



HPV 900 Series 2 Axial Flux PM Technical Manual



NOTE: This is a supplementary manual for the PM Axial Flux. If any detail about the HPV900 Series 2 is needed, please refer to the technical manual TM7333

TM7354 Rev 20

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**IMPORTANT
Grounding Considerations**

It is very important to make proper ground connections to the drive. The drive has a common ground bus terminal connection. All grounds need to land at this common point including building, motor, transformer, and filter grounds. This will limit the impedance between the grounds and noise will be channeled back to building ground. This improves the performance of the drive.

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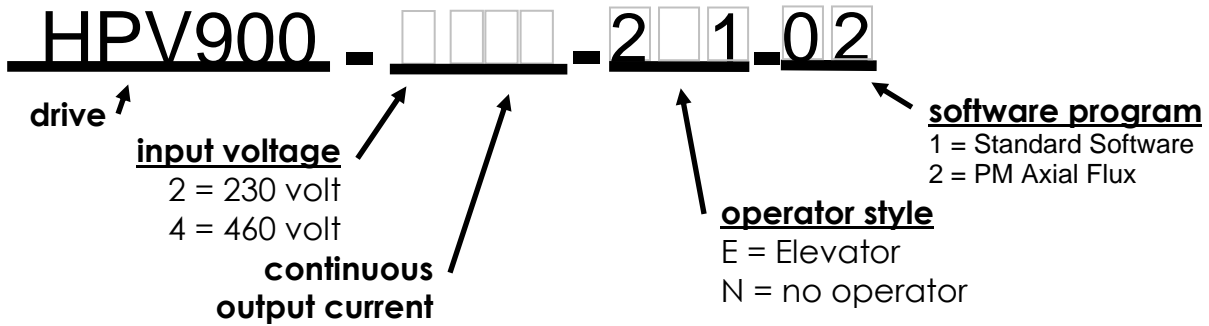
Start Up Guideline

1. Mechanically mount all the parts as explained in Mechanical Mounting Instructions on page 6. Connect the encoder and proximity sensor to the drive as explained in Encoder Electrical Connection on page 8 and Proximity Sensor Electrical Connection on page 8.
2. Then if not already pre-loaded, set all the drive parameters to parameters that are recommended by the car controller manufacturer so the drive and controller can interface with each other correctly; this includes all parameters in the A1 – A5 submenu and C1 – C4 submenus.
3. Proceed to PM Drive Setup Procedure on page 9 to continue with setting of motor data, Encoder Pulses, rotor alignment, and auto-tune.
4. Refer to Troubleshooting on page 16 if there are some initial start-up problems for Axial Flux specific problems ONLY. For general faults on the HPV900 Series 2, refer to the HPV900 Series 2 Technical Manual TM7333

NOTE: All the parts needed to get the Axial Flux drive to run are outlined on page 3 (need drive part number HPV900-____-2E1-02 and kit 46S04444-____)

NOTE: If the motor has a shaft, use a shaft mounted encoder. If a shaft mounted encoder is to be used, a standard HPV900 Series 2 is recommended.

Drive Model Number



HPV 900 Series 2 Drive Ratings

Rated Input Voltage	NA ¹ Rated HP	EU ¹ Rated HP	NA ¹ Rated kW	EU ¹ Rated kW	Overload Selection ²	Carrier Frequency (kHz) ³	Continuous Output Current General Purpose Rating	Continuous Output Current Elevator Duty Cycle Rating	Maximum Output Current for 5 Sec	Frame Size	Model Number
230V	7.5	--	5.5	--	250%	10	25	29	63	2	HPV900-2025-2E1-02
					200%	8	31	33			
	10	--	7.5	--	250%	10	31	36	78	2	HPV900-2031-2E1-02
					200%	8	39	41			
	15	--	11	--	250%	10	41	48	103	3.5	HPV900-2041-2E1-02
					200%	8	51	55			
	20	--	15	--	250%	10	52	60	130	3.5	HPV900-2052-2E1-02
200%					8	65	70				
25	--	19	--	250%	10	75	87	187.5	4	HPV900-2075-2E1-02	
30	--	22	--	250%	10	88	102	220	4	HPV900-2088-2E1-02	
40	--	30	--	250%	10	98	114	245	5	HPV900-2098-2E1-02	
460V	5	5	3.7	3.7	250%	10	8	9	20	1	HPV900-4008-2E1-02
					200%	8	10	11			
	7.5	5.5	5.5	4	250%	10	12	14	30	2	HPV900-4012-2E1-02
					200%	8	15	16			
	10	7.5	7.5	5.5	250%	10	16	19	40	2	HPV900-4016-2E1-02
					200%	8	20	21			
	15	10	11	7.5	250%	10	21	24	53	3	HPV900-4021-2E1-02
					200%	8	26	28			
	20	15	15	11	250%	10	27	31	68	3	HPV900-4027-2E1-02
					200%	8	34	36			
	25	20	19	15	250%	10	34	39	85	4	HPV900-4034-2E1-02
					200%	8	43	45			
	30	25	22	18.5	250%	10	41	48	103	4	HPV900-4041-2E1-02
					200%	8	51	55			
40	30	30	22	250%	10	52	60	130	4	HPV900-4052-2E1-02	
				200%	8	65	70				
50	40	37	30	250%	10	65	75	162.5	5	HPV900-4065-2E1-02	
60	50	45	37	250%	10	72	84	180	5	HPV900-4072-2E1-02	
75	60	56	45	250%	10	96	111	240	5	HPV900-4096-2E1-02	

Table 1: HPV900 Series 2 Drive Ratings

NOTE: all ratings at 60/50Hz bases on a geared elevator application

- 1. NA refers to drives sold in North America and ratings are based off of 460VAC input. EU refers to drives sold in Europe and are based off of 400VAC input
- 2. Based on Overload Select (C1) parameter selection
- 3. Maximum Carrier Frequency before derating

HPV900 S2 Axial Flux Drive Application Kits

		Application Description	Kits to Order for Axial Flux Application	Items in the Kits
Drive / Inverter		For all Axial Flux application. Based on motor voltage, amperes, and incoming volt	HPV900-_____-2E1-02 ⁱ	HPV900 Series 2 Axial Flux PM drive
	Cable Lengths	kits with 37.3mm rider wheel for MX05, MX06, and MX10 frames	For hoists that require 5m (16.4ft) of cable between the drive and motor.	46S04444-0005 ⁱ
For hoists that require 10m (32.8ft) of cable between the drive and motor.			46S04444-0010 ⁱ	10m cable for encoder, 10m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 15m (49.2ft) of cable between the drive and motor.			46S04444-0015 ⁱ	15m cable for encoder, 15m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 20m (65.6ft) of cable between the drive and motor.			46S04444-0020 ⁱ	20m cable for encoder, 20m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 30m (98.4ft) of cable between the drive and motor.			46S04444-0030 ⁱ	30m cable for encoder, 30m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 40m (131.2ft) of cable between the drive and motor.			46S04444-0040 ⁱ	40m cable for encoder, 40m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 60m (196.8ft) of cable between the drive and motor.			46S04444-0060 ⁱ	60m cable for encoder, 60m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
For hoists that require 100m (328ft) of cable between the drive and motor.			46S04444-0100 ⁱ	100m cable for encoder, 100m cable for proximity sensor, encoder, 37.3mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
kits with 75mm rider wheel for MX20 frames		For hoists that require 5m (16.4ft) of cable between the drive and motor.	46S04444-1005 ⁱ	5m cable for encoder, 5m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 10m (32.8ft) of cable between the drive and motor.	46S04444-1010 ⁱ	10m cable for encoder, 10m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 15m (49.2ft) of cable between the drive and motor.	46S04444-1015 ⁱ	15m cable for encoder, 15m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 20m (65.6ft) of cable between the drive and motor.	46S04444-1020 ⁱ	20m cable for encoder, 20m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 30m (98.4ft) of cable between the drive and motor.	46S04444-1030 ⁱ	30m cable for encoder, 30m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 40m (131.2ft) of cable between the drive and motor.	46S04444-1040 ⁱ	40m cable for encoder, 40m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
		For hoists that require 60m (196.8ft) of cable between the drive and motor.	46S04444-1060 ⁱ	60m cable for encoder, 60m cable for proximity sensor, encoder, 75mm rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts
	For hoists that require 100m (328ft) of cable between the drive and motor.	46S04444-1100 ⁱ	100m cable for encoder, 100m cable for proximity sensor, 75mm encoder, rider wheel, proximity sensor, sensor bracket, target, and other misc. hardware parts	

