INSTALLATION MANUAL
FOR
VEGA 2799503
USING K5700 WITH 1326AB-Bxx, 1326AH-B3xx, 1326AH-B4xx, 1326AH-B4xx, 1326AH-B5xx, 1326AS-B3xx, 1326AS-B4xx MOTORS

Document: 2799100
Revision: 05
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FUNCTIONAL OVERVIEW

Specifications

Excitation 2 Phase:	10 kHz
Resolver Input:	0.8 to 18 vpp
Power Requirements:	4.8-5.4 vDC @ 250 mA
Drive Capacity:	200 mA Peak
Mechanical:	1.485 x 4.58 x 0.85
Accuracy:	+/- 3 arc minutes typical

Tracking Rate

The 2799 board was designed for high speed applications. The standard converter accuracy is +/- 3 arc minutes. The maximum tracking rate is a function of the excitation frequency. With a 10 kHz excitation the maximum tracking rate would be 36,621 RPM.

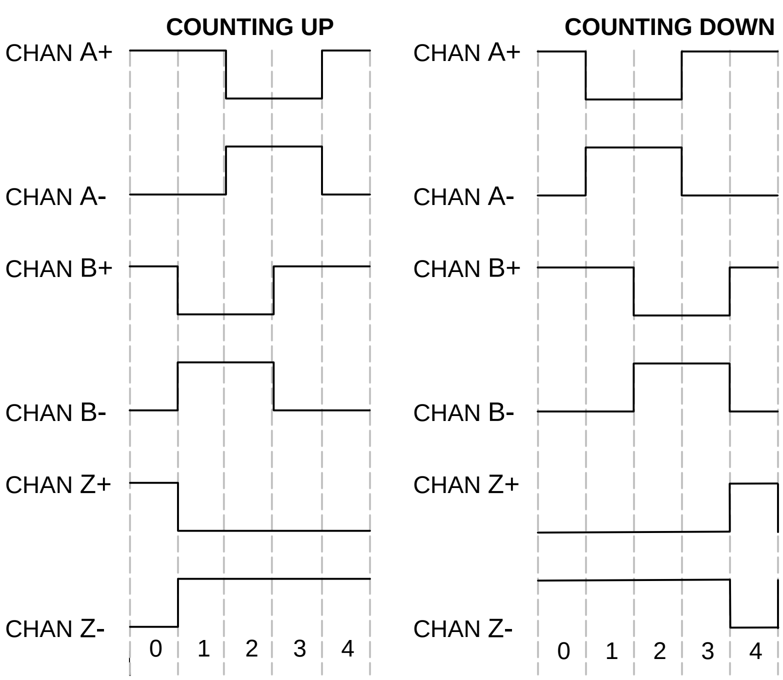
Quadrature Output

The VEGA 2799 series of converter boards use RS-422-A differential drivers to provide 40 mA into a 100 ohm differential load. These outputs are also TTL compatible.

The output latency is dependent on the excitation frequency. With a 10.0 kHz excitation the response will be less than 50 uSec.

Quadrature is provided via Channel A+, Channel A-, Channel B+ and Channel B-. A count is considered to occur whenever there is a transition in either the Channel A or Channel B output signals. The Channel Z (Index) occurs once per resolver cycle.

QUADRATURE OUTPUT FORMAT



Fault Output

The 2799 series will tri-state the A-Quad-B signals during a fault condition (HI or LO signal level). This interface will allow an immediate fault sense by equipment with loss of signal detection. The 2799 series will also open the contacts of the solid state relay between connector P1 terminals 11 and 12 to indicate a fault has occurred. This solid state relay can drive a 600 mAmp load.

Thermal Switch

The 2799503 is set for thermal switch applications and filters the thermal switch signal and passes it directly to the K6500 drive for processing.

Personality Module

The personality module contains the firmware. The firmware includes many system parameters including the quadrature resolution (8192 counts per tranducer cycle typical), the number of hall cycles per resolver cycle, and the hall offset for commutation purposes.

Status LED's

The 2799 series of converters has three LED indicators to show power, fault and high signal detection

PWR = Power Status Indicator
FLT:
- **1 Flash** = Low Signal
- **2 Flash** = High Signal
- **3 Flash** = PUPV Fault (Power Up Position Valid)
  power up position detected +/- 16 counts of error from the powered down last position
  Model 2799512 only
- **4 Flash** = Low Signal Intermittent
- **5 Flash** = High Signal Intermittent

HSG = High Signal Indicator

Test Points

The 2799 series of converters has three test points for trouble shooting purposes. These test points are located on the bottom of the board and the plastic housing must be remove to access them.

GND = Analog Ground
ST1 = Stage 1 Signal (3.8 vDC Peak to Peak)
SCL = Tracking Clock

COMMUTATION OVERVIEW

Commutation

Originally, dc motors used commutators and brushes to commutate the current in a wound rotor to provide torque in one direction or the other. Brushless dc motors use magnets on the rotor instead of windings, and require a means for indicating to the drive electronics the orientation of the motor shaft in order for the electronics to commutate the current to the stator windings.

Early brushless dc motors frequently used auxiliary magnets mounted on the rotor and 3 Hall effect detectors on the stator to indicate the orientation of the rotor. The Hall effect detectors would indicate 6 distinct rotor positions to the drive electronics. Later motors frequently used integral resolvers to detect the rotor position, and the associated electronics would provide signals which emulated the output of the Hall detectors.

Motor Poles

Brushless dc motors are frequently specified to have 2, 4, and sometimes 6 or more poles. The motors are invariably three phase. Current is commutated among the three windings to provide a magnetic field vector that rotates in one direction for clockwise and the other for counter-clockwise. The magnetic field vector will make one rotation per three phase electrical cycle. A 2 pole motor has a single magnet on the rotor with a north and a south pole, hence 2 poles or one pole pair. A 4 pole motor has 2 magnets, each with a north and a south pole, hence 4 poles or 2 pole pairs, and so on.

A 2 pole (single magnet) motor will make one rotor rotation per rotation of the magnetic field vector. That is, the rotor will make one revolution per motor electrical cycle.

A 4 pole (two magnet) motor will require two electrical cycles to make one revolution, and a 6 pole (3 magnet) motor will require three electrical cycles per revolution.

A three pase Brushless motor will have 3 windings. A 2 pole motor will have the windings distributed to 3 stator poles spaced 120 deg. apart. A 4 pole motor will have its windings distributed to 6 stator poles spaced 60 deg. apart. A 6 pole motor will have its windings distributed to 9 stator poles spaced 40 deg. apart.

Hall Effect Emulation

Similarly, for appropriate commutation, the Hall effect emulation must provide one Hall cycle per motor electrical cycle. That is, a 2 pole motor will require one Hall cycle per revolution, a 4 pole motor, two Hall cycles per revolution, and a 6 pole motor, three Hall cycles per revolution.

Resolvers

Resolvers are sometimes similarly described as having 2, 4, or more poles. This simply means that the resolver makes respectively, one, two, or more, electrical cycles per rotor revolution.

Required Hall Cycles

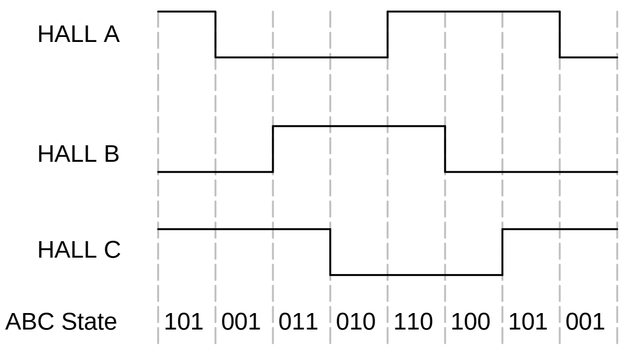
Reduce everything to cycles. There will always be one Hall cycle per motor electrical cycle. There will always be an integral number of resolver cycles per shaft revolution. And there will always be an integral number of Hall cycles per resolver cycle.

