305.104°. Red arrows indicate the direction of rotation. A blue link at the bottom right reads 'Goto Wake and Shake'.

The Summary is presented again here for convenience. Please refer back to the wiring section of this application guide for details and diagrams.

Summary:

If feedback counts are opposite of convention

Feedback Type	Feedback Remedy	Motor Remedy	Wake and Shake Required?
Halls Only	This is beyond the scope of this application note; see the support documentation for AKD Halls Only operation.		
Resolver	Swap Sin + and Sin -	Not required	No
Incremental Encoder no halls	Swap A+ and A-	Not required	Yes
Incremental encoder with halls	Swap A+ and A- and Swap Halls U and V	Swap Motor U and W	No
Sine Encoder without Halls	Swap Sin+ and Sin-	Not required	Yes
Sine encoder with Halls	Swap A+ and A- and Swap Halls U and W	Swap Motor U and W	No
EnDat with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
EnDat digital only	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
BISS with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Renishaw BISS C (digital only)	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Hiperface with analog	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No
Hiperface DSL (digital only)	Feedback Direction cannot be inverted by wiring; motor phasing must change	Swap Motor U and W	No

9. Checking Motor Feedback Resolution

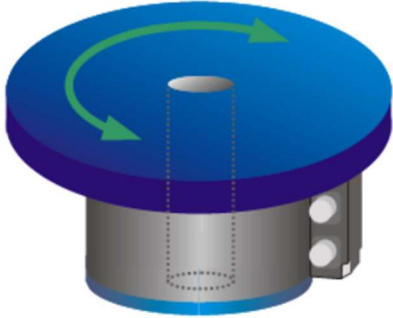
Workbench Units setup will depend on your application and if fieldbus communications (i.e. Ethernet IP, Profinet, Canopen, Ethercat, etc.) is used the scaling and setup may be different than what is shown.

In this example it is assumed the KBM(S) motor is direct drive and the desired units are degree, degree/s, and degree/s².

? Units

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

Select Type of Mechanics:



Position Unit:

Velocity Unit:

Acceleration Unit:

Custom Position Unit:

Modbus Unit: [Goto Modbus](#)

Position: deg

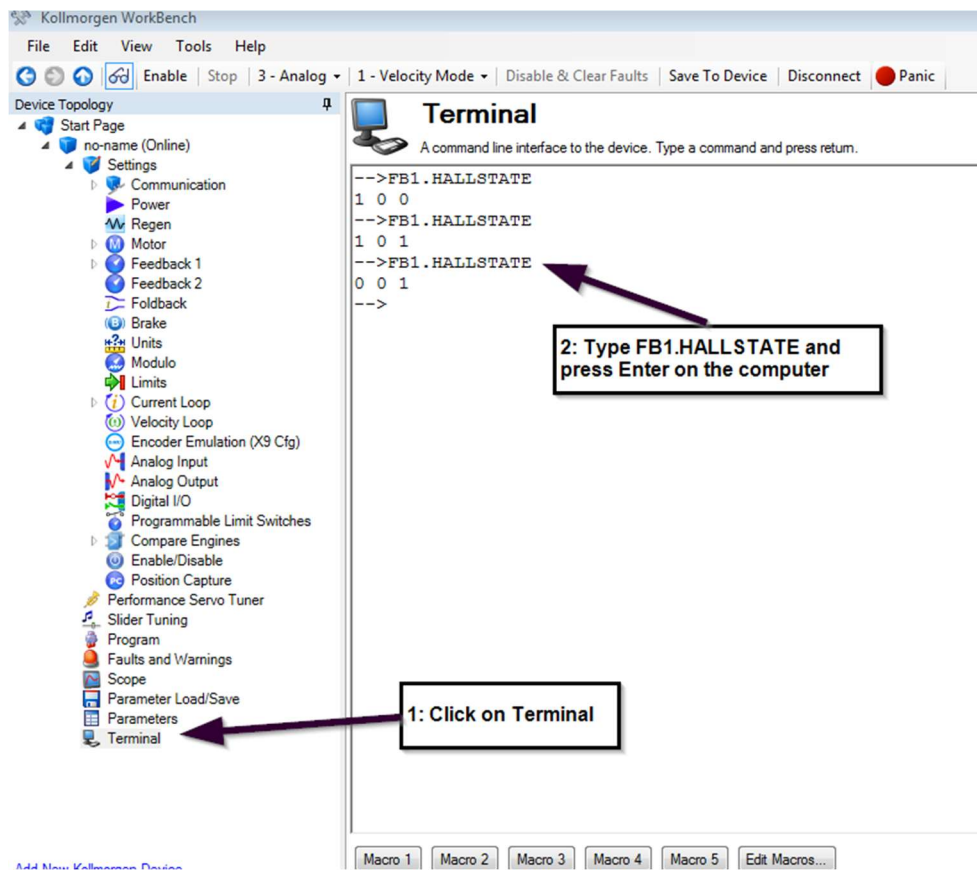
If possible, move the rotor manually with the drive disabled and monitor the change in Position on the readout of the Units screen above.

