KOLLMORGEN™

Application Note

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Element	Mating	Author	M. Brown
		# Of Pages	18

Utilizing Kollmorgen Goldline Series Servo Motors with the AKD Drive

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Languages	Target Group	Status	Usage	International Restrictions (checked = allowed to view)
☑ English	☑ Basic	☐ In Process	☐ Internal	☐ U.S. Citizens or Nationals
☐ German	☐ Normal	☐ Completed	☐ Public	Non-Restricted Countries, End
☐	☑ Specialist			☐ Uses, and End Users (www.bis.doc.gov)

About the Content:

Guide to utilizing a Kollmorgen Goldline series servo motor with the Kollmorgen AKD digital servo drive. This Application Note shall cover motors using the standard resolver feedback device.

Content

1.0 Notes

1.1 Torque Angle Advance (TAA): The Goldline BH motors were initially to be operated with Kollmorgen S300 and S600 drives. For Goldline motor applications, many were run on a dynamometer to determine parameters for the drive in order to obtain maximum high speed torque. This is very similar to a car engine that varies the ignition timing throughout the RPM range, yielding better performance and economy. The AKD drive ***DOES NOT*** support TAA, so a reduction in torque of typically 15-40% can be expected at speeds higher than 50% of rated speed.

1.2 This document is meant to outline the specific differences between typical AC servo motors, such as the Kollmorgen AKM, and the Goldline series. **For general installation information and safety concerns, etc., follow all instructions in the AKD Installation Manual**. These manuals are at: http://www.kollmorgen.com/en-us/products/drives/servo/akd/

2.0 Preparation

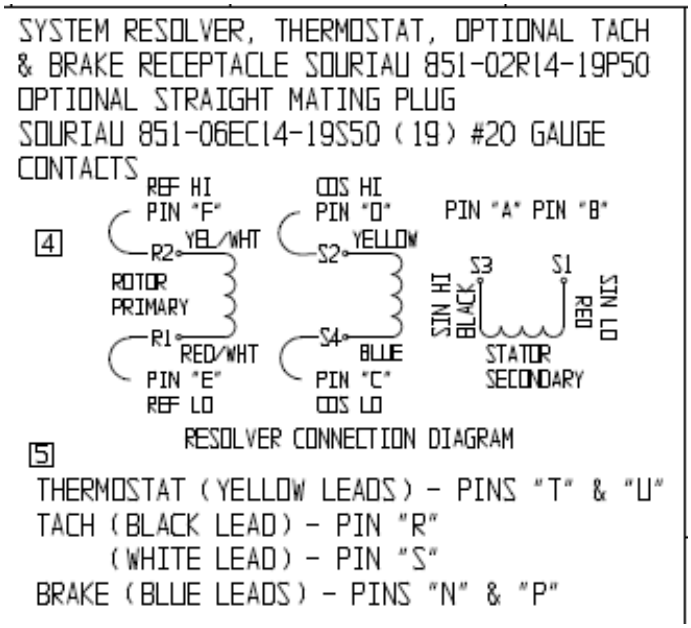
2.1 Obtain catalog data (CD) and Hook-Up Data (HD) sheets from your Kollmorgen distributor or from Kollmorgen Customer Support (KCS). This data is required for loading motor parameters into the drive and fabricating power and feedback cables.

2.2 Once the motor current and supply voltages are determined, make sure that the correct cable and AKD has been ordered / received. (Reference the Installation Manual, or contact your local Kollmorgen distributor concerning any questions.)

2.3 For existing application, modify the drive end of the cables as required. (If cable diagrams are required, contact your distributor.)

2.3.1 Resolver Cable - Configure the resolver cable as indicated in the HD drawing and the AKD instruction manual. Goldline motor resolver wiring connections:

Motor Resolver Connections



2.3.1 Resolver Feedback Cable – Assemble the resolver cable as instructed below. Use "Table 1" (on page 4 of this document) for recommended feedback connections.

AKD Drive Resolver Connection (Connector X10)

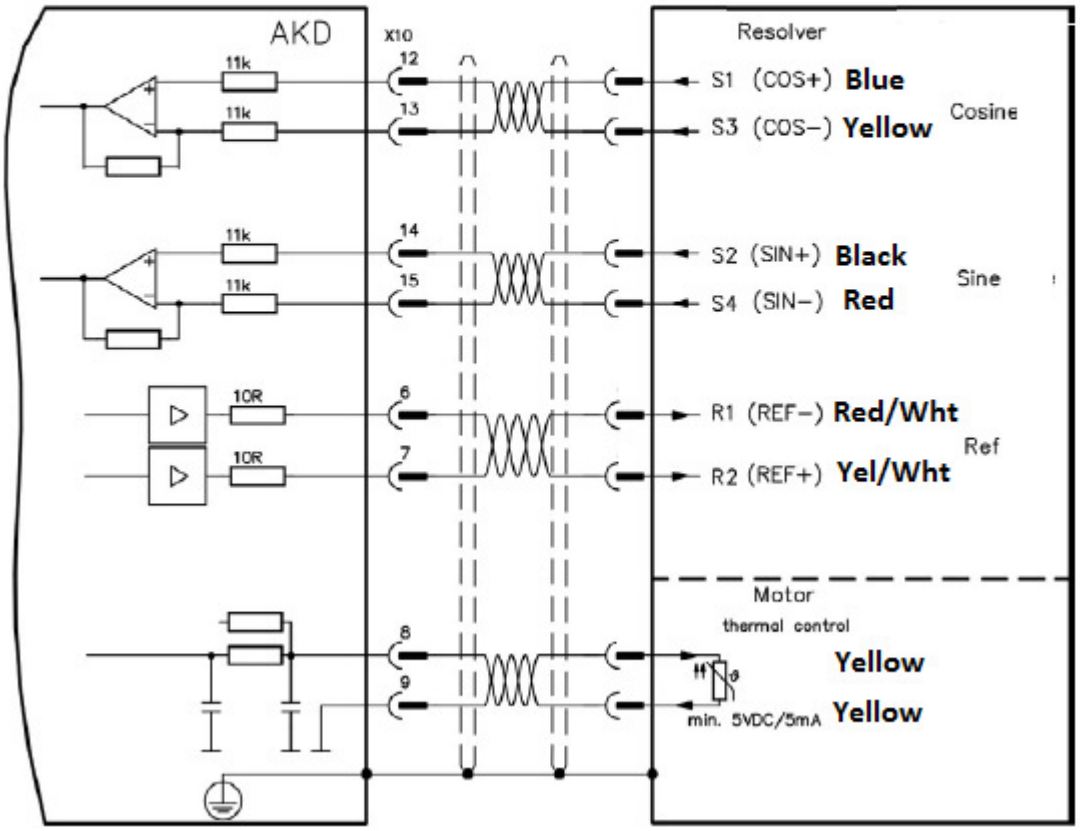
Resolver

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 cable lengths of more than 100 m are planned, please contact customer support.

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

The pin assignment shown on the resolver side relates to Kollmorgen™ motors.



NOTE: Ohm out all conductors (end to end, and each conductor to ground) PRIOR to installing cables.

The Goldline Motor Resolver Feedback Connections

Table 1

AKD X10 Feedback Connector	"Euro" Motor Resolver Connector MT(XT) Height and Low voltage versions, BH and MH series	"MS" Motor Resolver Connector B and M series	Resolver Flying Leads EB Motor Series	Resolver Signal Description
6	9	E	Red/White	R1 (Ref-)
7	5	F	Yellow/White	R2 (Ref+)
14	7	B	Black	S2 (Sin+)
15	3	A	Red	S4 (Sin-)
12	8	D	Blue	S1 (Cos+)
13	4	C	Yellow	S3 (Cos-)
8	2	T	White	Thermal Sen
9	6	U	White	Thermal Sen

NOTE: Always use Shielded Cables

The standard feedback and power cables that are used with the AKD servo drive and AKM servo motor can be used with the MT(XT) high and low voltage versions, the BH and the MH motors that use the Euro style connectors.