The number of hall cycles required for a motor can be calculated by dividing the number of motor pole pairs by the number of resolver pole pairs. Such that a 6 pole motor using a 2 pole resolver will require 3 hall cycles. The number of hall cycles is set by the firmware on the personality module. You must have the correct firmware to run the motor based on the number of hall cycles required.

Hall Outputs

Motors with Hall Effect Sensors and magnet are arranged to provide an output from the sensors to which the magnet is adjacent. The magnet may be adjacent to one sensor or between two sensors. When it is between two sensors, both sensors output a signal. This permits the detection circuitry to resolve the motor shaft position into 6 different sectors. The 2800 series produce signals that emulate the Hall Effect sensors for a seamless interface. The 2799 series supports up to 12 hall cycles per resolver cycle.

HALL EFFECT OUTPUT FORMAT



THEORY OF OPERATION

The return signal level is monitored for high signal level (HSG LED), and low signal level (FLT LED). During a low level detection or loss of power to the board the fault relay contacts will open (connector P1 terminal 11 and 12). The A-Quad-B outputs will be tri-stated during and after fault detection has occurred. The A-Quad-B will NOT be tri-stated in a power up position valid (PUPV) fault condition.

The Z channel (Marker Pulse) will occur once per resolver cycle (resolver pole pair) and will occur around 90 degrees from the sine excitation.

The power-up sequence for the 2799 is as follows:

1. The 2799 allows 50 mSec for the power to stabilize
2. The 2799 will then initialize the A-Quad-B outputs with channel A and B active (high state) and the Z channel (index/marker) to inactive (low state).
3. The input gain is then adjusted to mid-range as described below. This process will take 150 mSec.
    a. The input gain is set to the minimum level with the low level gain detection on (red FLT LED)
        i. The 2799 will flag a “LOW LEVEL” fault if it is unable to adjust the gain out of the low level band.
    b. The gain is increased until high level gain is detected (yellow HSG LED).
        i. The 2799 will flag a “HI SIG” fault if it is unable to adjust the gain out of the high level band.
    c. The gain is then set to the mid point of the low level detection and the high level detection.
4. 200 mSec after power on the 2799 will then set channel A and B inactive (low state) and set the Z channel (index/marker) active (high state).
5. The 2799 will then interpolate out quadrature counts to the nearest marker pulse. The interpolation rate during this period is fixed (1 mHz) and the time required for interpolation is based on the selected resolution.
6. After interpolating out the position to the nearest null, the 2799 will set the hall states based on the current motor shaft position to the resolver cycle.
7. The 2799 will then set the fault relay output based on any faults detected during and after the power-up sequence.
8. If low signal and high signal faults are not present, the 2799 will track the resolver position and output quadrature counts.
9. Once tracking has started, any feedback fault will cause the A-quad-B to be tri-stated. This will cause the drive to fault and shut down. Power must be cycled to clear the fault on the 2799 board.

CABLE & CONNECTIONS

Cable Specifications

The 2799 series converters provide stable and precise sine and cosine excitations. These signals and the return signal are analog and proper routing and shielding techniques should be observed. Shielded twisted pair cables with drain wires and an overall braided shield should be used for the resolver interface.

P1 Resolver and I/O Connector

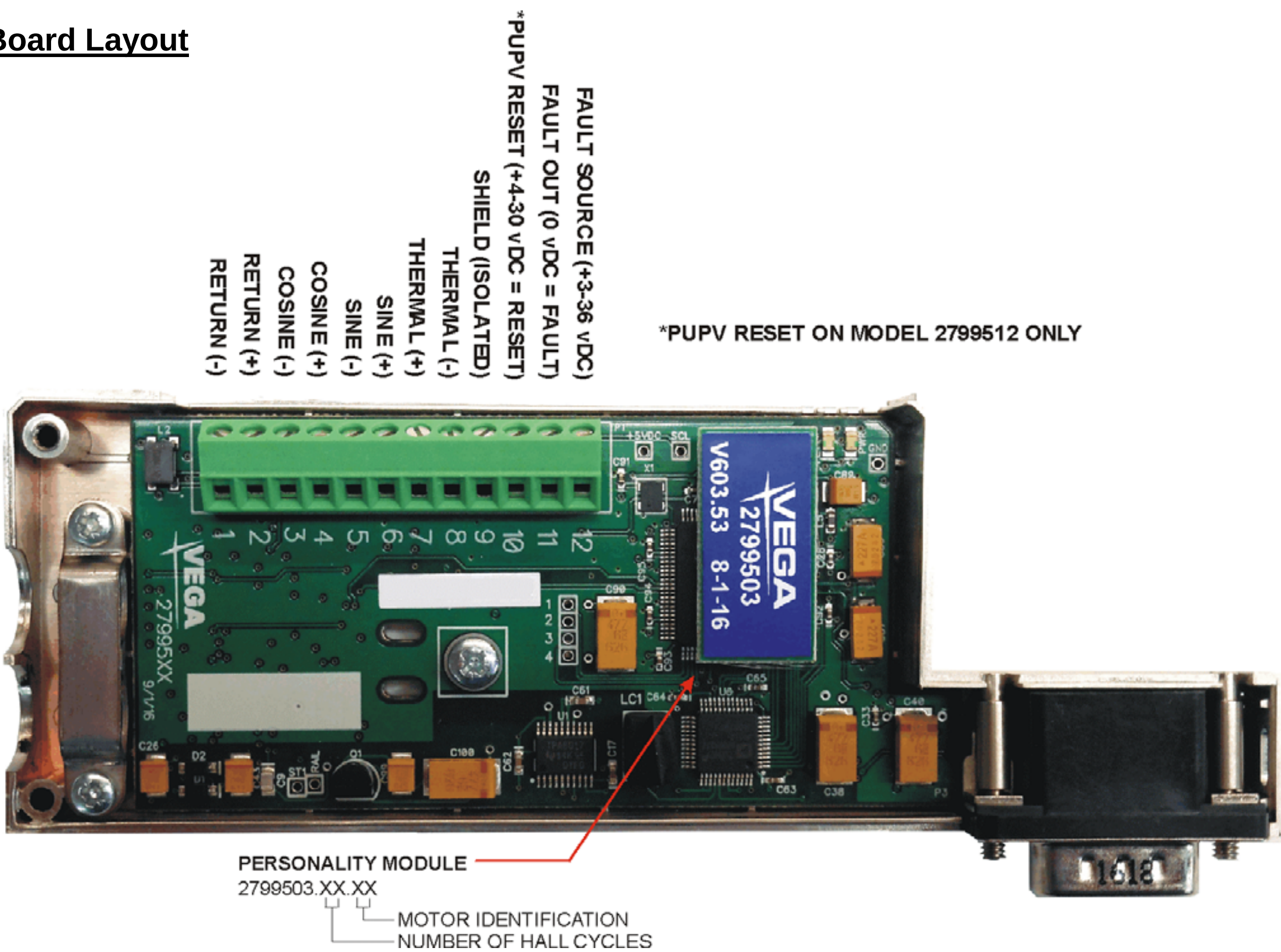
PIN#	FUNCTION	1326 Cable COLOR	1326-CCUT COLOR
1	Rtn-	Black	Blk/Wht
2	Rtn+	White	White
3	Cosine-	Black	Blk/Wht
4	Cosine+	Green	Wht/Grn
5	Sine-	Black	Blk/Wht
6	Sine+	Red	Wht/Red
7	Thermal IN	Clear	Clear
8	Thermal OUT (GND)	Black	Black
9	Shield (Isolated)	*Shield	*Shield
10	PUPV Reset (+24 vDC)		
11	!Fault (0 vDC = Fault)		
12	Fault IN (+24 vDC)		