ⁱ NOTE: materials needed for Axial Flux are 1x HPV900 S2 Axial Flux drive and 1x of the 46S04444-____ kit (which comes with everything but the drive)

Axial Flux Specific Parameters

Parameters additional to standard HPV900 Series 2

C0 Menu

Submenu	Parameters	Units	Range	Default	Site Setting
C1	User Switches C1 Submenu				
C1	Encoder Select	None	-Axial Flux	-Axial Flux	

U0 Utility

Submenu	Parameters	Units	Range	Default	Site Setting
U6	Drive Info U6 Submenu				
U6	Drive Version	None	-SA4810-030_ _ _ _ _	-SA4810-030_ _ _ _ _	

D0 Display 1 or 2

Submenu	Parameters	Units	Range	Default	Site Setting
D1	Measured PPR	PPR	0 - 40000	-0	
D1	Z Edge Count	None	-32767 - 32767	-0	

A1 Drive

Name	Description	Units	Recommended Setting
Encoder Pulses	(Encoder Pulses) This parameter sets the number of pulses the drive should see coming back from the encoder at high running speeds.	PPR	-Refer to step 4 on page 9 in PM Drive Setup Procedure.
Enc PPR Low	(Encoder Pulses Per Revolution Low) This parameter sets the number of pulses the drive should see coming back from the encoder at low running speeds.	PPR	-

D1 Elevator Data

Name	Description	Units	Recommendation
Measured PPR	This is a setup/fine tuning parameter. This parameter will show how many pulses the drive counted for one full revolution of the rotor. NOTE: the number displayed here when a motor is running at high speed/contract speed is more accurate than one running at slower speeds	Pulses Per Revolution (PPR)	Use the value in this parameter to set the Encoder PPR (A1) to the correct number for your particular motor. This is outlined in step 4 on page 9 in PM Drive Setup Procedure.
Z Edge Count	This parameter is used for troubleshooting noise/functionality on the Proximity Sensor. The function of this parameter is to tell the user how many times has the drive seen the target sensor (aka how many revolutions has the motor made) since it was powered up. The drive will increase the number if it is rotating in the up and decrease the number in the down. (it will only decrease the number if the drive receives a valid run command in the down)	NONE	Use for troubleshooting the proximity sensor

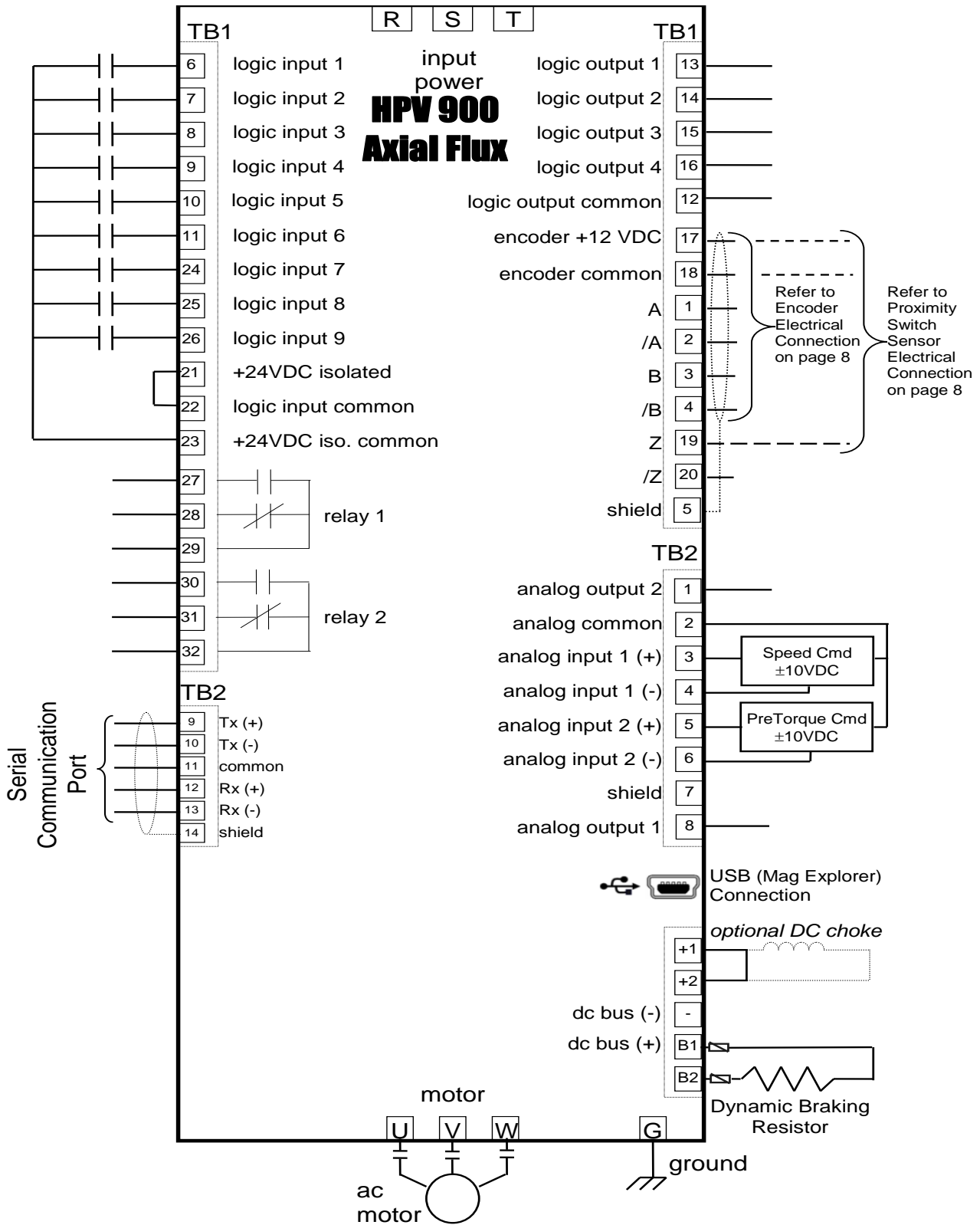


Figure 1: Interconnection Diagram

Mechanical Mounting Instructions

The following parts need to be mounted on to the motor: proximity sensor (red device with 3 wires coming out of it as shown in [Figure 3](#)), incremental encoder, rider wheel, sensor bracket, target, sticky pad, and hex nuts.

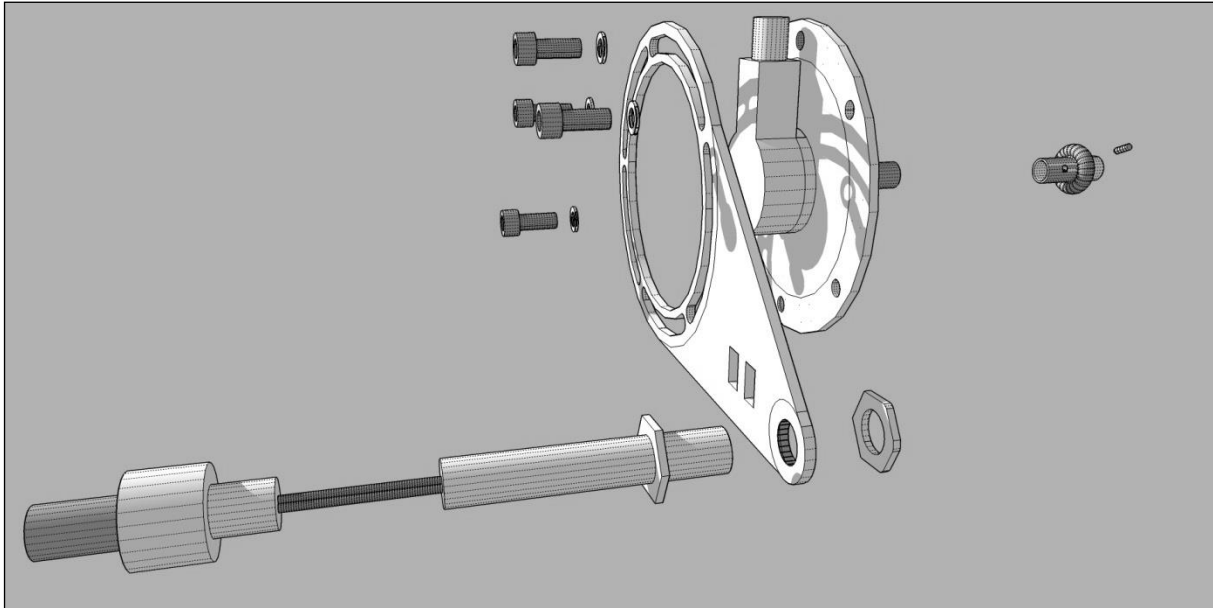


Figure 2: Axial Flux Assembly Kit



Figure 3: Picture of Proximity Sensor (PN 05P00217-0097)

encoder shaft has a keying slot, do NOT place any of the set screws in the keying slots.