2.3.2 Power Cable – Assemble the power cable as instructed below. Use Table 2 for recommended motor power connections.

The motor power connections are U, V, W at the AKD drive, to C, B, A at the Goldline motor respectively.

Motor Connector

PHASE A (BROWN LEAD) - PIN "A"
PHASE B (RED LEAD) - PIN "B"
PHASE C (WHITE LEAD) - PIN "C"
CASE GROUND (GREEN w/
YELLOW STRIPE) LEAD - PIN "D"

Drive Connector

Pin	Signal	Description
1	-BR	Motor holding brake, negative
2	+BR	Motor holding brake, positive
3	PE	Protective earth (motor housing)
4	U	Motor phase U
5	V	Motor phase V
6	W	Motor phase W

NOTE: ALL POWER CONDUCTORS MUST BE TERMINATED AT THE DRIVE AS SHOWN:

The Goldline Motor Power Connections

Table 2

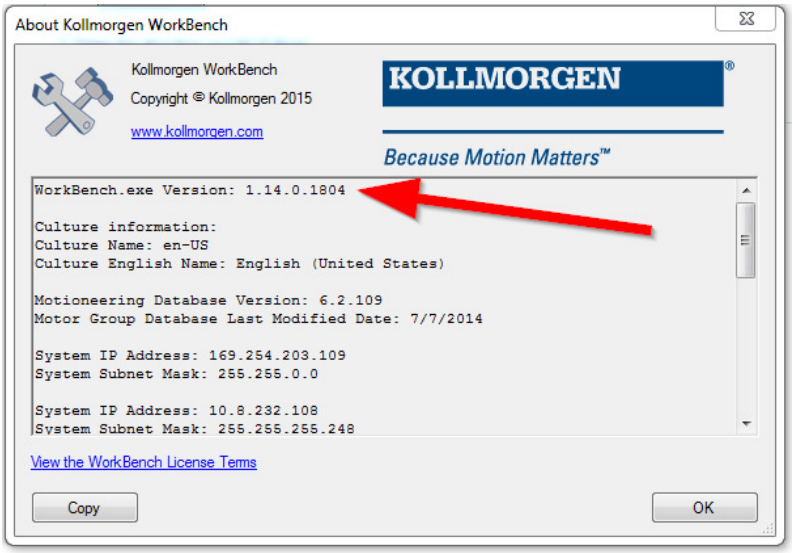
AKD X2 Motor Power Connections	"Euro" Motor Resolver Connector MT(XT) High and Low voltage versions, BH and MH series	"MS" Motor Resolver Connector B and M series	Power Connections Flying Leads EB Motor Series	Motor Phase Connection Description
U	1	C	White	C
V	4	B	Red	B
W	3	A	Brown	A
PE	2	D	Green/Yellow	D
+Br	A	N (resolver conn)	Blue	+ 24 Brake
-Br	B	P (resolver conn)	Blue	-24 Brake

NOTE: Always use Shielded Cables

NOTE: Ohm out all conductors (end to end, and each conductor to ground) PRIOR to installing cables.

2.3.3 Install the resolver and power cables to the drive and motor.

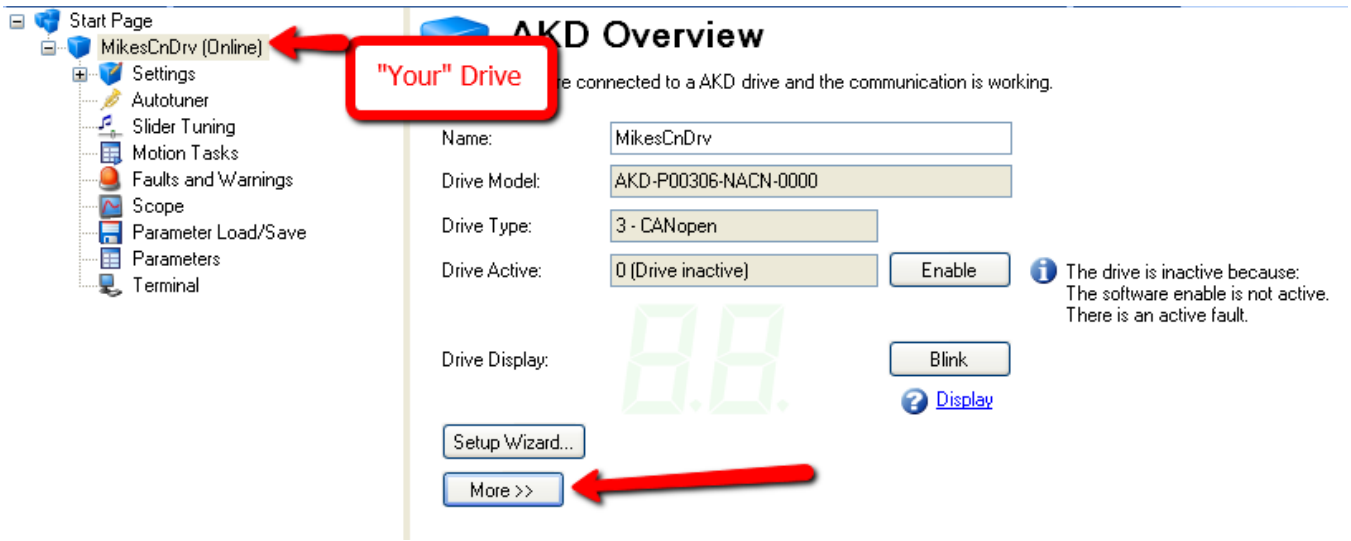
2.4 Ensure that the version of the AKD Graphic User Interface (GUI), which is called Workbench, is the correct version for the firmware loaded into the AKD drive. To determine the version of Workbench, open Workbench and click on "Help", then "About".



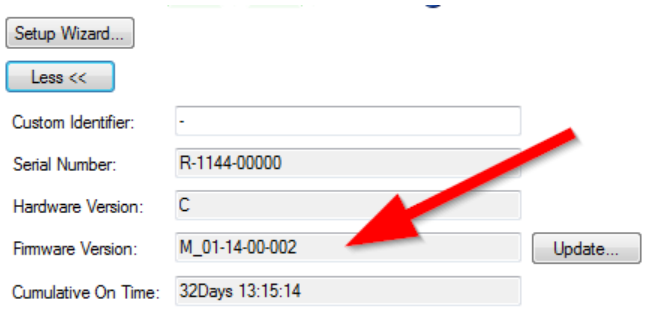
CAUTION: DO NOT APPLY AC POWER TO THE DRIVE AT THIS TIME.

NOTE: DO NOT COUPLE THE MOTOR TO THE LOAD AT THIS TIME.

2.5 To determine the version of firmware within the drive, apply 24VDC control power to the drive. Connect your PC to the drive directly or via an Ethernet connection. Start up Workbench, select your drive and click on "More".



2.6 The firmware version will be displayed.



2.7 **As indicated, both the Workbench and firmware versions are 1.14.xx.xxx.**

2.8 **NOTE: With the AKD, Workbench and firmware versions MUST match.**

An example: You cannot use firmware version 1.1.xxxxx with Workbench 1.6.xxxx.