*Use Shield Clamp to terminate braided shield and drain wires

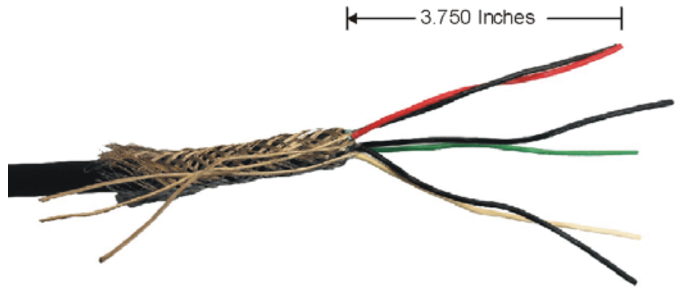
P3 K5700 Connector

PIN#	FUNCTION
1	Channel A+
2	Channel A-
3	Channel B+
4	Channel B-
5	Channel Z+
6	DC Ground
7	No Connect
8	Hall C+ (S3)
9	No Connect
10	Channel Z-
11	Thermal Fault (0 vDC = Fault)
12	Hall A+ (S1)
13	Hall B+ (S2)
14	+5 vDC
15	No Connect

Board Layout

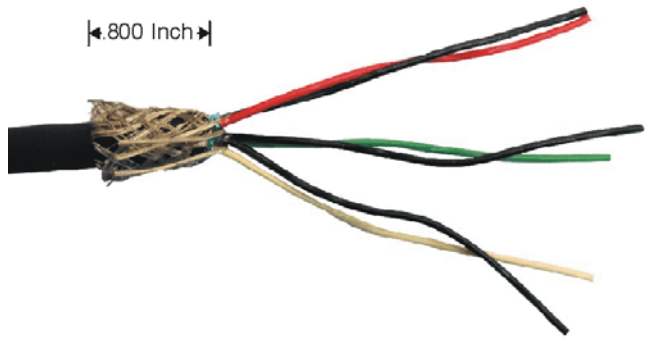


1326 CABLE INSTALLATION



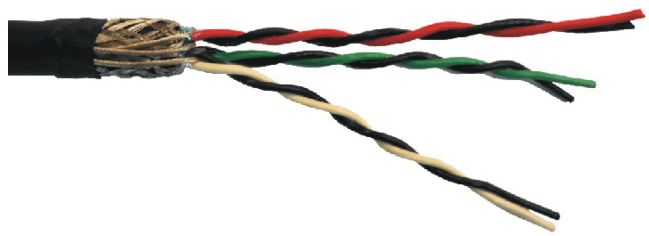
1) Strip the cables outer insulation 3.750 inches from the end and fold the braid shield back over the outer cable insulation.

2) Remove the individual shielded pairs insulation and fold the drain wires from the individual shielded pairs back over the braided shield.



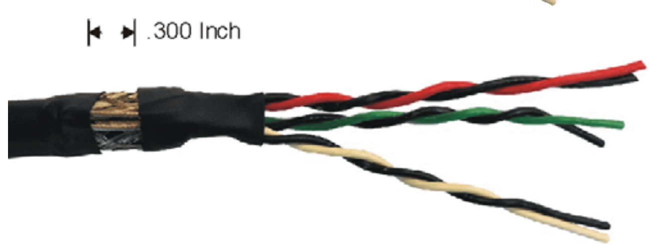
3) Trim the braided shield and drain wires to 0.800 inches from end of the cable insulation.

4) Organize the drain wires so that all of them are on one side of the cable and they are next to each other.

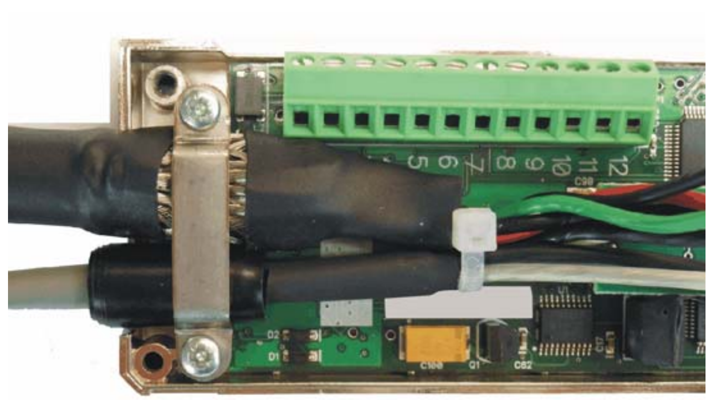


5) Twist the individual shielded pairs together so that the pairs can be identified during termination.

6) Cut a piece of shrink tube 1.000 inch long and slide it over the cable so that the last 0.250 inch of the braided shield and drain wires are covered.



7) Cut a second piece of shrink tube 1.000 inch long and slide it over the cable so that the first 0.250 inch of the braided shield and drain wires are covered and there is 0.300 inch of braided shield and drain wires exposed in the center.



8) For motors with thermal switches with wires routed through the motor power cable. Use single twisted pair wire with a drain wire for the connection. Insulate the drain wire to insure it does not short to nearby components. Build up the wire diameter using electrical tape to match the diameter of the feedback cable.

9) With the drain wires exposed at the bottom to the metalized plastic housing, install the shield clamp over the exposed braided shield.

10) Inspect the shield clamp to insure that there are no loose wire strands that could potentially short to nearby components.

11) Install the provided tywrap through the mounting holes on the board and plastic housing as an additional strain relief.

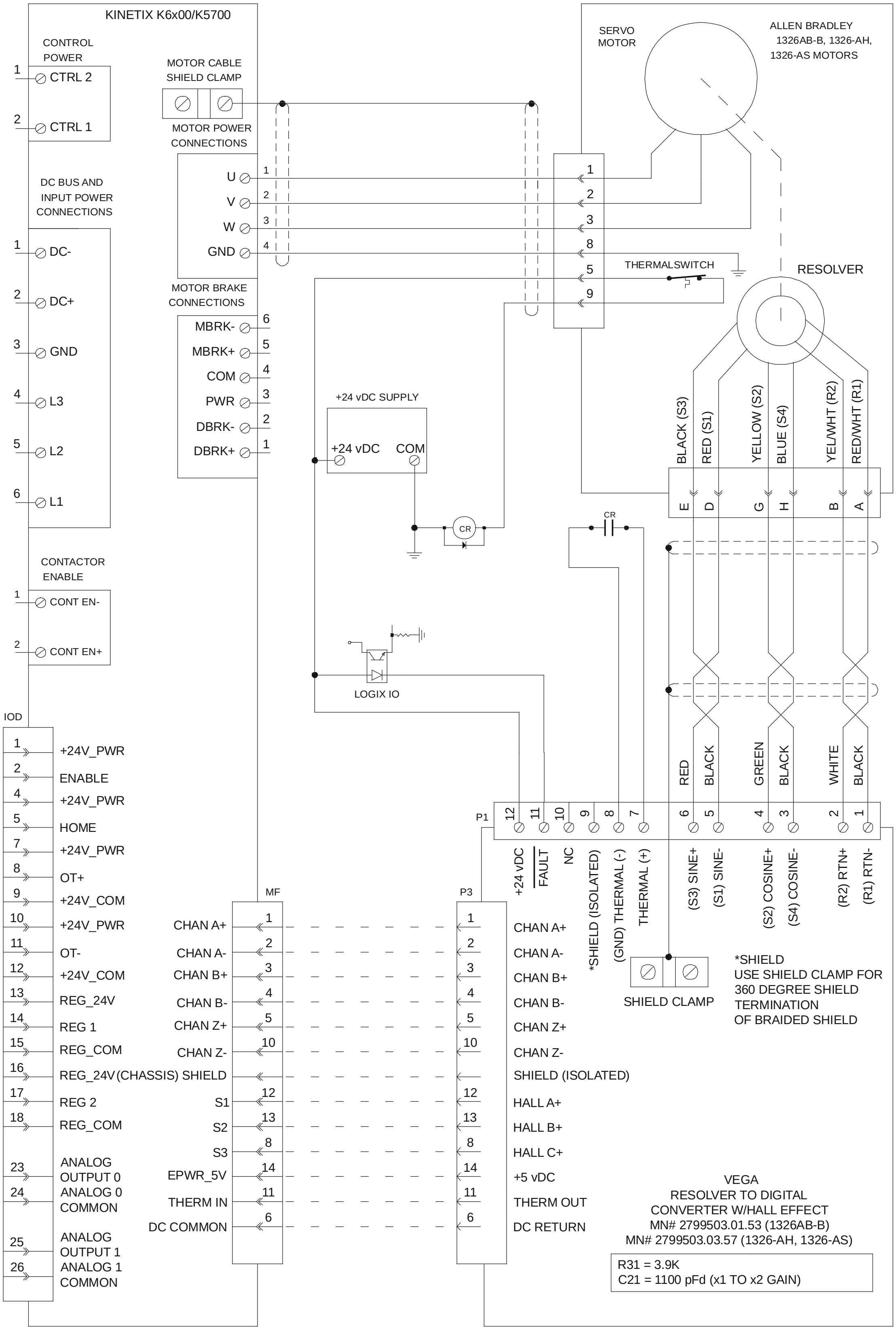
12) Trim the length of the wires as needed and terminate the wires as described in the application drawing.