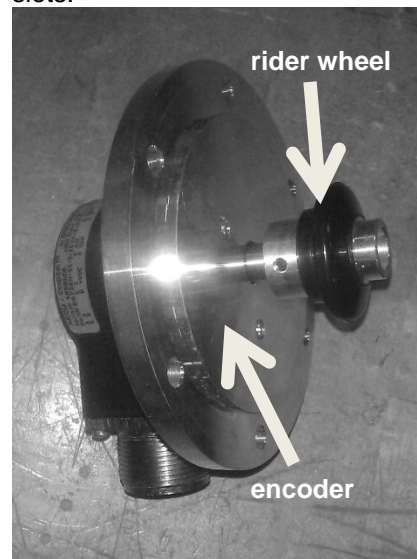


Figure 4: Incremental Encoder with the rider wheel fitted on shaft

1. The rider wheel should be tightly fitted on the incremental encoder's shaft as shown in [Figure 4](#) with 2mm allen key (or a Philips head screw driver depending on the wheel type). It should be positioned so that the wheel will sit on the center of the exposed edge of the rotor. **NOTE:** if the

2. The proximity sensor should be loosely fitted to the bracket with 2x M12 nut with 19mm wrench as shown in **Figure 5**.

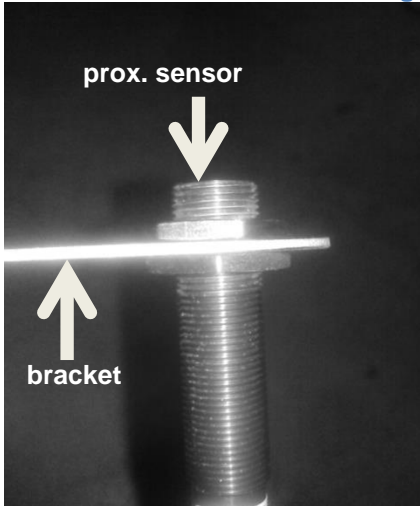


Figure 5: Proximity sensor fasten on bracket

3. The sensor bracket and encoder should be loosely mounted on the motor with socket head cap screws with washers as shown in **Figure 6**. NOTE: there should be a pre-made encoder mount on the motor frame to mount the rider wheel and encoder. Make sure that the rubber on the rider wheel is making good physical contact on the rotor so that the wheel rotates with the rotor.

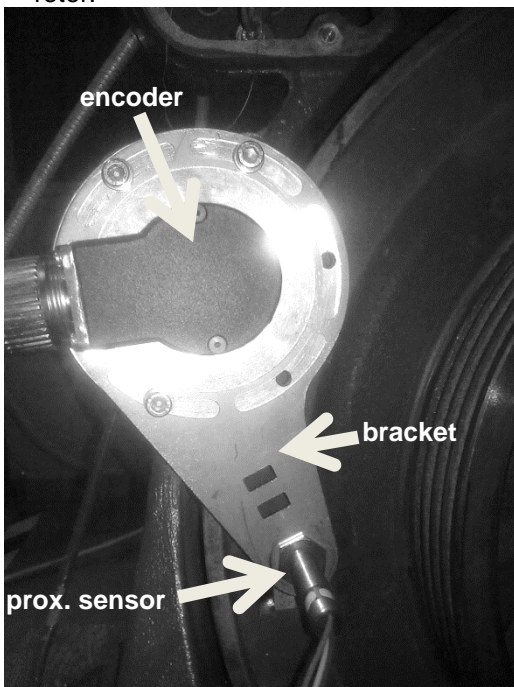


Figure 6: Picture of encoder, proximity sensor, and sensor bracket (PN 43T02814-0030)

4. Ascertain the correct location on the rotor where the target is to be fitted and prepare the surface by cleaning using the alcohol pad provided. The target should be positioned so that the shorter rounded face of the target extends to line up with the proximity sensor as shown in **Figure 8**.

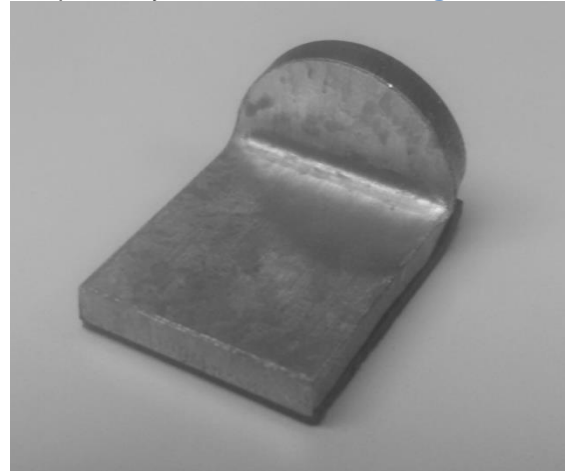


Figure 7: Picture of the proximity targets (PN 43T02814-0018 REV 00)

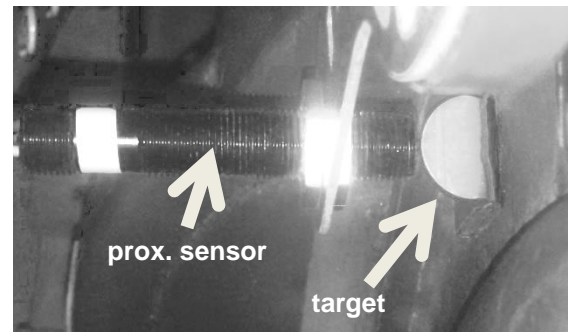


Figure 8: Top view picture of the proximity sensor and target

5. As a final adjustment, use the gap tool to get the proximity sensor within 0.060in [1.6mm] of the target as shown in **Figure 10**. The gap tool is 0.060in thick.



Figure 9: Gap tool (PN 43T02814-0020)

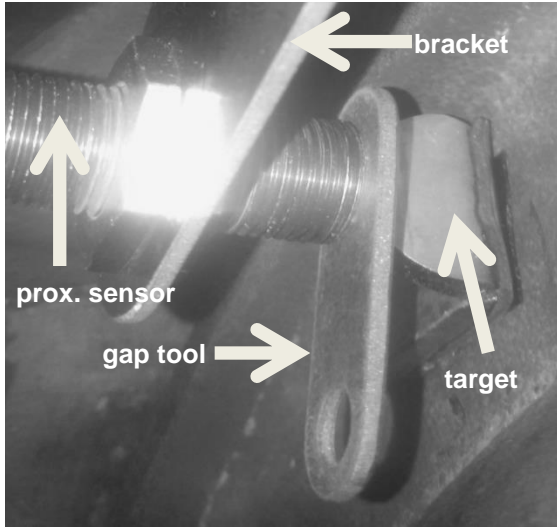


Figure 10: Using gap tool to get the target into the sensing range of the proximity sensor

- Then tighten the nuts after the gap has been met with a 19mm wrench and remove the gap tool.

Encoder Electrical Connection

NOTE: Before connecting any encoder onto the drive, make sure that the encoder can operate at 12V_{DC} because the power supply on the drive will be 12V_{DC}.