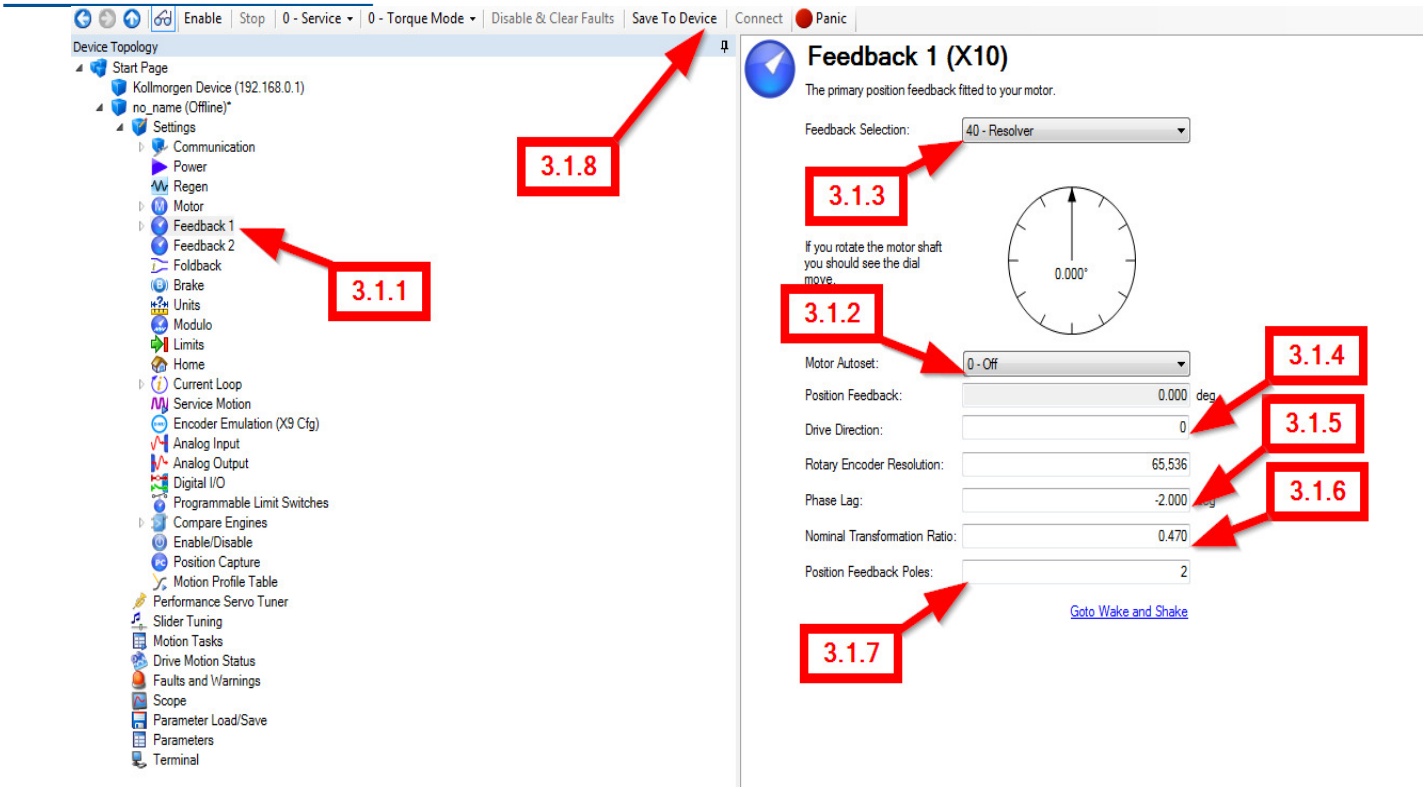
3 Set-up of Workbench

3.1 Setting the Feedback Device to a Resolver – Leave the 24VDC control power applied to the drive, and the Workbench GUI connected to the drive. Here, we will instruct the drive NOT to look for the motor type, as well as set the feedback type to a resolver. From Workbench, complete the following five (5) steps as shown below:

3.1.1 Click on Feedback 1.
3.1.2 Set Motor Autoset to "0- Off".
3.1.3 Set the Feedback Selection to "40 – Resolver".
3.1.4 Drive Direction to "0 – CW Dir Feedback Counts Up"
3.1.5 Phase Lag use Table 3 to determine value
3.1.6 Nominal Transformation Ratio use Table 3 to determine value
3.1.7 Position Feedback Poles set to 2 as a starting value
3.1.8 After these two (6) fields are set, click on "Save to Device".
3.1.9 Conduct the feedback verification test below.

Table 3

AKD Drive Parameter Settings	MT(XT) High and Low voltage versions	Goldline B, M and BH, MH series	EB Motor Series
Phase Lag	**-2.0**	**-2.0**	**-2.0**
Nominal Transformation Ratio	**0.01**	**0.47**	**0.47**
Position Feedback Poles	**2**	**2**	**2**

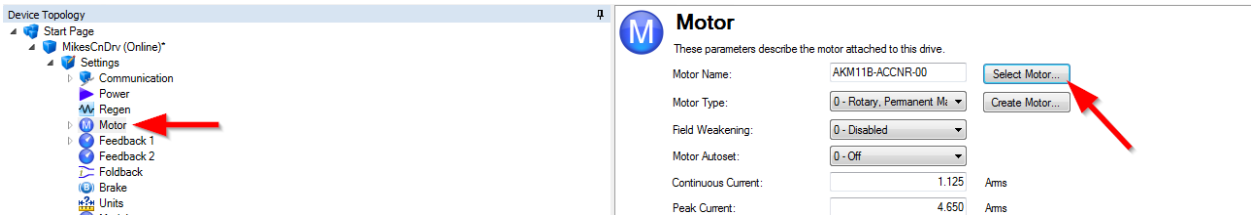


Feedback Verification Test

With no AC power applied to the drive and the motor shaft uncoupled, turn the motor shaft one (1) turn while you observe the dial indicator in the "Feedback 1" screen. For every rotation of the motor shaft, the dial indicator should rotate one (1) revolution as well. Rotate the motor shaft in the opposite direction, and the dial should rotate in the opposite direction. Again, confirm that one (1) revolution of the motor shaft in the reverse direction results in one (1) revolution of the dial. If the dial indicator turns more than (1) revolution, check the motor CD sheet to determine if the resolver poles are correct "Position Feedback Poles". **Looking at the motor shaft, turning the shaft clockwise should cause the dial to turn clockwise, and vice versa**.

3.2 Entering Motor Data into the AKD

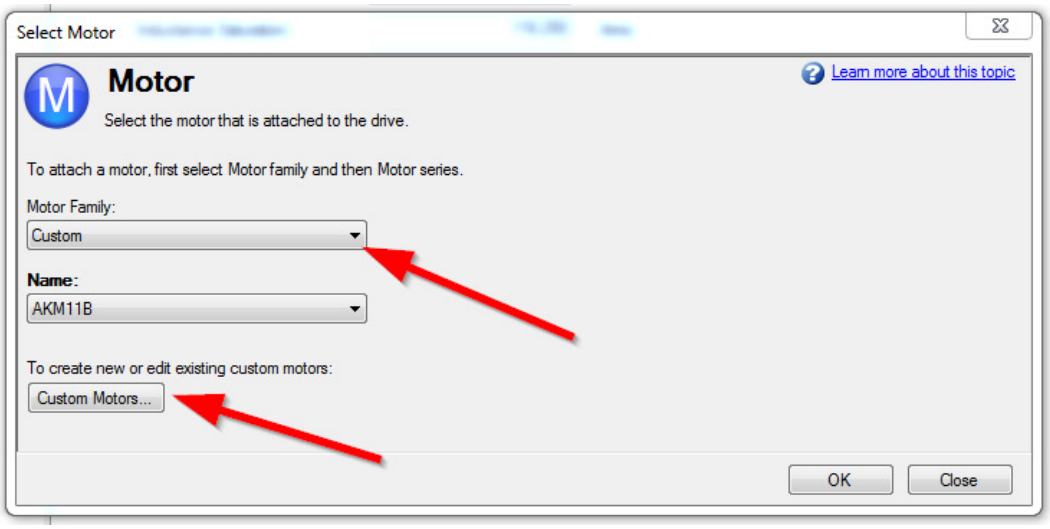
3.2.1 Click on “Motor” and then the screen below will appear. Now click on “Select Motor”.