13) Install the upper plastic housing on the unit and tighten the cover screw.

14) Insure that the drive power is turned off. Install the converter on the drives MF connector and tighten the jack screws

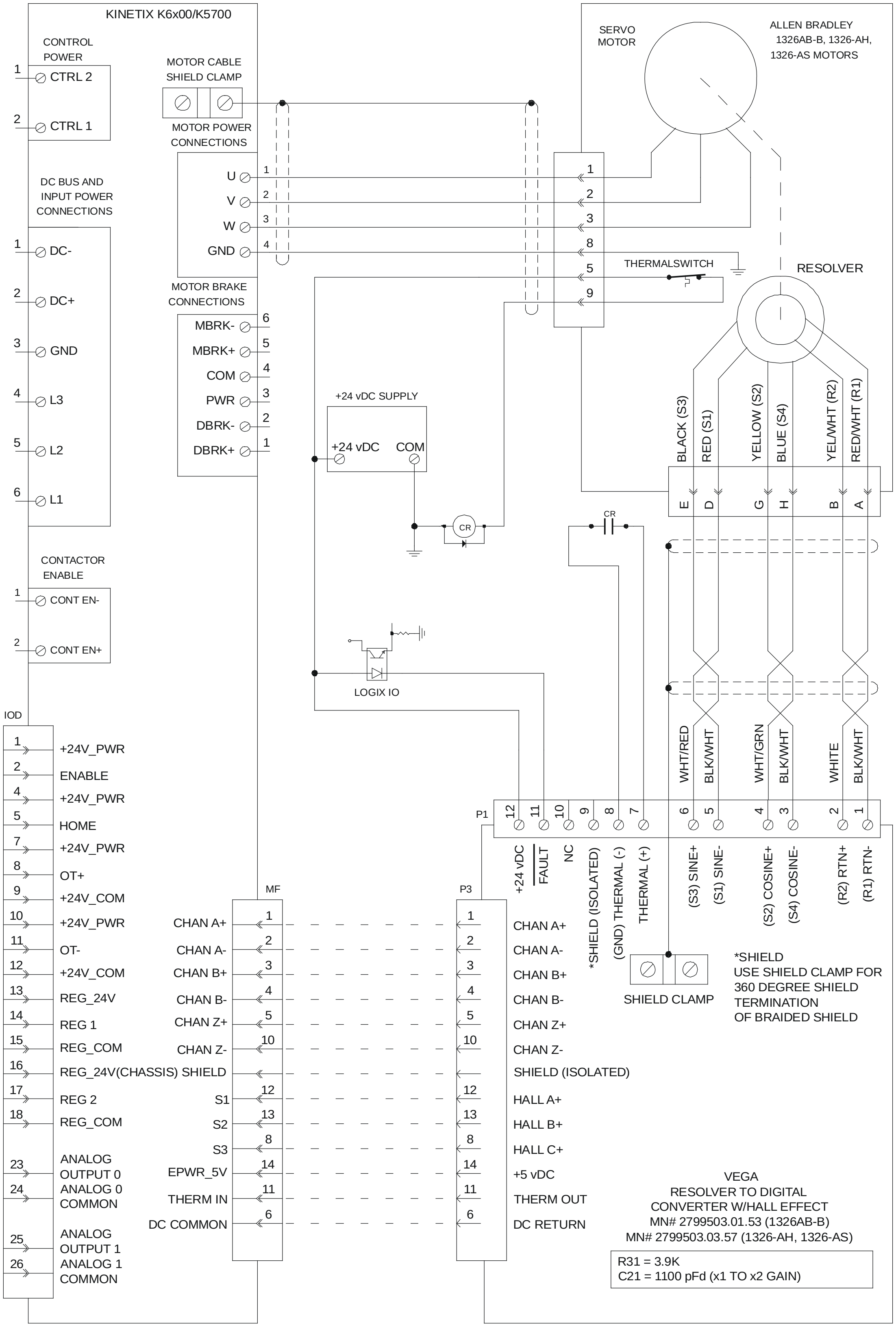
15) Proceed to the K5700 Configuration.

1326 CABLE APPLICATION DRAWING



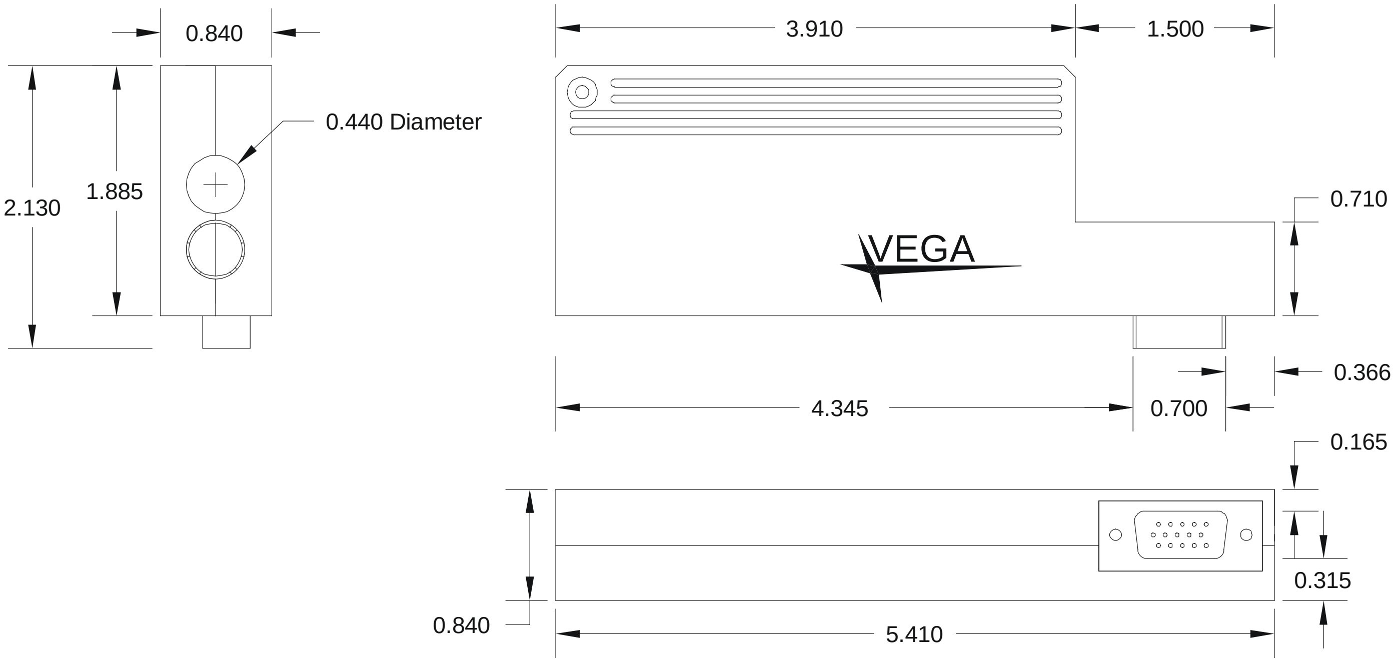
UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS 2 PLACES .010 ±3 PLACES .005 ± ANGLE 2± ° BREAK ALL SHARP EDGES .005 REMOVE ALL BURS	VEGA CNC 1270 SOUTER BLVD. TROY, MI 48083	SCALE N/A DRAWN CODY CHECKED CODY ENGINEER WLH DATE 8-24-17	NAME: 2799503.01.53 2799503.03.57 Kintetix K6x00 & K5700 1326AB-B, 1326-AH, 1326-AS Motor with 1326 Cable
FINISH			
MATERIAL	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE OR USED FOR MANUFAC-TURING PUPOSES WITHOUT WRITTEN PERMISION FROM INNOVATIVE SUPPORT SERVICES INC.	W.O.# 2799 SHEET NO. 1 OF 1	DRAWING NUMBER 2799100.002 / CHANGE 3