NOTE: The TerMag board part number 46S04284-0010 will not work on the Axial Flux drive. The TerMag board used on the Axial Flux is pn 46S04284-1020

The encoder cable has 3 twisted wire pairs. The connection of the encoder to the drive is shown in **Figure 11**.

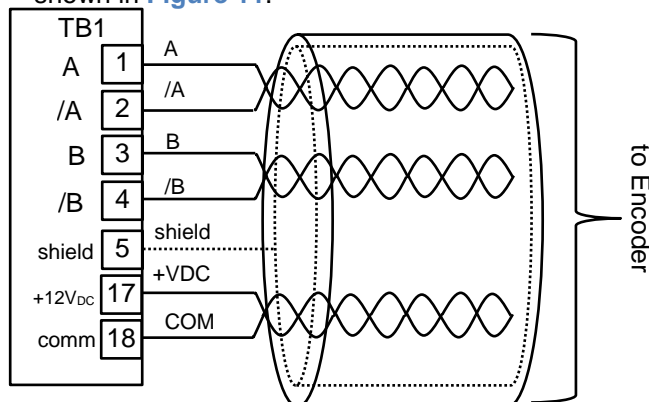


Figure 11: Encoder Connection to Drive TB1 46S04284-1020 TerMag Board

Proximity Sensor Electrical Connection

NOTE: The proximity sensor should ONLY be used on TerMag board number 46S04284-1020.

The proximity sensor cable should be wired up to the drive as shown in **Figure 12**. When connecting the cable to the proximity sensor, latch the coupling ring on the female (cable end) connector into its open position (rotate the ring clockwise as you look into the sockets of the connector). Then insert the male (proximity sensor end) connector into the female (cable end) connector. Finally, rotate the coupling ring on the female connector in the opposite direction until it latches into its closed position.

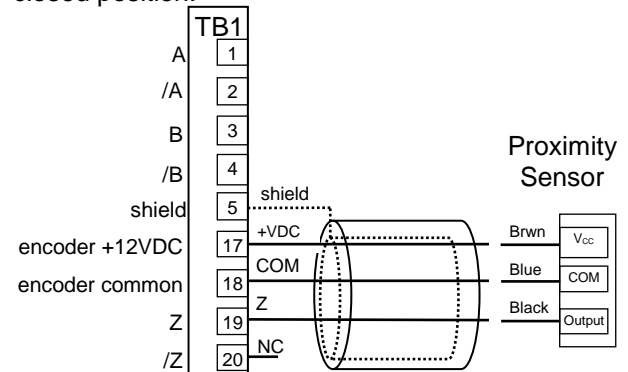


Figure 12: Proximity Sensor Connection to Drive TB1 46S04284-1020 TerMag Board

SW1: It is recommended that the 2 dip switches for encoder channel filtering be turned on (up position) for SW1 as shown in **Figure 13**: SW1-2 is the filter for Z and SW1-3 is for A/B. SW1-1 is used to place a 120 ohm terminating resistor across the receiver input for serial communication; it should be in the on position when serial cables longer than 50 feet is being used.

SW2: The proximity sensor requires a 12V_{DC} power supply. So if not already done, SW2 on the TerMag Board should be set for the 12V (right position) rather than the 5V power supply (left position) as shown in **Figure 13**.

SW3: SW3 should also be configured so that the A and B channels are set for differential input and the Z channel is set for single ended input as shown in **Figure 13**; starting from the left: up, down, down, up, down, and up.

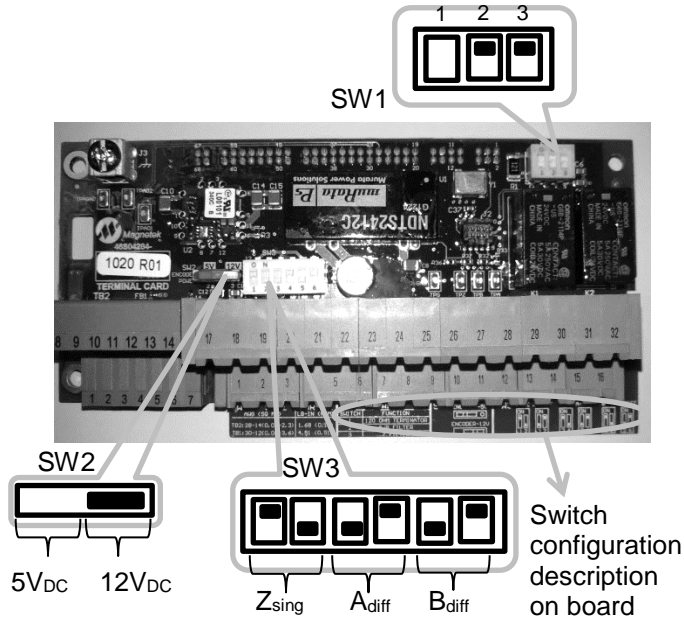


Figure 13: TerMag Board Switch Configuration

PM Drive Setup Procedure

1. Verify that the drive is in PM Mode for Drive Mode in U9.
2. Enter the measured building voltage going into the drive in the 'Input L-L Volts' (A4)
3. Enter your motor data from the motor nameplate into Sub-menu A5: Motor ID, rated motor power, rated motor volts, rated motor current, rated motor poles, and rated motor speed.

a.
$$\text{motor poles} = \frac{120 * \text{mtr freq}}{\text{rated mtr rpm}}$$

If your motor speed and motor poles are entered correctly, motor frequency on nameplate and the 'Rated Excit Freq' in the D2 sub-menu should be the same

4. Setup both 'Encoder Pulses' and 'Enc PPR Low' in the A1 sub-menu using one of the following method: a (preferred), b, or c.

NOTE: Encoder Pulses (A1) is set higher than the PPR on the encoder nameplate (in this case 1024 PPR)

because the encoder shaft is mounted on a rider wheel that sits on the rotor; 1 revolution of the rider wheel doesn't equate to 1 revolution of the motor

- a. Ropes off PPR (preferred):
 - i. with **ropes removed from/off** sheave, perform an Open Loop Alignment on page 12.
 - ii. After the alignment, enter the number in Measured PPR (D1) into the Encoder Pulses (A1).
 - iii. Then run the motor at contract speed and look at the Measured PPR (D1) while motor is rotating at contact speed with ropes OFF
 - iv. The number in Measured PPR (D1) while motor was rotating at contract speed should be entered to Encoder Pulses (A1)

NOTE: if this is done, step 8 in PM Drive Setup Procedure on page 10 doesn't need to be done.

NOTE: Measured PPR (D1) at high speed is more accurate than at low speed.

- b. Ropes on PPR estimate:
 - i. Select from Table 2 (page 10) the number of encoder pulses that correspond to the motor frame you have. Enter that number as the Encoder Pulses in the A1 menu

PM Motor Frame Types	Encoder Pulses (A1) / Enc PPR Low (A1)
MX05/10	14395 PPR
MX05/16	14452 PPR
MX06/05	17067 PPR
MX06/10	17067 PPR
MX06/16	17067 PPR
MX10/05	19819 PPR
MX10/08	19735 PPR
MX10/10	19819 PPR
MX10/15	19680 PPR
MX20	12929 PPR
Elevator Motor	

Table 2: Setting for A1 Encoder Pulses for different motor types

- c. Ropes on PPR calculation:
 - i. Mathematically calculate the Encoder Pulses (A1) using the equation below. The diameter of the rider wheel is either 37.3mm (1.469in) or 75mm (2.952in) depending on which one you have.

Encoder Pulses (A1)

$$= \text{Encoder Nameplate PPR} \frac{\text{diameter}_{\text{rotor}}}{\text{diameter}_{\text{rider wheel}}}$$

- 5. Verify that both Encoder Pulses (A1) and Enc PPR Low (A1) are set to the same value for low speed operation (such as the construction phase).
- 6. Before the motor can run, a rotor alignment to find the motor poles needs to be performed. The 3 methods to find the motor pole are: High Frequency (HF) Injection, Open-Loop Align, and Auto-Align beginning on page 11 in PM Alignment Procedure.

NOTE: HF injection is recommended because it can locate the motor's poles more reliably on these motors than Auto-Align.

- 7. Perform an auto-tune on the drive so that the drive has a more accurate motor model outlined in Auto-Tune Procedure on page 15.