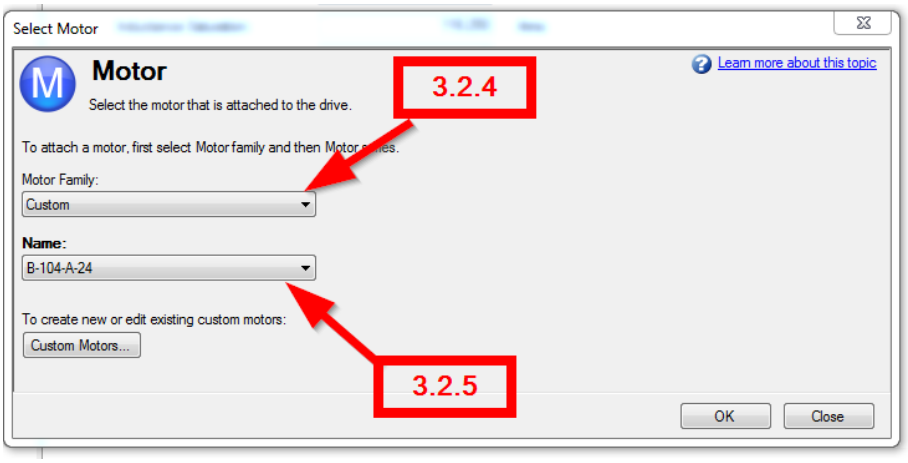
3.2.2 Create a name for the motor file.

–

3.2.3 Select the “Custom” in the pull down window. Now click on “Custom Motors”



3.2.4 In Motor Family select Custom.
3.2.5 In Name select the Motor’s name you created



3.2.6 The next step is to name the motor (in my example, a B-104-A-24) and input the motor data into the fields shown on page eleven (11). Typically, all fields except for two (2) can be found in the catalog or on a Catalog Data (CD) sheet, which can be obtained through your local distributor. Fields that prove to pose most problems include the following:

a. Inertia – Be alert to the units selected.

b. Pole Pairs – If the motor has four (4) poles (as in my example), it has "two (2) pole pairs". The number "2" goes in this field, and not four (4).

c. Coil Thermal Constant
There are 2 methodologies for determining the coil thermal constant of a motor not in the AKD's database.

Method 1 is to find an AKM motor with similar ratings and physical size (the amount of copper is the key to the coil thermal constant) and use the coil constant in the AKM's motor file in the custom motor file.

Method 2 is to estimate the value using the following formula. This is posted as an application note on our KDN (Kollmorgen Developer's Network).

http://kdn.kollmorgen.com/content/coil-thermal-constant-motorctf0

If the Coil Thermal Time Constant is not known but the Thermal Time Constant is know, you can use the following formula to estimate:

CoilThermalTimeConstant = 1,000 / (2 * PI * (thermalTimeConstant / 30.0))

Note the units for the thermalTimeConstant is in seconds. In the manual often the units are in minutes and must be converted accordingly. The units for the CoilThermalTimeConstant is 1/sec or Hz.

d. MOTOR.PHASE use Table 4

Table 4

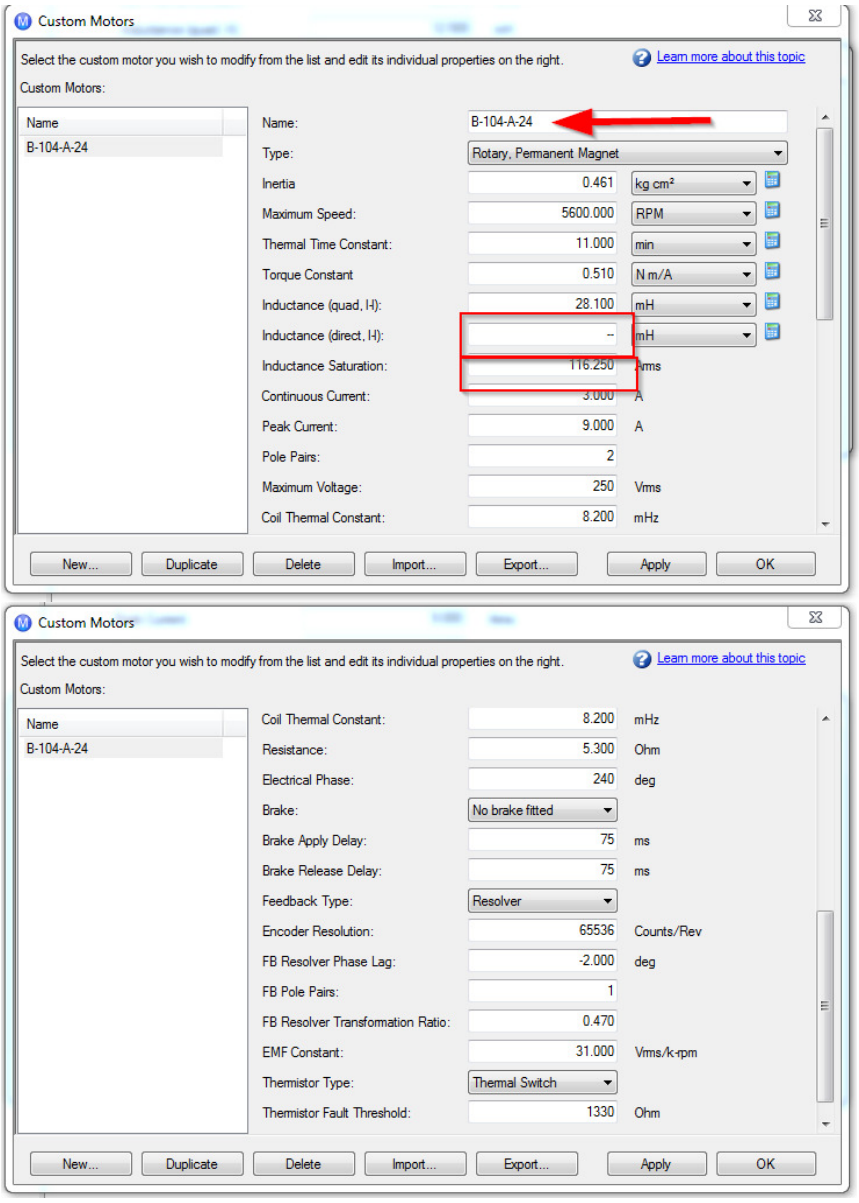
Motor Type	Number of Motor Poles	Motor.Phase Degrees
Goldline EB, M, and B -10X, 20X and 40X	**4**	**240**
Goldline EB, M, and B -60X and 80X	**6**	**150**
MT(XT) Low Voltage	**8**	**60**
Goldline BH and MH	**All**	**0**
MT(XT) High Voltage	**All**	**0**

NOTE: Table 4 Motor.Phase values are correct, if wiring is done as shown in Table 1 and Table 2 and motor resolver feedback alignment is set to the Kollmorgen standard.

Look below for an image of the Custom Motors screen.