1326-CCUT CABLE APPLICATION DRAWING



UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS 2 PLACES .010 ±3 PLACES .005 ± ANGLE 2± ° BREAK ALL SHARP EDGES .005 REMOVE ALL BURS	VEGA CNC 1270 SOUTER BLVD. TROY, MI 48083	SCALE N/A DRAWN CODY CHECKED CODY ENGINEER WLH DATE 8-24-17	NAME: 2799503.01.53 2799503.03.57 Kintetix K6x00 & K5700 1326AB-B, 1326-AH, 1326-AS Motor with 1326-CCUT Cable
FINISH			
MATERIAL	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE OR USED FOR MANUFAC-TURING PUPOSES WITHOUT WRITTEN PERMISION FROM INNOVATIVE SUPPORT SERVICES INC.	W.O.# 2799 SHEET NO. 1 OF 1	DRAWING NUMBER 2799100.002 CHANGE 1

MECHANICAL DRAWING

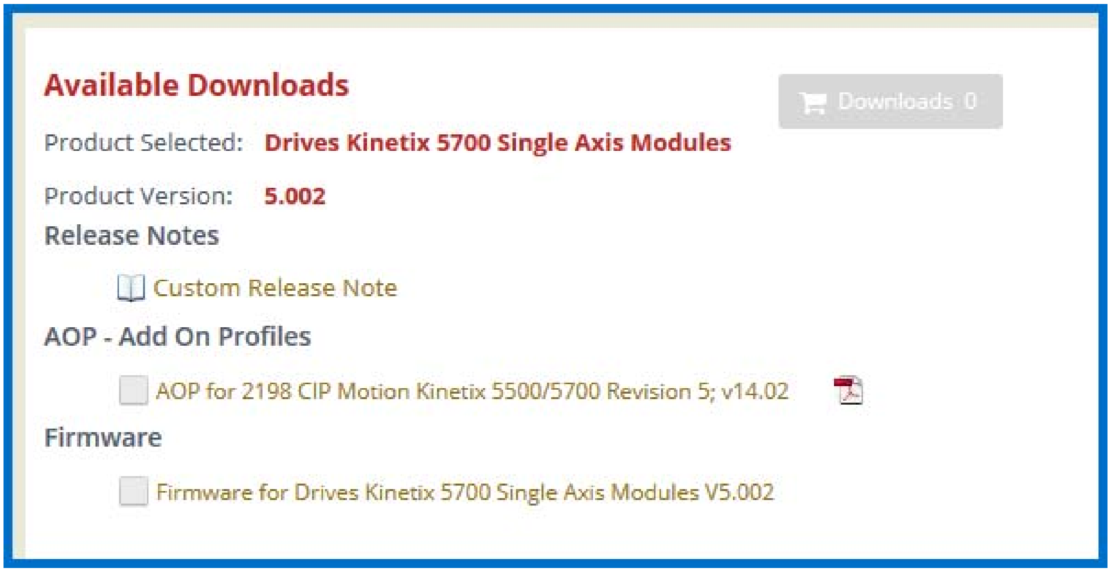


UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS 2 PLACES ±.010 3 PLACES ±.005 ANGLE ±2° BREAK ALL SHARP EDGES .005 REMOVE ALL BURS. ALL UNITS ARE IN INCH.	VEGA CNC 1270 SOUTER BLVD. TROY, MI 48083	SCALE N/A DRAWN CODY CHECKED CODY ENGINEER WLH	NAME: 27995xx Housing For Kinetix K5700 Drive
FINISH	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE OR USED FOR MANUFAC-TURING PUPOSES WITHOUT WRITTEN PERMISION FROM INNOVATIVE SUPPORT SERVICES INC.	DATE 8-30-17 W.O.# 2799	DRAWING NUMBER 2799402
MATERIAL		SHEET NO. 1 OF 1	CHANGE 0

K5700 CONFIGURATION

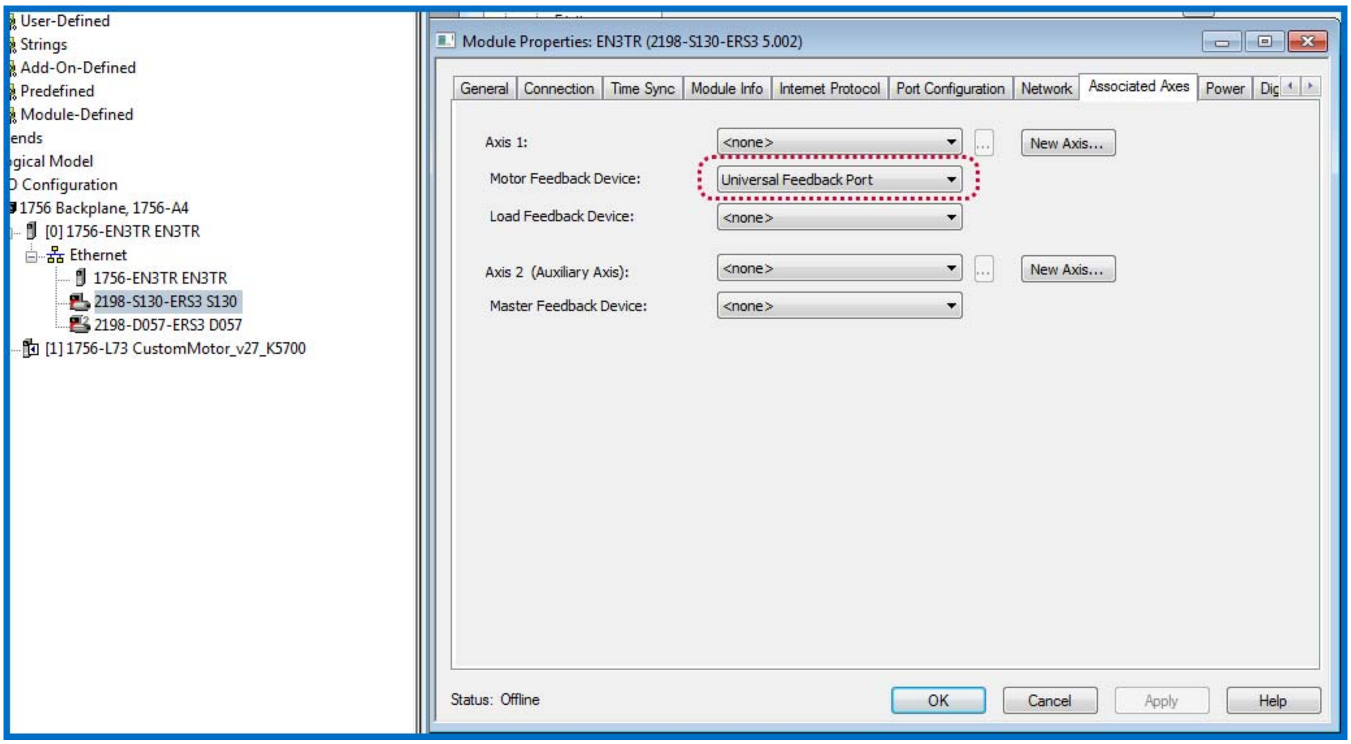
Add On Profiles

Insure that the latest AOP is installed to enable the v4.001 & v5.002 features required to set-up the VEGA Resolver to Digital interface.