NOTE: skip step 8 if the motor was running at high speed with ropes off

- 8. After the motor can run up/down the hoist at high speed, fine tune the Encoder Pulses (A1) and Enc PPR Low (A1) by entering the number in the D1 'Measured PPR' into these parameters.

NOTE: The number set in the Encoder Pulses (A1) HAS to be the value displayed in D1 'Measured PPR' at high speed. The number set in the Enc PPR Low (A1) HAS to be the value displayed in D1 'Measured PPR' at low speed.

Refer to Troubleshooting page 16 if the drive faults out

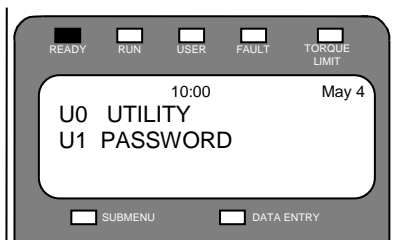
PM Alignment Procedure

Before the motor can run, a rotor alignment to find the motor poles needs to be performed. The 3 method to find the poles are: High Frequency (HF) Injection, Open-Loop Align, and Auto-Align.

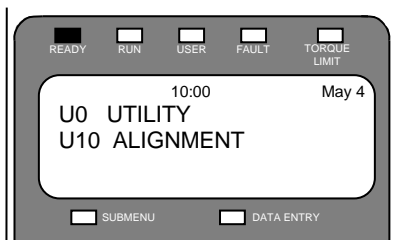
HF Inject (preferred method)

High Frequency Injection is a function that will locate the poles without the need to spin the motor. This procedure should be done with the brakes set. This is especially useful for replacing encoders. HF Inject may be enabled two different ways, one way is to enable the function through the operator and the other is to enable HF Inject by giving the drive a run command. In order for the function to properly work, all faults must be cleared, the brake must be set and the motor contactor must pull in.

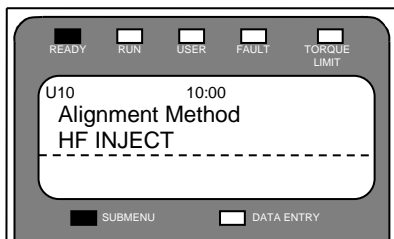
1. Press the RIGHT or LEFT arrow until you see the U0 Utility menu as shown below.



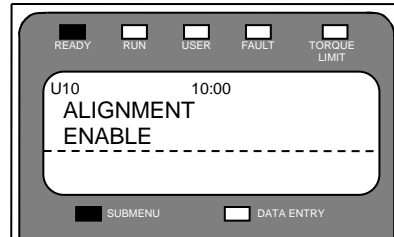
2. Use the UP or DOWN arrow to navigate through the U0 menu to the U10 sub-menu as shown below.



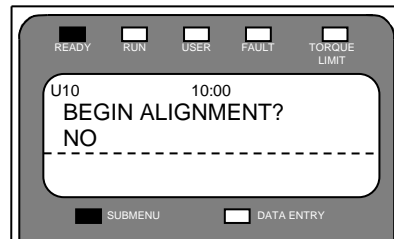
3. Press Enter, then UP arrow until Alignment method is shown. Press Enter, then the UP arrow until HF Inject is shown. Then press Enter to save the setting.



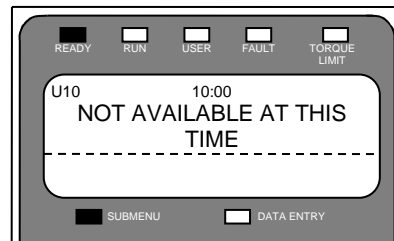
4. Press the DOWN arrow until ALIGNMENT is displayed. Press Enter and UP arrow to change the ALIGNMENT from DISABLE to ENABLE then press Enter as shown below.



5. Press the DOWN arrow to see BEGIN ALIGNMENT.



Note: If the operator displays the screen below, verify ALIGNMENT (U10) is set to enable, there are no active faults (FAULT LED is off), and the drive is not in a RUN mode (RUN LED is off).



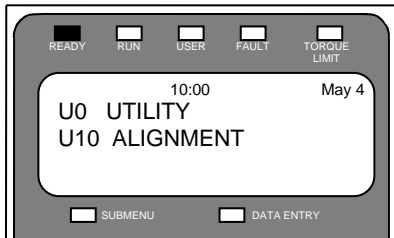
6. If **YES** is selected, the drive will immediately start sending current to the motor and calculate the alignment value. NOTE: When using YES, make sure that the contactor is closed before YES is entered.
7. If **ON RUN** is selected, the drive expects the following sequence to occur:
 - a. Car Controller asserts DRIVE ENABLE
 - b. Car Controller issues RUN Command
 - c. Drive asserts CLOSE_CONTACT (all other outputs will stay false during the Alignment excluding READY TO RUN which will stay active)
 - d. Motor Contactor closes
 - e. Drive starts Alignment procedure with the brakes set (not picked)

During the Alignment, a loud high pitch beep will come out of the motor and the RUN LED will be lit for the duration of the procedure.

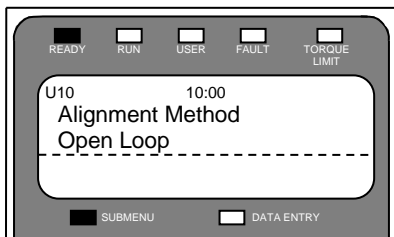
Open Loop Alignment

Open Loop Alignment is a function that will locate the motor poles by spinning the motor. This requires that the ropes be off the motor sheave and that the brakes are lifted/picked when performing the alignment. Open Loop may be enabled two different ways, one way is to enable the function through the operator and the other is to enable it by giving the drive a run command. In order for the function to properly work, all faults must be cleared, the brake must be picked and the motor contactor must pull in.

- 1) In order to accurately measure the alignment, the motor has to operate in a no-load condition. This can be achieved by removing the ropes from the sheave of the motor
- 2) Press the RIGHT or LEFT arrow until the U0 menu is displayed.
- 3) Press the UP or DOWN arrow in the U0 menu to find Alignment (U10) sub-menu.

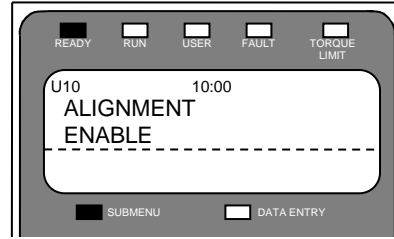


Press ENTER, then the UP arrow to display:

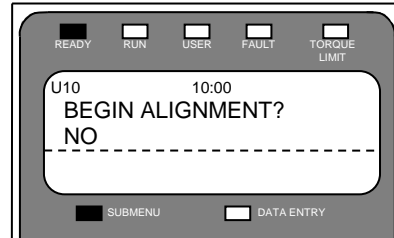


Verify ALIGNMENT METHOD is set to OPEN LOOP.

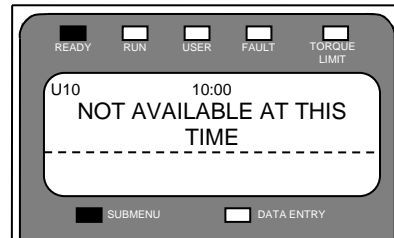
Scroll to ALIGNMENT and press ENTER to change parameter ALIGNMENT from DISABLE to ENABLE. Press ENTER.



Press the DOWN arrow to start the alignment procedure. The operator will display:



Note: If the operator displays the following screen, verify ALIGNMENT (U10) is set to enable, there are no active faults (FAULT LED is off), and the drive is not in a RUN mode (RUN LED is off).



Press ENTER to change the data from NO to either **YES** or **ON RUN**.

Note: For either selection, any speed command issued to the drive will be ignored, however it may be necessary for the car controller to anticipate the motor moving at 1/8th rated motor speed (A5).