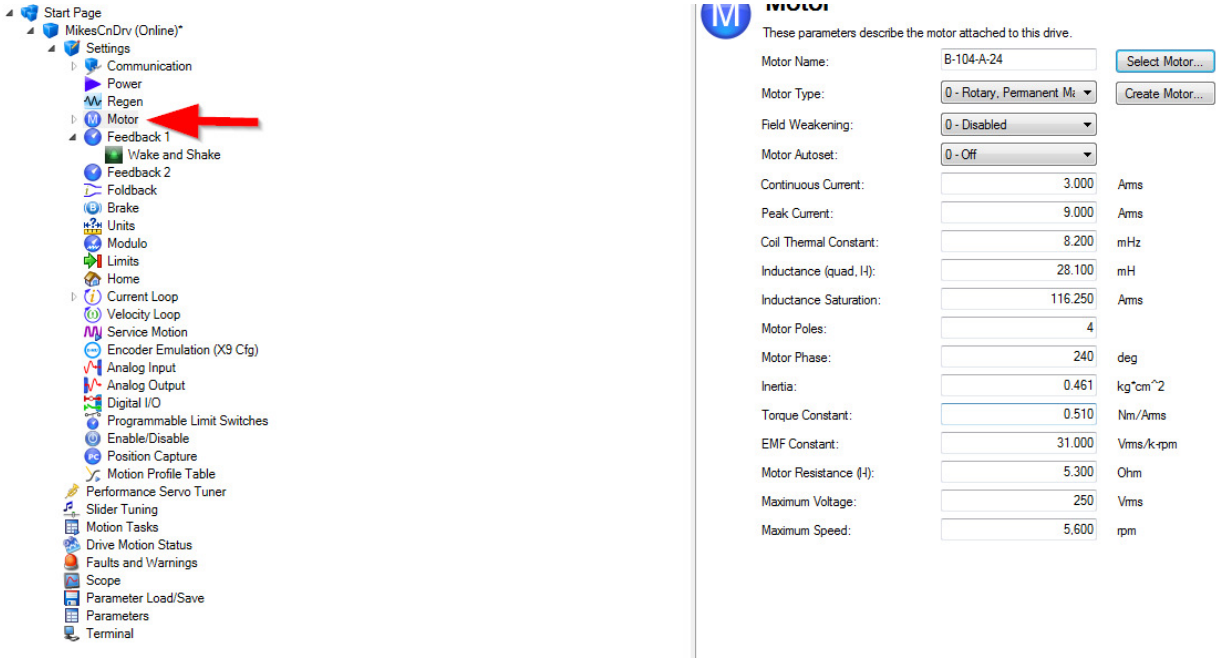
3.2.7 Inductance (direct, l-l) not applicable

3.2.8 Inductance Saturation leave as default value



3.2.9 After entering all motor data (in the fields shown on page ten (10) and eleven (11)), select “Apply” then “OK”. In the “Select Motor” window, select the motor you are using and hit “OK”. The window below will be visible.

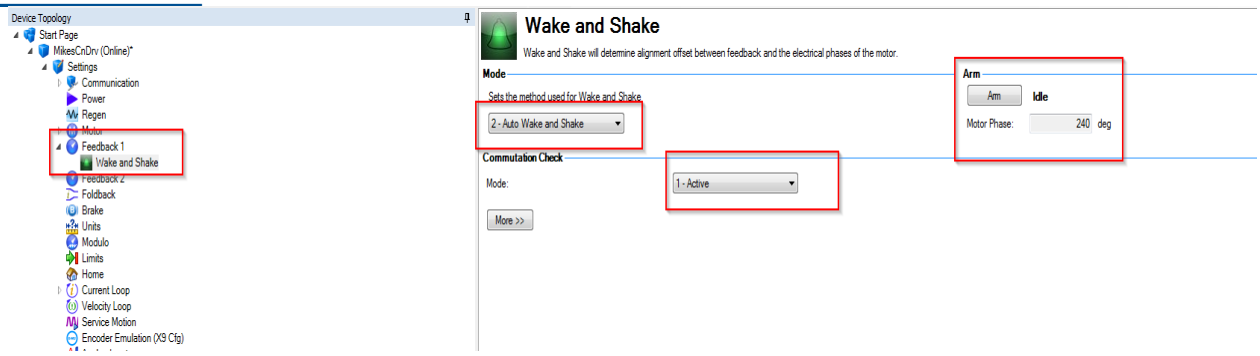
3.2.10 The data entered will now appear in the fields visible from the “Motor” tab, as shown on page 12.



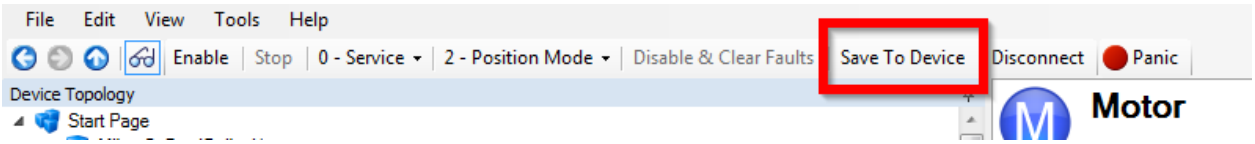
3.2.11 Commutation alignment check

From the Feedback 1->Wake and Shake screen, the mode can be changed to 2- Auto Wake and Shake. When you click the “Arm” button the motor will move and the Motor Phase as a read-only will appear. The motor should be free to turn and not connected to anything while you are attempting to setup and verify proper commutation. It is generally a good idea to run the commutation alignment check several times to see the value is approximately the same angle.

From under the Feedback 1 screen, go to the Wake and Shake screen.
Set the mode to 2- Auto Wake and Shake and set the Commutation Check as desired.
Disable the drive from the toolbar in Workbench and then press the Arm button. On re-enable the status changes from “Idle” to “Running”. Assuming “Successful” once the test is done, the Motor Phase is reported in degrees.