Universal Feedback Port Setup

Under the Associated Axes Motor Feedback Device: select "Universal Feedback Port"



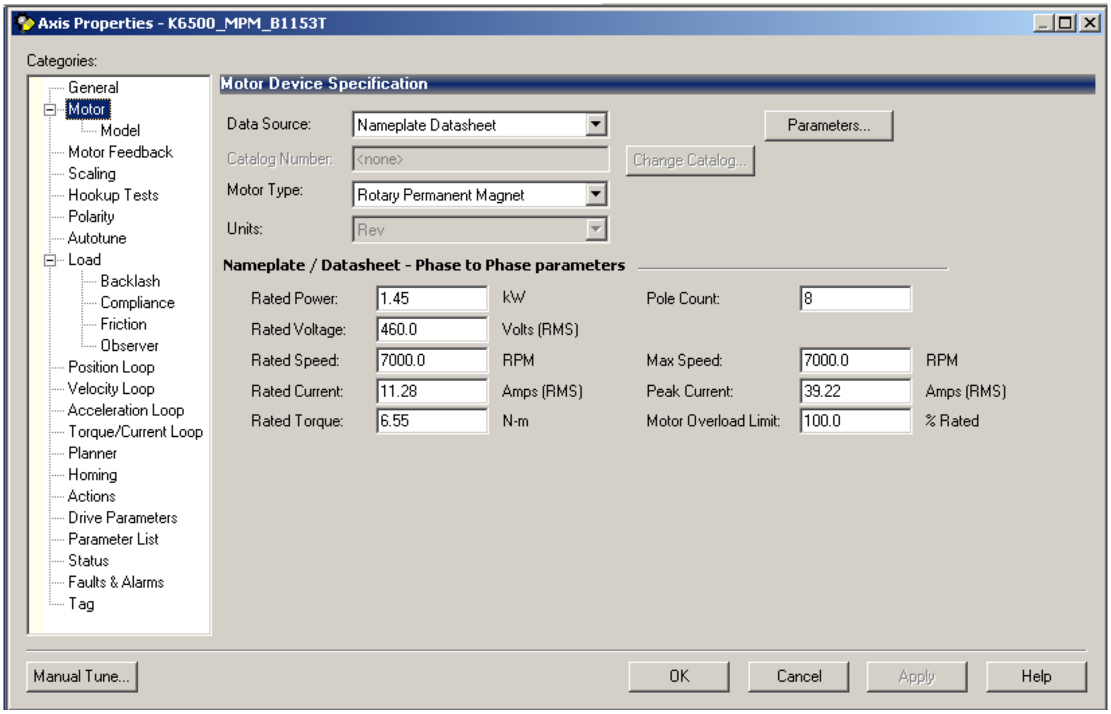
Axis Properties Motor Data

In the Axis properties on the Motor tab "Data Source" select Nameplate Datasheet" and enter the motor data.

Extracting Motor Data Parameters

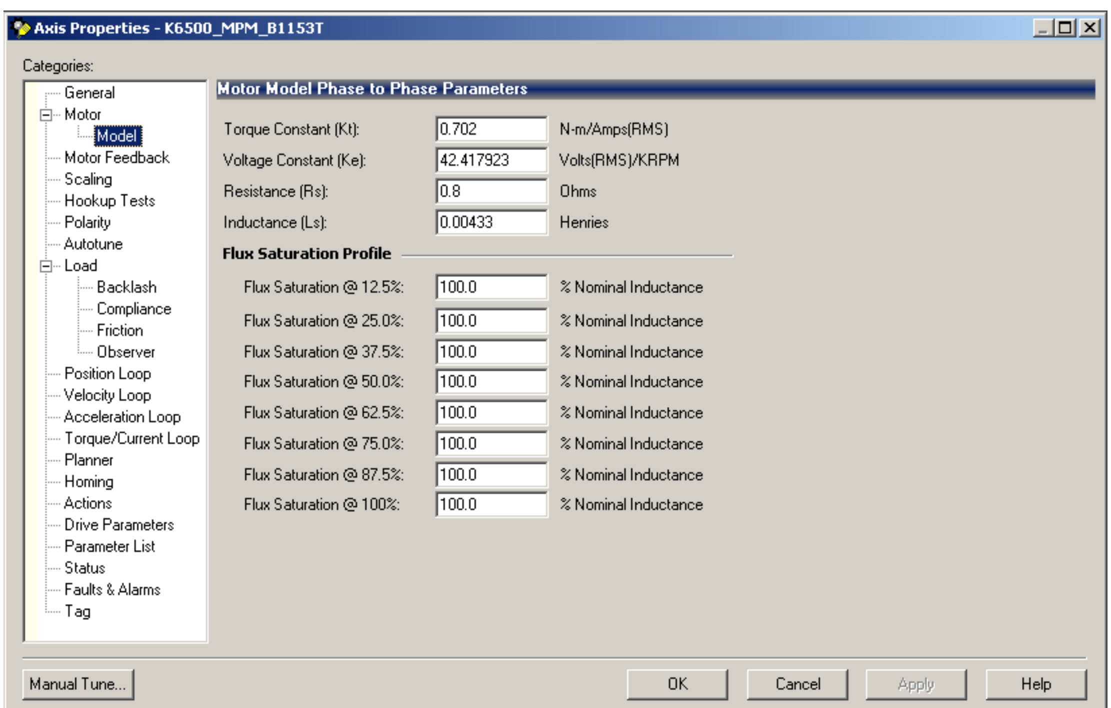
If you are unsure of the motor parameters for a motor, you can select an identical motor with a Rockwell Automation supported feedback device and copy the motor parameters from it. Example: You are working with a MPL-B320P-RJ72AA resolver motor. You can change the "Data Source" to "Catalog Number", then press the "Change Catalog" button and search for a similar motor like MP-B320P-M. Then copy the data from the "Motor" tab and the "Model" tab.

Then select "Nameplate Datasheet" for the Data Source and input the motor parameters for the motor.



Axis Properties Motor Model

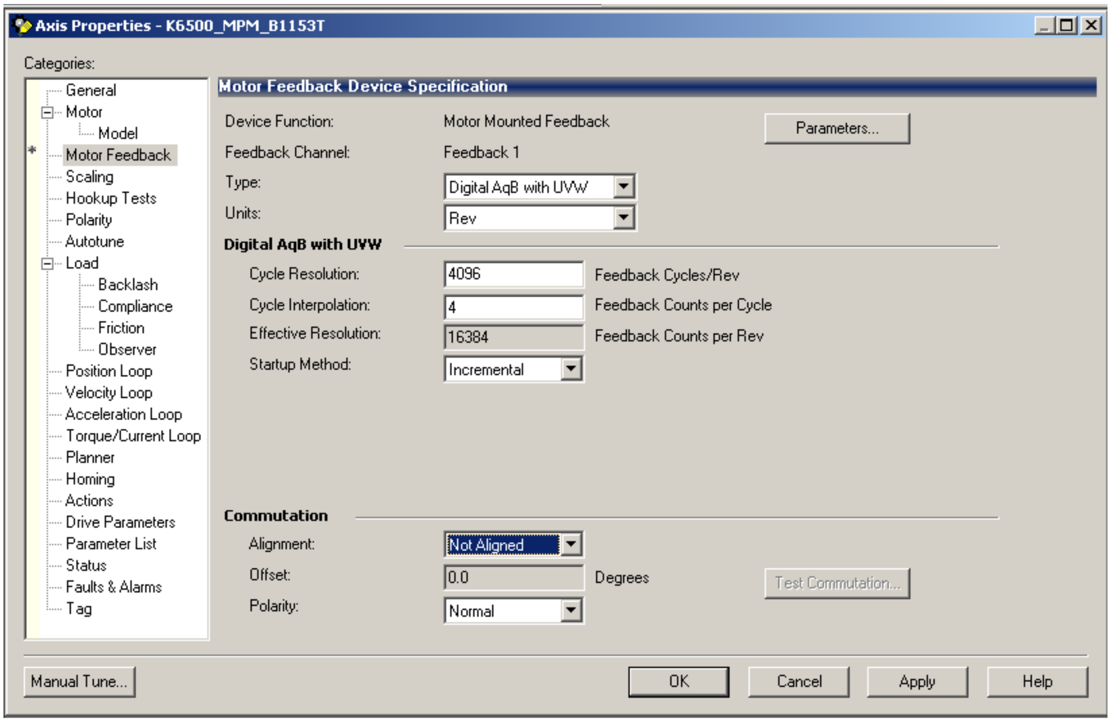
In the Axis properties on the Motor/Model tab enter the remaining motor data and enter 100.0 for all Flux Saturation entries.