- 4) If **YES** is selected, the motor will immediately start applying current to the motor and calculating the alignment value.
- 5) If **ON RUN** is selected, the drive expects the following items to occur:
 - a. Car Controller asserts DRIVE ENABLE
 - b. Car Controller issues Run Command

- c. Drive asserts SPD_REG_RLS and CLOSE_CONTACT (all other outputs will operate as programmed and have no special status or benefit during the Alignment Procedure)
- d. Motor Contactor closes
- e. Drive asserts BRAKE_PICKED, if used
- f. Brake is lifted
- g. Drive starts the Open Loop Alignment running at approximately 1/8th of the rated motor speed (A5)
- h. When the Alignment is finished, the drive will go to zero speed and simulate removal of the run command (i.e. SPD REG_RLS = 0 (false); CLOSE CONTACT = 0 (false)) even if Run Command is still being asserted
- i. Run Command is removed

During the test, the motor should rotate for about four seconds and the RUN light will be lit for the duration of the procedure.

- Erratic movement of the motor may occur during acceleration and deceleration segments of the alignment, but constant speed operation will be smooth. If the motor is jerking as it is rotating, increase the OL ALIGN SCALE (A5) by 0.5.
 - If the alarm **SPD DEV ALM** is displayed, increase the value of SPD DEV ALARM LVL (A1) then retry procedure to see what fault the drive may actually be getting. The SPD DEV ALM will not allow the alignment procedure to finish and must be moved out of the way to proceed.
 - If the fault **SPD DEV FLT** is displayed, first, verify the shield of the encoder cable is properly grounded. Then retry the alignment procedure. If the fault still exists, increase SPD DEV FLT LVL (A1), and then retry alignment procedure.
 - If the fault **OVERCURR FLT** is displayed; decrease ALIGN VLT FACTOR (A4) and/or the OL ALIGN SCALE (A5) retry alignment procedure
 - If **ENCODER FAULT** or **TACH LOSS** is displayed, verify that the encoder is working or that the brakes on the motor are being picked.
- 6) View the value of ENCODER ANG OFST(A5). If the value is 30000, the alignment procedure did not work and must be redone. If the, ENCODER ANG OFST (A5) is 00000, the alignment procedure passed.
 - 7) Enter the value in 'Measured PPR' (D1) into 'Encoder Pulses' (A1)

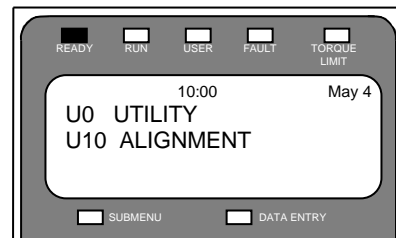
- 8) Run motor at 20% contract speed and verify alignment is correct.
 - If ropes are not attached, set INERTIA (A1) to 0.25 seconds
 - If the SPD DEV FLT occurs, check if TORQ CURR (D2) is greater than 5% (>5%). If this is the case, repeat the alignment procedure.
- 9) Run the motor at 100% contract speed. While the motor is running at contract speed, make note of number in the 'Measured PPR' (D1).
- 10) Enter the 'Measured PPR' from above at contract speed into 'Encoder Pulses' (A1)

Auto Alignment Procedure

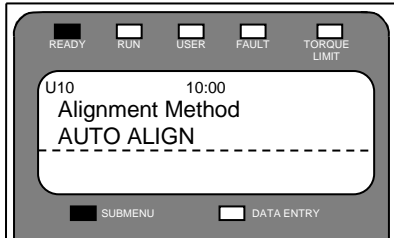
Auto Alignment is a function that will calculate the alignment angle without the need to spin the motor. This procedure has to be done with the brake set. This is especially useful for replacing encoders. Auto Alignment may be enabled two separate ways, one way is to enable the function through the operator and the other is to enable Auto Align by giving the drive a run command. In order for the function to properly work, all faults must be cleared (FAULT LED is off), the brake must be set, and the motor contactor must pull in.

NOTE: If HF Inject can be performed, it is recommended that the HF Inject be performed instead of the Auto Alignment because HF Inject is more reliable.

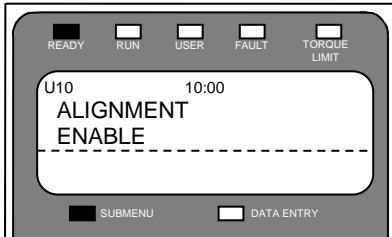
- 1) In order to accurately measure the alignment, the brake must be set and the motor contactor must be closed. Depending on the method used for enabling Auto Alignment, drive signals may be used in conjunction with the contactor.
- 2) Run the Auto Alignment (U10) to determine the position of the motor poles.



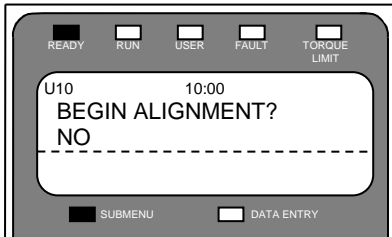
Press Enter, then the UP Arrow to display:



Verify ALIGNMENT METHOD is set to AUTO ALIGN.
 Scroll to ALIGNMENT and press Enter to change parameter ALIGNMENT from DISABLE to ENABLE. Press Enter.



Press the DOWN arrow to start the alignment procedure. The Operator will display:



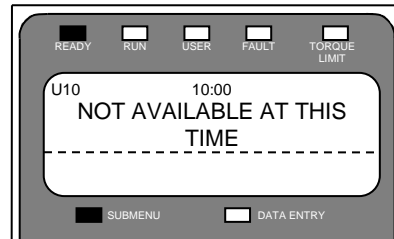
Press Enter to change the data from NO to either **YES** or **ON RUN**.

- 3) If **YES** is selected, the drive will immediately start applying current to the motor and calculate the alignment value.

NOTE: the motor contactor should be manually pushed in BEFORE the ENTER button is pressed.

- 4) If **ON RUN** is selected, the drive expects the following sequence to occur:
 - f. Car Controller asserts DRIVE ENABLE
 - g. Car Controller issues RUN Command
 - h. Drive asserts CLOSE_CONTACT (all other outputs will stay false during the Alignment excluding READY TO RUN which will stay active)
 - i. Motor Contactor closes
 - j. Drive starts the Alignment procedure

Note: If the operator displays the following screen, verify ALIGNMENT (U10) is set to enable, there are no active faults (FAULT LED is off), and the drive is not in a RUN mode (RUN LED is off).



During Alignment, a slight buzzing noise should come from the motor for approximately two seconds and the RUN light will be lit for the duration of the procedure.

- If the fault **AT CONTACT FLT** is displayed, verify the motor contactor is closed
- If the fault **BRAKE IS OPEN** is displayed, the drive has detected motion, verify the brake is set. If brake is set and minimal movement has occurred, increase BRK FLT LEVEL (A4).

When the Alignment is finished, the drive will simulate the removal of the run command even if Run Command is still being asserted.

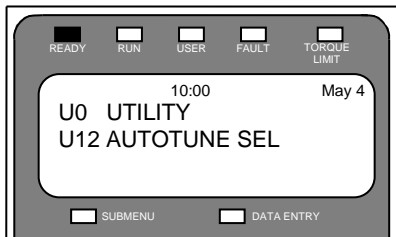
Auto-Tune Procedure

Auto-Tune is a function used only on **PM (U9)** that will automatically calculate the D and Q Axis Inductances and the Stator Resistance based on the calculated value of the motor's Base Impedance. Auto-Tune may be enabled two separate ways, one way is to enable the function through the operator and the other is to enable Auto-Tune by giving the drive a run command. In order for the function to properly work, all faults must be cleared, the brake must be set and the motor contactor must pull in.

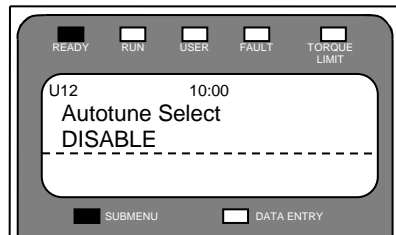
Setting Auto-Tune

Note: Alignment Procedure should precede this Auto-Tune function. Alignment will affect the accuracy of the D and Q Axis Stator Inductances.

- 1) In order to accurately measure the motor parameters, the brake must be set and the motor contactor must be closed. Depending on the method used for enabling Auto-Tune, drive signals may be used in conjunction with the contactor
- 2) Scroll to AUTOTUNE SEL (U12) to run the Auto-tune function. No Faults may be present on the drive when engaging Auto-Tune.