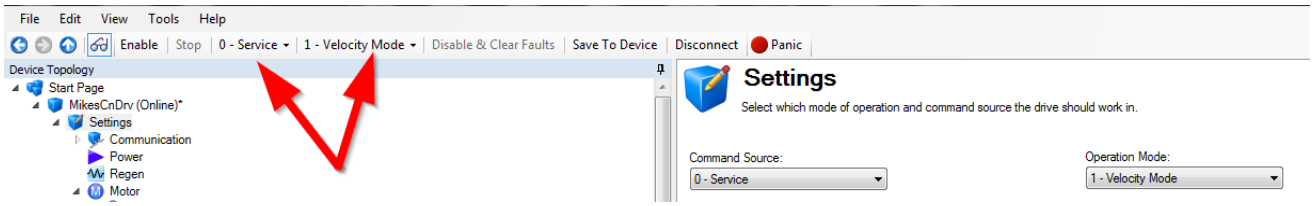


3.2.12 At the top of the Workbench screen, click on “Save to Device”.

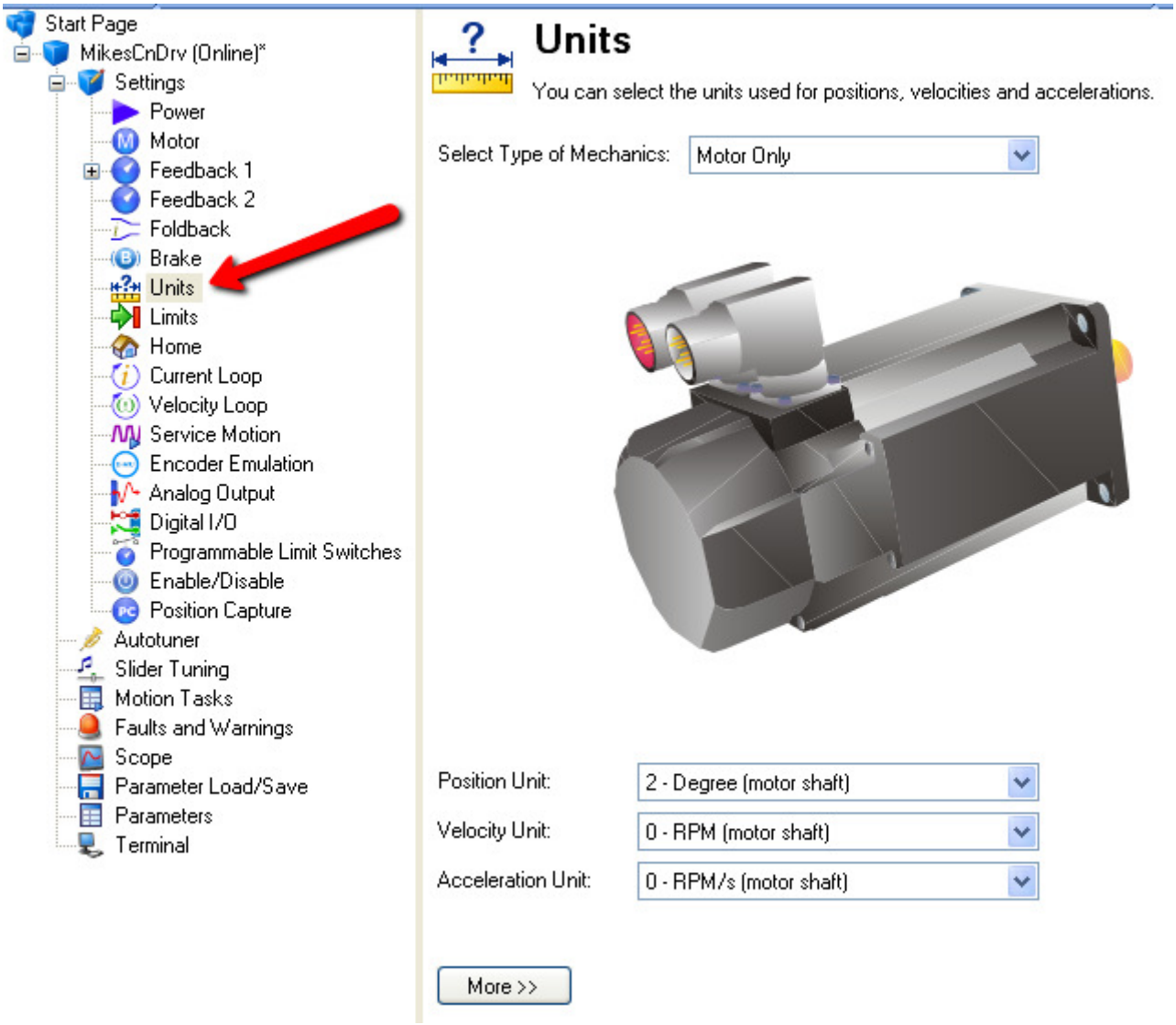


4.0 Running the Goldline Motor

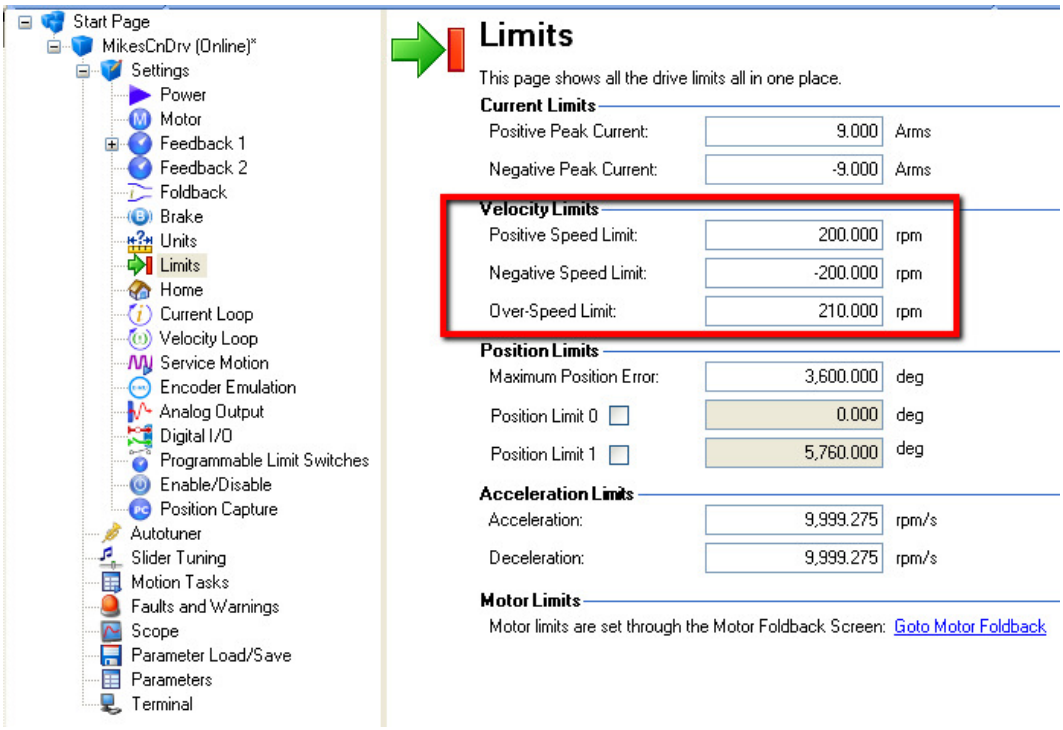
4.1 With the drive still disabled, and NO AC power applied to the drive, we want to set the drive to “Service Velocity” mode.



4.2 Looking at the parameters on the left side of the screen, we have to tell the drive if the motor has a brake (which my motor does not have) and what units we wish to use. For units, I am using "Motor Only" for the Type of Mechanics, and for Position Unit, I have chosen option 2 – Degree (motor shaft).

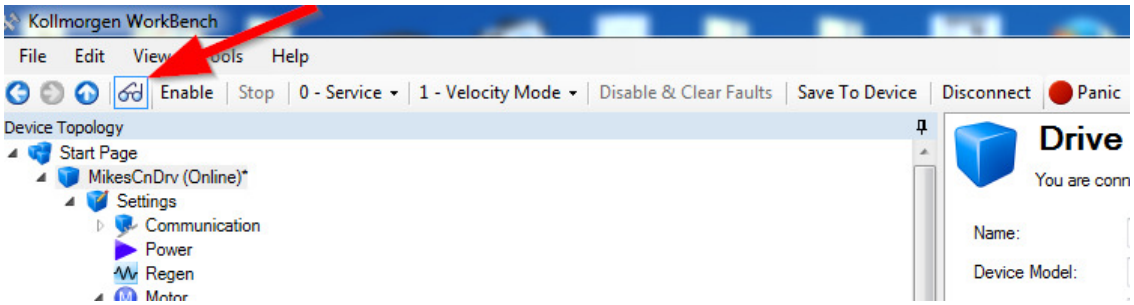


4.3 The next step involves setting our "Limits" fields. Current, velocity, position and acceleration limit values are entered here. **It is strongly suggested to set the velocity limits to a very low value, such as 100 or 200 RPM when first running the motor**.