Axis Properties Motor Feedback

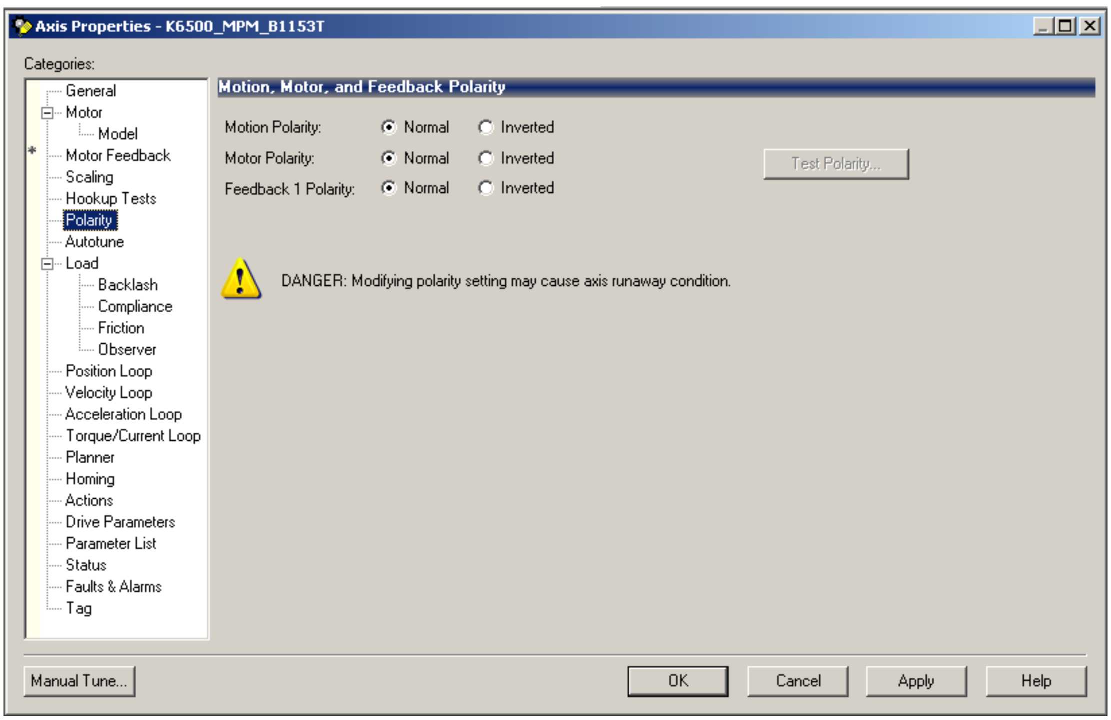
In the Axis properties on the Motor Feedback tab under Type: select "Digital AqB with UVW. The "Cycle Resolution" is the number of resolver pole pairs divided by 2 times 2048 (4 pole resolver/2 * 2048 = 4096). The 1326AB-B and MPM motors have 4096 Cycle Resolution and the MPL, 1326-AH, and 1326-AS series motors have 2048 Cycle Resolution. The "Cycle Interpolation" will always be 4. The "Startup Method" is Incremental.

Set the Commutation "Alignment" Not Aligned and the "Polarity" to Normal.



Axis Properties Polarity

In the Axis properties on the Polarity tab Select Normal for all Polarity's.



Axis Properties Hookup Tests

The quadrature "Counts" are the resolver pole pairs divided by 2 times 8192. In this example we are using a four pole resolver such that there will be 16384.0 counts per motor revolution (ie: 2 pole resolver = 8192 counts per rev, 6 pole resolver = 24576 counts per rev). The test distance for the 1326AB-B and MPM motors is 16384 and for the MPL series of motors it is 8192.0

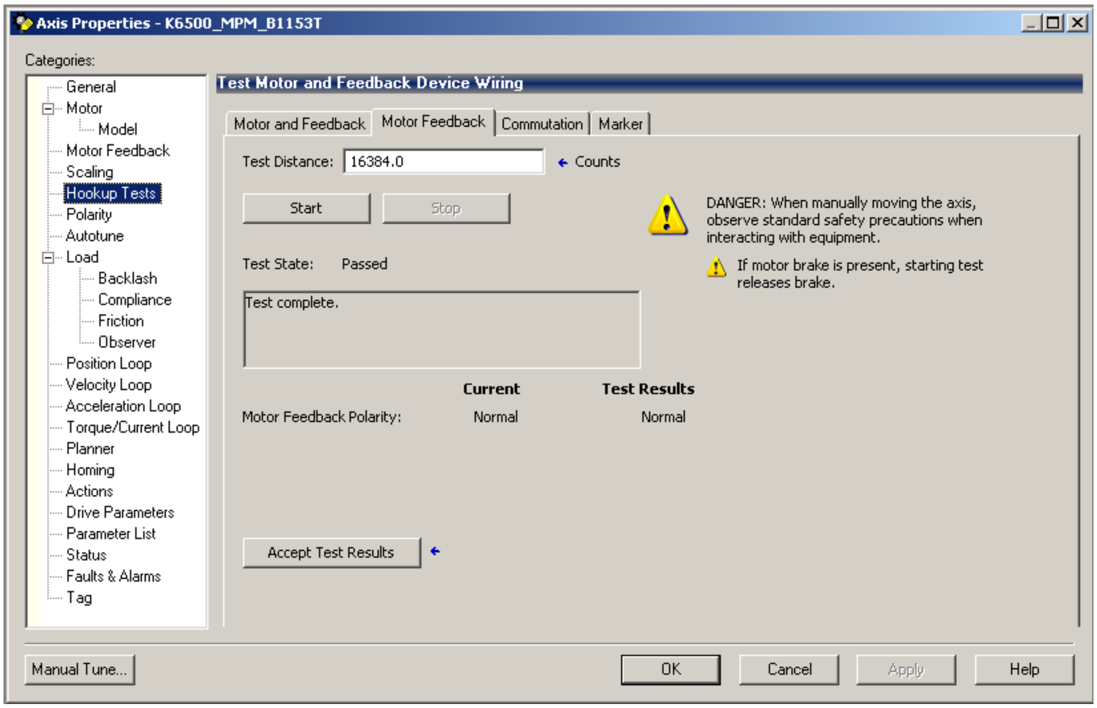
In the Axis properties on the Hookup Tests tab enter the quadrature counts for 1 motor revolution and start the test. Rotate the motor clockwise (as viewed from the motor shaft). The test should not complete prior to 1 full revolution.

If the test comes completes after 1 motor revolution and the polarity is normal, press the "Accept Test Results" button and proceed to the commutation test.