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. IF THE MOTOR HAS HALLS THEN CHECK THE HALLSTATE SEQUENCE WHEN MOVING MOTOR USING THE CONVENTIONS IN THIS APP. NOTE.

Standard Convention (assuming the halls and motor phasing do not need to change from standard)

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.



Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive When Using AKD Firmware Version = or > 01-13-10-001. Do not use the parameter FB1.HALLSTATE in the oscilloscope feature to monitor Hall sensor state

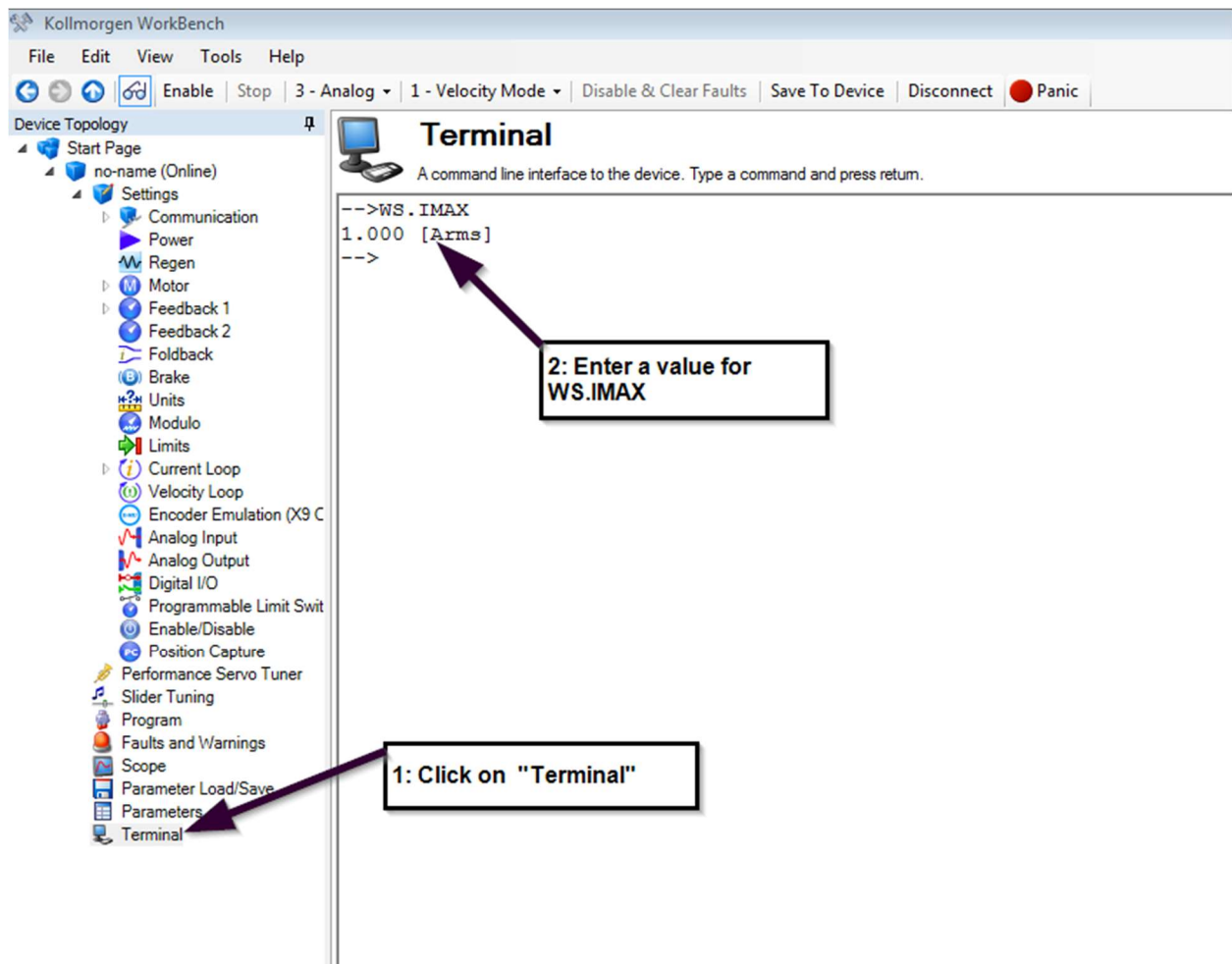
Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	0	1	1
3	0	1	0
4	1	1	0
5	1	0	0
6	1	0	1
7	0	0	1

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive When Using AKD Firmware Version < 01-13-10-001. Do not use the parameter FB1.HALLSTATE in the oscilloscope feature to monitor Hall sensor state.

Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	1	0	1
3	1	0	0
4	1	1	0
5	0	1	0
6	0	1	1
7	0	0	1

11. HOW TO VERIFY THE MOTOR'S COMMUTATION ALIGNMENT ANGLE (MOTOR.PHASE) FOR For Incremental without Halls or Sine Encoders without Halls Feedback Types that require Wake and Shake everytime on powerup of the AKD.

Set the Wake & Shake Current WS.IMAX equal to continuous of your KBM(S) motor in the Terminal Screen.