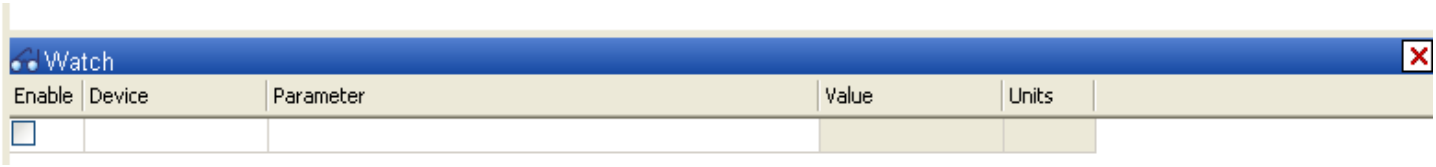


5.0 Running the Motor

5.1 Enable the "Watch" function within Workbench by clicking on the symbol of the glasses. This is located by the Enable / Disable button on the toolbar.

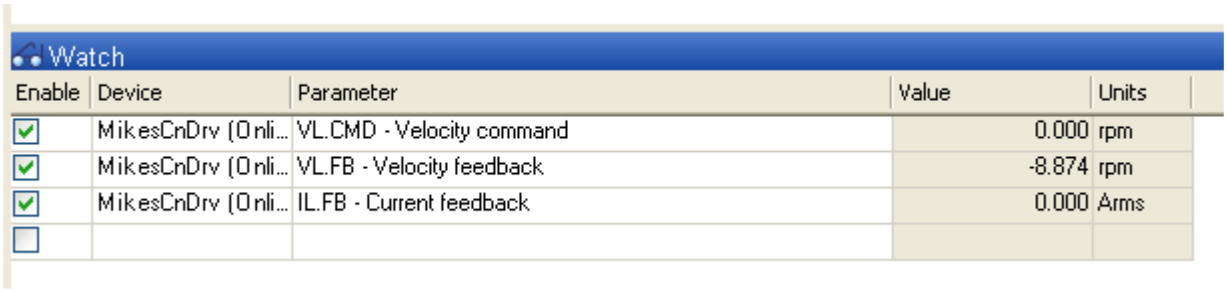


5.2 The view below will appear at the BOTTOM of your screen.



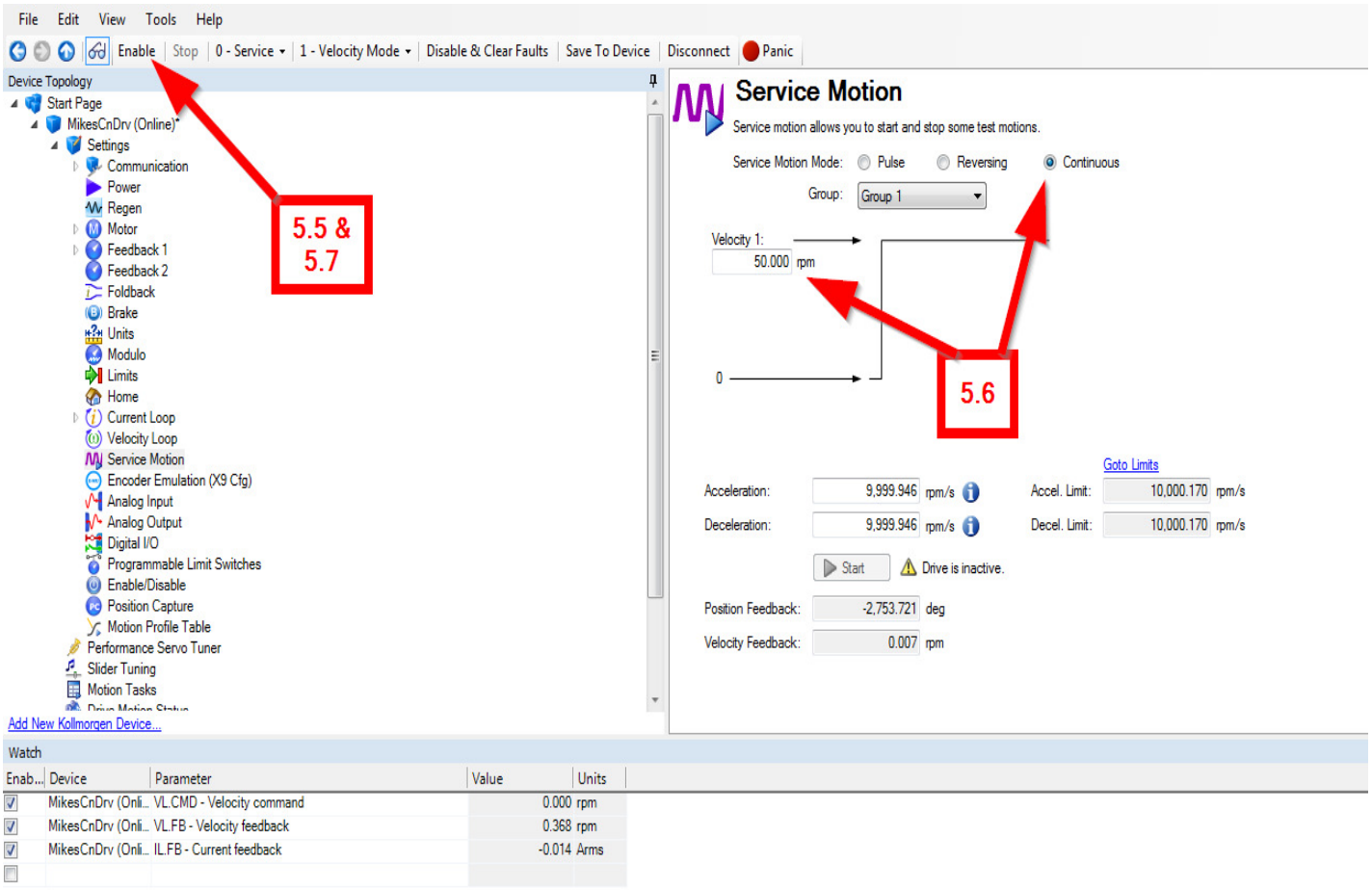
5.3 Click within the box under the "Device" column, and pick the name of your drive. Do this two (2) more times.

5.4 In the top box, under the "Parameter" column, select "VL.CMD" for Velocity – Command, followed by "VL.FB" for Velocity – Feedback, and finally select "IL.FB" for Current Feedback. Your "Watch" window will look like the image below.



5.5 Apply AC power to the drive. Leave the software enable "off", so that the drive is disabled. **(NOTE: When the software enable is "off", the display shows "Enable".)**