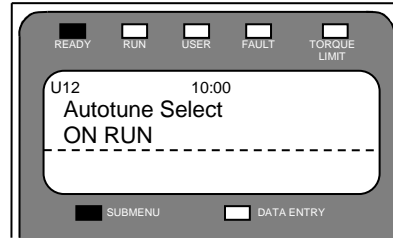


Press Enter to display:

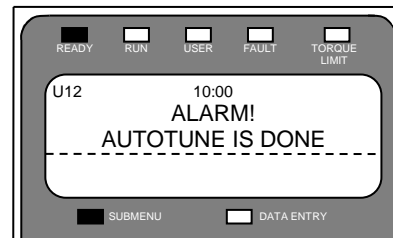


Press Enter and use down arrow keys to select **ON RUN** or **YES** to enable Auto-Tune
 Note: The contactor needs to be in for Auto-Tune to run. If necessary, manually hold the contactor in while the test is running.

- 3) Press Enter to change the data from DISABLE to either YES or ON RUN.



- 4) If the selection **YES** is made, the drive will immediately start applying current to the motor and calculate the motor characteristics.
- 5) If the selection **ON RUN** is made, the drive expects the following sequence to occur prior to the drive applying current to motor: Command run (inspection) on the car controller. The speed command must be set to zero (0) speed. The following sequence must be observed by the car controller to properly perform Auto-Tune via Car Controller
 - a. Car Controller asserts DRIVE ENABLE
 - b. Car Controller issues RUN Command
 - c. Drive asserts CLOSE_CONTACT (all other outputs will stay false during the Auto-Tune)
 - d. Motor Contactor closes
 - e. Drive starts the Auto-Tune procedure
 - f. When the Auto-Tune is finished, the drive will simulate the removal of the run command even if Run Command is still being asserted.



- g. Run Command is removed
- During Auto-Tune, a slight buzzing noise should come from the motor for approximately two seconds and the RUN LED will be lit for the duration of the procedure.
- If the fault **CONTACTOR FLT** is displayed, verify the motor contactor is closed
 - If the fault **BRAKE IS OPEN** is displayed, the drive has detected motion, verify the brake is set. If brake is set and minimal movement has occurred, increase BRK FLT LEVEL (A4).
 - The following parameters will populate:
 - a. D Axis Induct (A5)
 - b. Q Axis Induct (A5)
 - c. Stator Resist (A5)

Troubleshooting

This is just a short list of faults/alarm/difficulties that can come up when starting up a HPV900 Series 2 Axial Flux drive ONLY.

NOTE: A more detailed fault list can be found in the HPV900 Series 2 Technical Manual TM7333.

Faults/Alarms/Difficulties	Description	Solutions
Encoder Flt	The drive is in a run condition and the encoder is: not functioning or not connected or phasing is not proper with motor phasing	<p>Incorrect Encoder Phasing</p> <ul style="list-style-type: none"> ⇓ Verify that the encoder phasing is correct ⇓ Swap encoder A and /A channel on TB1-1 and TB1-2 ⇓ Perform an Open-Loop Alignment <p>Encoder Power Supply</p> <ul style="list-style-type: none"> ⇓ Check that the encoder power supply on TB1-17 and TB1-18 is 12V_{DC} ⇓ Verify that SW2 is switched to the 12V position (at right). Verify that the voltage between TB1-17 and TB1-18 is 12 volts DC <p>Parameter Settings</p> <ul style="list-style-type: none"> ⇓ Verify that the Encoder Connect (C1) is set to axial flux ⇓ Verify that the Encoder Pulses (A1) is set to a reasonable number <p>Encoder Mechanical Setup</p> <ul style="list-style-type: none"> ⇓ Verify that the rider wheel is firmly on the rotor and that the encoder spins as the rotor is spinning

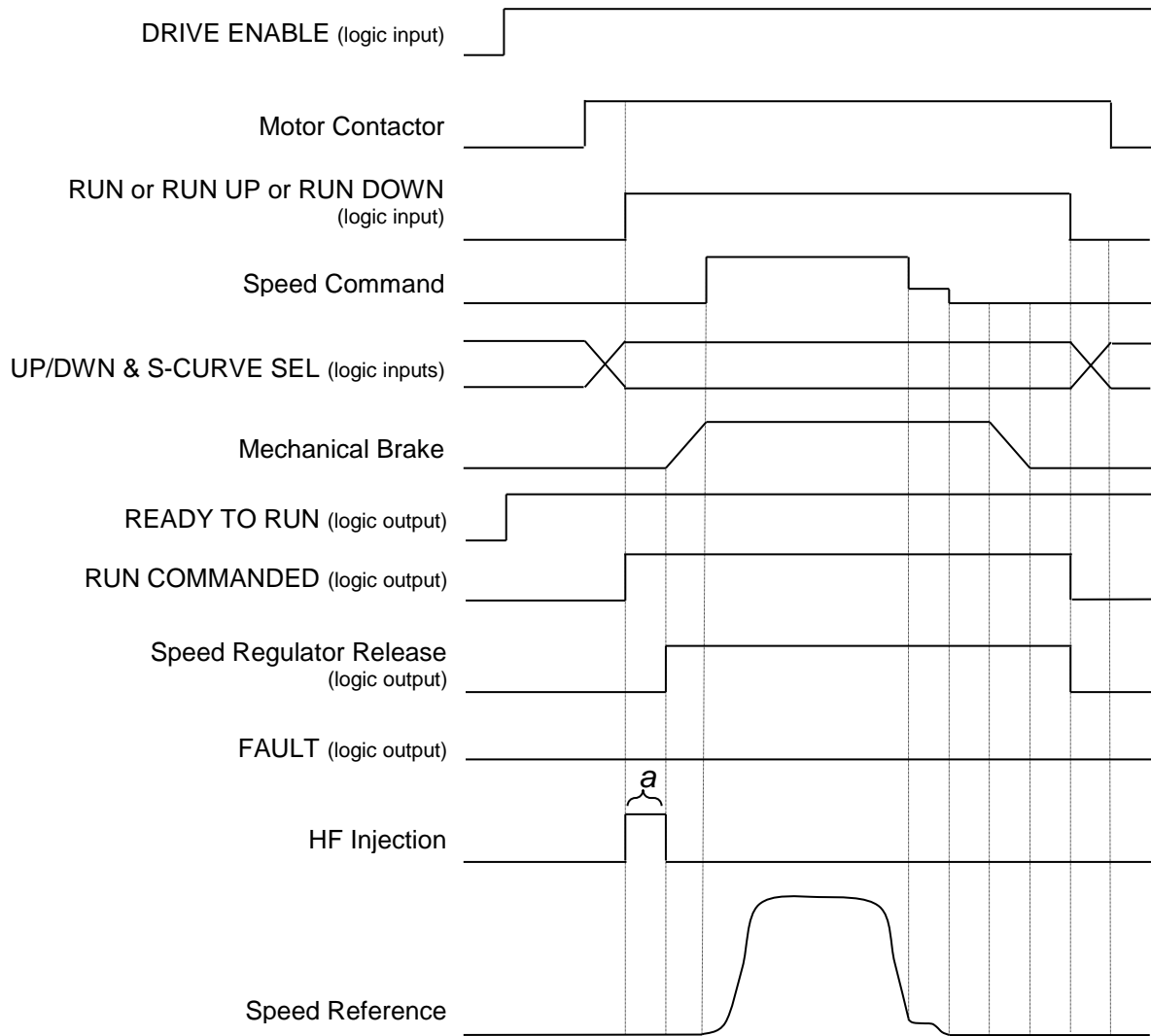
Faults/Alarms/Difficulties	Description	Solutions
<p>HIT TORQUE LIMIT (alarm)</p>	<p>The drive has reached its torque limit as defined in the A1 menu.</p>	<p>Incorrect Encoder Phasing</p> <ul style="list-style-type: none"> ⇓ Verify that the encoder phasing is correct. ⇓ Swap the A and /A wires in TB1-1 and TB1-2 ⇓ Perform an Open-Loop Alignment <p>Proximity Sensor</p> <ul style="list-style-type: none"> ⇓ Verify that the target sensor is being seen by the proximity sensor every time the target is lined up with the proximity sensor using the Z Edge Count (D1) ⇓ Verify that there is no noise on the proximity sensor channel by verifying that the Z Edge Count (D1) isn't incrementing/decrementing more than once per motor rotation ⇓ Check that the proximity sensor power supply on TB1-17 and TB1-18 is 12V_{DC} ⇓ Verify that SW2 is switched to the 12V position (at right). Verify that the voltage between TB1-17 and TB1-18 is 12 volts DC <p>Parameter Settings</p> <ul style="list-style-type: none"> ⇓ Verify that the Encoder Connect (C1) is set to axial flux incremental ⇓ Verify that the Encoder Pulses (A1) is set to a reasonable number <p>Rotor Alignment</p> <ul style="list-style-type: none"> ⇓ Perform a rotor alignment in the U10