If the test results comes back as "Inverted", follow these steps:

1. Remove all power from the drive and the VEGA converter.
2. Move the wire from Sine- (P4-7) to Sine+ (P4-8)
3. Move the wire from Sine+ (P4-8) to Sine- (P4-7)
4. Apply power and re-run the Motor Feedback test

Rolling the Sine+ and Sine- wires will reverse the counting direction of the quadrature.



Axis Properties Commutation Test

Prior to running the commutation test insure that the VEGA converter has the proper hall cycles selected. The number of hall cycles required for a motor can be calculated by dividing the number of motor pole pairs by the number of resolver pole pairs. Such that a 6 pole motor using a 2 pole resolver will require 3 hall cycles. The number of hall cycles is set by the firmware on the personality module. You must have the correct firmware to run the motor based on the number of hall cycles required.

VEGA Firmware Versions for Allen Bradley Motors

V603.53 has 1 Hall Cycle for 1326AB-B motors

V603.52 has 2 Hall Cycles for MPM motors

V603.57 has 3 Hall Cycles for 1326AH-B3xx, 1326AH-B4xx, 1326AH-B4xx, 1326AH-B5xx, 1326AS-B3xx, and 1326AS-B4xx
V603.56 has 4 Hall Cycles for MPL and Exlar motors

The commutation test will determine the “Commutation Offset” required for the VEGA converter. When running the commutation test observing the motor shaft direction will be required. During the commutation test the motor should rotate in a clockwise direction (as viewed from the motor shaft). If the motor does not rotate in a clockwise direction follow these steps:

1. Remove all power from the drive
2. Check the motor power lead wiring and insure U goes to U, V goes to V, and W goes to W
3. If a third party motor is being used, and the connections to U,V, and W are correct. Roll the motor leads U and V (V goes to U and U goes to V)
4. Apply power to the drive and re-run the commutation test.

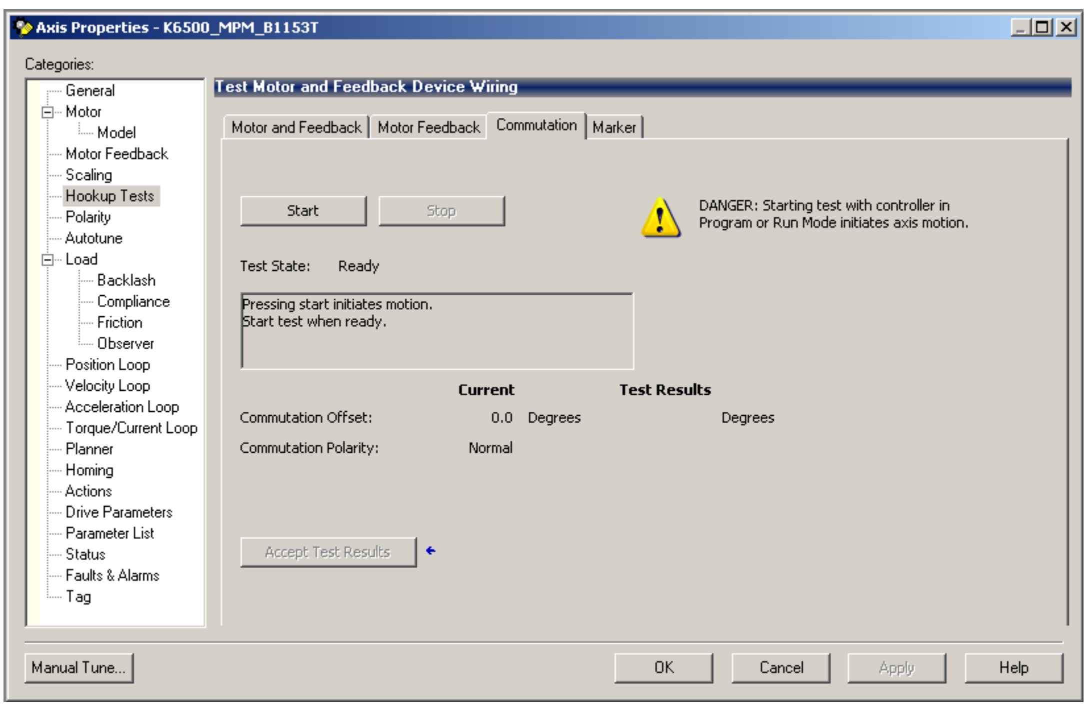
The commutation test should be run several times to observe the reported “Commutation Offset”. The commutation offset should not vary by more that 3 degrees from test to test and should be in the range of 357.0 to 3.0 degrees.

If you are using a third party motor it is possible to be outside of the 357.0 to 3.0 degree range. As long as the reported offset is consistent, and within 3 degrees it is an acceptable value.

If the test reports that the “Commutation Polarity” is inverted, follow these steps:

1. Remove all power from the drive and the VEGA converter
2. Move the wire from Sine- (P4-7) to Cosine+ (P4-5)
3. Move the wire from Sine+ (P4-8) to Cosine- (P4-4)
4. Move the wire from Cosine- (P4-4) to Sine- (P4-7)
5. Move the wire from Cosine+ (P4-5) to Sine+ (P4-8)
6. Apply power to the drive and re-run the commutation test.

When the commutation test passes several test and the commutation polarity is normal, press the “Accept Test Results” button. At this point the motor is ready to be tuned.



Trouble Shooting

SYMPTOM	CHECKS	SOLUTION
No Power LED	Check +5 vDC	+5 vDC Present → Board Failure – Replace board
Fault LED (1 Flash) Low Signal Detection	Check resolver cable	
	Check resolver coils resistance for open circuit and shorts to ground (S1 & S3, S2 & S4, R1 & R2)	Resistance values are less than 30 ohms – Check for shorts between "S1" and "S3" as well as ground. Check for shorts between "S2" and "S4" as well as ground. Check for shorts between "R1" and "R2" as well as ground.
	Check Sine and Cosine output excitations 3.6 vPP (P1-3 & P1-4) and (P1-5 & P1-6)	Missing excitation- Replace board
	Check "ST1" test point for 3.8 vPP	Missing reference signal- ➔ Check cable for open/shorts on R1 & R2 ➔ Replace resolver
Fault LED (2 Flash) High Signal Detection	Check for proper personality module gain setting	
	Check resolver cable	
	Check "ST1" test point for saturation (excitation is clipped)	Check for missing excitation on P1-3 & P1-4 and P1-5 & P1-6
Fault LED (3 Flash) 2800912 Version Only Power Up Position Valid Fault (PUPV Fault)	The 2799512 board has detected +/- 16 counts of position error from the power down stored position.	The 2799512 requires an external reset from this fault. This fault is latched and requires +4-30 vDC applied to P1-10 to clear this fault.
Fault LED (4 Flash) Low Signal Detection (Intermittent)	See Low Signal Detection above	
Fault LED (5 Flash) High Signal Detection (Intermittent)	See High Signal Detection above	
Cyclic Error (erratic velocity)	Check "ST1" test point for Amplitude bounce of > 40 mvDC	Check resolver cables/ resover
	Remove power and ohm between P1-3 & P1-4 note value. Ohm between P1-5 & P1-6 note value.	Resistance values are less than 30 ohms – Check for shorts between P1-3 & P1-4 as well as ground. Check for shorts between P1-5 & P1-6 as well as ground.
	With power on, check Sine and Cosine output excitations for 3.6 vPP on (P1-3 & P1-4) and (P1-5 & P1-6)	Missing excitation- Replace board
HSG LED (High Signal) Continuous	Check for proper personality module gain setting	Check ST1 for saturation- ➔ See "Cyclic Error" ➔ Install proper personality module
HSG LED (High Signal) Intermittent	Check "ST1" test point for 3.8 volts peak to peak	Follow procedures described in the Fault LED (Low Signal) Intermittent section
Feedback Polarity is Reversed	None	Swapping the Sine HI with the Sine LO wires will reverse the counting direction of the A-quad-B