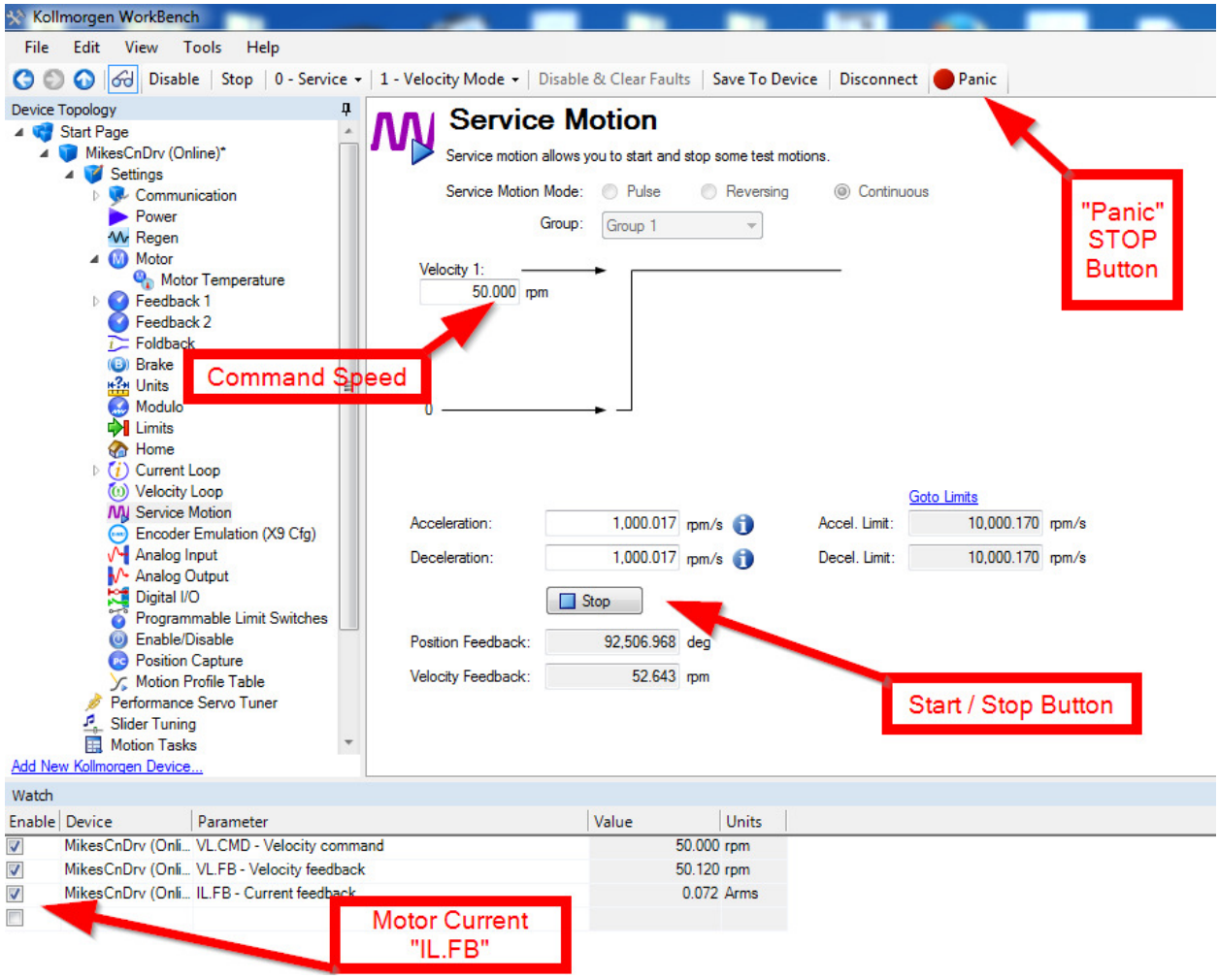
5.6 In the "Service Motion" screen, set the motion mode to "Continuous" and the Velocity to a low speed, such as 50RPM.



5.7 Activate the STO input, as well as the hardware and software enables. The motors shaft should NOT turn, but should have torque on it.

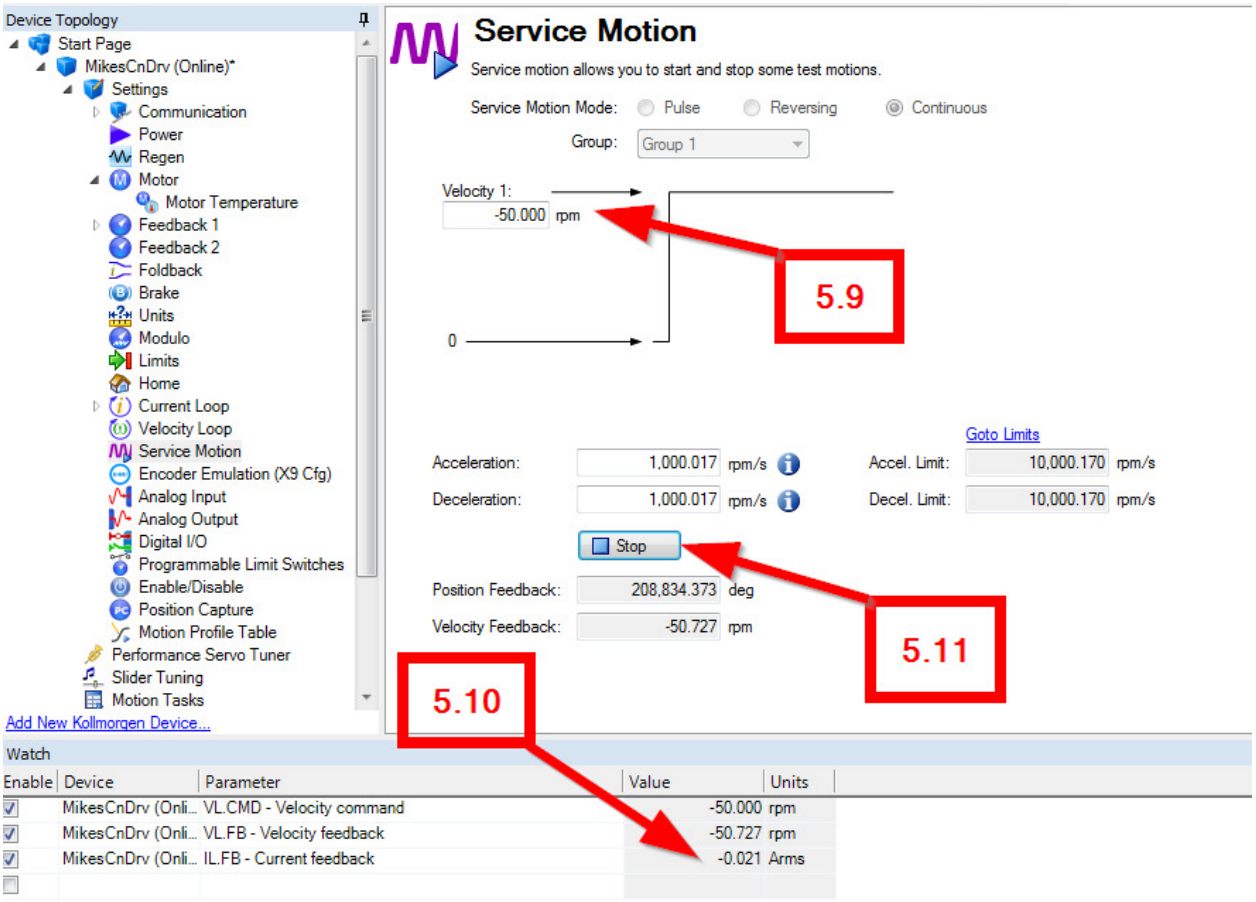
CAUTION: *We are now ready to command motor movement*. Make sure the motor is uncoupled from the load and that all personnel are clear of the motor shaft. If the motor does not perform as outlined, be ready to hit an E-Stop button or the "Panic" icon at the top of the Workbench screen, as shown below.

5.8 Confirm that the drive is enabled and in Service Velocity mode. By pressing "Start", the motor should run at 50 RPM.
5.8.1 Observe the direction of motor rotation. Note if it is clockwise or counter-clockwise.
5.8.2 Note the motor current, in the "Watch" window, parameter IL.FB. In my example, my current in this direction is 0.021 to 0.072 Arms.



5.9 We now have motion from the Goldline motor. Press the "Stop" button in Workbench and place a negative "-"sign in front of the speed and hit "enter". Now Velocity 1 (command) is –50RPM. Press the "Start" button and the Velocity Feedback should be reading around –50RPM. (See screen shot below.)

5.10 Note the current to rotate the motor at the same velocity, but in the opposite direction. This should be close to the initial current reading noted in step 5.8.2. This test is called the "Reversing Error" test.



5.11 Press the "Stop" button, then **disable** the drive with the software and/or hardware enables. You can now begin adjusting the limits for your application, setting up your I/O, programming, tuning, etc. What we have covered are simply the details required to connect and verify operation of the Goldline motor with the AKD servo drive.