Faults/Alarms/Difficulties	Description	Solutions
<p>Once Per Revolution Bump</p>	<p>The motor would jerk every time the target sensor goes pass the proximity sensor</p> <p>NOTE: for MRL setup, use the Z Edge Count (D1) to see when the target is being seen by the drive if you can't see the motor</p>	<p>Parameter Setting</p> <ul style="list-style-type: none"> ⇓ Verify that the Encoder Pulses (A1) matches the number for Measured PPR (D1) while the motor is rotating at high speed ⇓ If they don't match, enter measured PPR in Encoder Pulses (A1).
<p>RTR NOT ALIGN</p>	<p>Run command given before aligning the rotor.</p> <p>The drive does not have a good fix on the motor's magnets.</p>	<p>Alignment Failed</p> <ul style="list-style-type: none"> ⇓ Perform a Rotor Align (U10) ⇓ Verify the motor is connected properly ⇓ Verify that the motor isn't bad ⇓ Verify that the contactor is picked while the drive is performing the alignment

Faults/Alarms/Difficulties	Description	Solutions
<p>Spd Dev Flt or Spd Dev Alm</p>	<p>The speed feedback is failing to properly track the speed reference</p>	<p>Encoder Cable not properly grounded ↓ Verify encoder cable is properly grounded Encoder Hardware ↓ Verify encoder operation Motor Runaway Condition – (PM) ↓ Verify that the rider wheel is firmly connected to the rotor and that the encoder spins as the rotor is spinning Drive and/or Motor is Undersized ↓ Perform another PM Alignment Procedure on page 11 ↓ Usually drive’s “HIT TORQUE LIMIT” alarm message is displayed (depending on setting of TRQ LIM MSG DLY (A1) parameter) ↓ Verify drive and/or motor sizing. May need a larger capacity HPV 900 S2 and/or motor. Check Parameter Settings – PM ↓ Check for the proper setting of Encoder Pulses (A1) ↓ Usually drive’s “HIT TORQUE LIMIT” alarm message is displayed (depending on setting of TRQ LIM MSG DLY (A1) parameter) ↓ Check speed regulator parameters RESPONSE and INERTIA (A1) ↓ Fault/Alarm sensitivity – SPD DEV FLT LVL or SPD DEV ALM LVL (A1) parameter is set too low for required acceleration/deceleration rate. NOTE: Setting SPD DEV FLT LVL too high will reduce drive’s sensitivity runaway conditions!</p>

Faults/Alarms/Difficulties	Description	Solutions
<p>Z Marker Lost</p>	<p>The drive is expecting a signal back from the proximity sensor but doesn't see any within the expected window.</p>	<p>Proximity Sensor</p> <ul style="list-style-type: none"> ⇓ Verify that the target sensor is being seen by the proximity sensor every time the target is lined up with the proximity sensor using the Z Edge Count (D1) ⇓ Verify that there is no noise on the proximity sensor channel by verifying that the Z Edge Count (D1) isn't incrementing/decrementing more than once per motor rotation ⇓ Check that the proximity sensor power supply on TB1-17 and TB1-18 is 12V_{DC} ⇓ Verify that SW2 is switched to the 12V position (in the right position). Verify that the voltage between TB1-17 and TB1-18 is 12 volts DC

Timing Diagram



- a: Every time the drive powers up after being powered down or after the drive has seen an encoder related fault, the drive will perform a HF Injection before the first run to locate the motor magnets. When it does this, a humming noise will come out of the motor. The drive takes approximately 0.30s to perform the HF Inject before running.

NOTE: the brakes should NOT be opened while the drive is performing this initial magnet search after power up or an encoder fault.

Spare Parts List for HPV900 Series 2 Axial Flux

Part Numbers	Description	Detailed Description
HPV9-CTL0030-01	FRU,HPV900 Series 2, Ctl PCB, Axial Flux	<i>Includes control PCB with Axial Flux software</i>
HPV9-TER0010	FRU,HPV900 Series 2 Axial Flux, TerMag Brd	<i>Includes Axial Flux Terminal Board with terminal blocks</i>
HPV9-AF-HDWE	FRU, Axial Flux Motor Hardware Kit	<i>Includes Proximity Sensor, Sensor Bracket, Target, 2x M12 nuts, Gap Tool, Alcohol Pad, Tape</i>
LA46S04416-0005	FRU, 5 meter cable for Proximity Sensor	<i>Includes 5 meters [16.4 ft] of cable for the Proximity Sensor</i>
LA46S04416-0010	FRU, 10 meter cable for Proximity Sensor	<i>Includes 10 meters [32.8 ft] of cable for the Proximity Sensor</i>
LA46S04416-0015	FRU, 15 meter cable for Proximity Sensor	<i>Includes 15 meters [49.2 ft] of cable for the Proximity Sensor</i>
LA46S04416-0020	FRU, 20 meter cable for Proximity Sensor	<i>Includes 20 meters [65.6 ft] of cable for the Proximity Sensor</i>
LA46S04416-0030	FRU, 30 meter cable for Proximity Sensor	<i>Includes 30 meters [98.4 ft] of cable for the Proximity Sensor</i>
LA46S04416-0040	FRU, 40 meter cable for Proximity Sensor	<i>Includes 40 meters [131.2 ft] of cable for the Proximity Sensor</i>
LA46S04416-0060	FRU, 60 meter cable for Proximity Sensor	<i>Includes 60 meters [196.8 ft] of cable for the Proximity Sensor</i>
LA46S04416-0100	FRU, 100 meter cable for Proximity Sensor	<i>Includes 100 meters [328 ft] of cable for the Proximity Sensor</i>
LA05P00057-0112	FRU, Motor Encoder Kit	<i>Includes Incremental Encoder, 4x socket head cap screws, 4 washers</i>
LA05P00066-0622	FRU, 37.3mm [1.47in] Rider Wheel Kit	<i>Includes 37.3mm rider wheel with set screws</i>
LA05P00066-0631	FRU, 75mm [2.96in] Rider Wheel Kit	<i>Includes 75mm rider wheel with set screws</i>
LA46S04417-0005	FRU, 5 meter cable for Motor Encoder	<i>Includes 5 meters [16.4 ft] of cable for the Incremental Encoder</i>
LA46S04417-0010	FRU, 10 meter cable for Motor Encoder	<i>Includes 10 meters [32.8 ft] of cable for the Incremental Encoder</i>
LA46S04417-0015	FRU, 15 meter cable for Motor Encoder	<i>Includes 15 meters [49.2 ft] of cable for the Incremental Encoder</i>
LA46S04417-0020	FRU, 20 meter cable for Motor Encoder	<i>Includes 20 meters [65.6 ft] of cable for the Incremental Encoder</i>
LA46S04417-0030	FRU, 30 meter cable for Motor Encoder	<i>Includes 30 meters [98.4 ft] of cable for the Incremental Encoder</i>
LA46S04417-0040	FRU, 40 meter cable for Motor Encoder	<i>Includes 40 meters [131.2 ft] of cable for the Incremental Encoder</i>
LA46S04417-0060	FRU, 60 meter cable for Motor Encoder	<i>Includes 60 meters [196.8 ft] of cable for the Incremental Encoder</i>
LA46S04417-0100	FRU, 100 meter cable for Motor Encoder	<i>Includes 100 meters [328 ft] of cable for the Incremental Encoder</i>

NOTE: Refer to the 'Replacement Parts' in the HPV900 S2 Tech Manual TM7333 for all other HPV900 S2 parts

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HPV 900 Series 2 Axial Flux PM

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E L E V A T O R

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