12. Start the Wake and Shake Routine

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

- Mode:** Sets the method used for Wake and Shake. The dropdown menu is set to "2 - Auto Wake and Shake".
- Commutation Check:** Mode: 1 - Active.
- Arm:** A button labeled "Arm" and "Idle". The "Motor Phase" is set to 4 deg.
- Device Topology:** A tree view on the left showing the system structure, with "Wake and Shake" highlighted under the "Motor" section.
- Toolbar:** Includes buttons for "Enable", "Stop", "3 - Analog", "1 - Velocity Mode", "Disable & Clear Faults", "Save To Device", "Disconnect", and "Panic".

Four callout boxes with arrows indicate the steps to start the routine:

- 1: Click on the the "Wake and Shake"
- 2: Select 2 - Auto Wake and Shake
- 3: Click the Arm Button
- 4: Click on the Enable

Start the Wake and Shake routine to find the MOTOR.PHASE offset value. 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.

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

The screenshot shows the Kollmorgen WorkBench software interface. The 'Service Motion' configuration window is active, showing a velocity profile graph and various control parameters. Seven numbered callouts point to specific settings:

- 1: Select Service Mode (points to the 'Service Motion' icon in the left sidebar)
- 2: Select Velocity Mode (points to the '1 - Velocity Mode' dropdown in the top toolbar)
- 3: Select Service Motion (points to the 'Service Motion' option in the left sidebar)
- 4: Select Pulse (points to the 'Pulse' radio button in the 'Service Motion Mode' section)
- 5: Input a slow Motor Velocity (points to the 'Velocity 1' input field set to 32,000 mm/s)
- 6: Make sure the move time does not allow the motor to hit the hard stops (points to the 'Time 1' input field set to 2,000 ms)
- 7: Select Start (points to the 'Start' button)
- 7: Enable the AKD (points to the 'Enable' button in the top toolbar)

The 'Service Motion' window also displays a graph of velocity over time, showing a trapezoidal profile. Below the graph, the following parameters are visible:

- Acceleration: 3,584,000,000.000 Counts/s²
- Deceleration: 715,839,984,631.808 Counts/s²
- Position Feedback: 0 mm
- Velocity Feedback: -0.757 mm/s

A warning icon is present next to the 'Start' button, with the text 'Drive is inactive.'



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

The AKD to KBM(S) motor initial commissioning is now complete!

[How to Verify The Motor's Commutation Angle \(MOTOR.PHASE \) for motors with feedback devices that do not require Wake and Shake on power.](#)

For motors with feedback devices that do not require Wake and Shake on powerup, a commutation alignment test must be performed so the correct MOTOR.PHASE is set in the AKD drive.



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

The AKD to KBM(S) motor initial commissioning is now complete!

Commutation alignment check

From the Feedback 1->Wake and Shake screen:

- Set Mode to 1-Commutation Alignment Check.
- Set Commutation Check Mode to 1-Active
- Set the Maximum allowed current to the continuous rating of the motor. Keep in mind additional loading can affect the accuracy of the test. The motor should be free to turn and not connected to anything while you are attempting to setup and verify proper commutation.
- Before enabling the drive make sure you take precautions in the event the motor runs away. When ready click the "Arm" button and then enable the drive. The motor will move and the Motor Phase as a read-only will appear under the Arm button as shown in the screenshot below. The status will show "Running" and if successful when done will indicate "Successful and the Motor Phase angle will be reported in degrees.

It is generally a good idea to run the commutation alignment check several times to see the value is approximately the same angle.

Wake and Shake
Wake and Shake will determine alignment offset between feedback and the electrical phases of the motor.

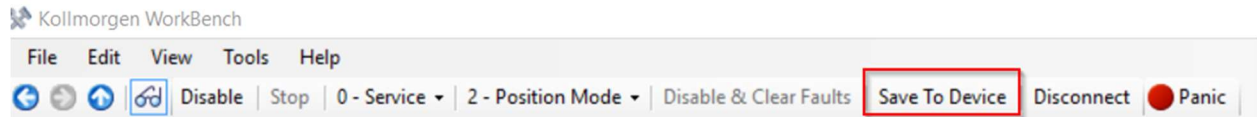
Mode
Sets the method used for Wake and Shake
1 - Commutation Alignment

Commutation Check
Mode: 1 - Active

Settings
Maximum allowed current: 1.390 Arms
Setting Time: 1.000 ms

Arm Successful
Motor Phase: 359 deg

At the top of the Workbench screen, click on “Save to Device”.



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

7: Enable the AKD

1: Select Service Mode

2: Select Velocity Mode

3: Select Service Motion

4: Select Pulse

5: Input a slow Motor Velocity

6: Make sure the move time does not allow the motor to hit the hard stops

7: Select Start

Service Motion

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

Service Motion Mode: Pulse Reversing Continuous

Group: Group 1

Velocity 1: 32,000 mm/s

Time 1: 2,000 ms

Acceleration: 3,584,000,000.000 Counts/s²

Deceleration: 715,839,984,631.808 Counts/s²

Position Feedback: 0 mm

Velocity Feedback: -0.757 mm/s

Start Drive is inactive.



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

The AKD to KBM(S) motor initial commissioning is now complete!