

Electromechanical Automation Applications Note

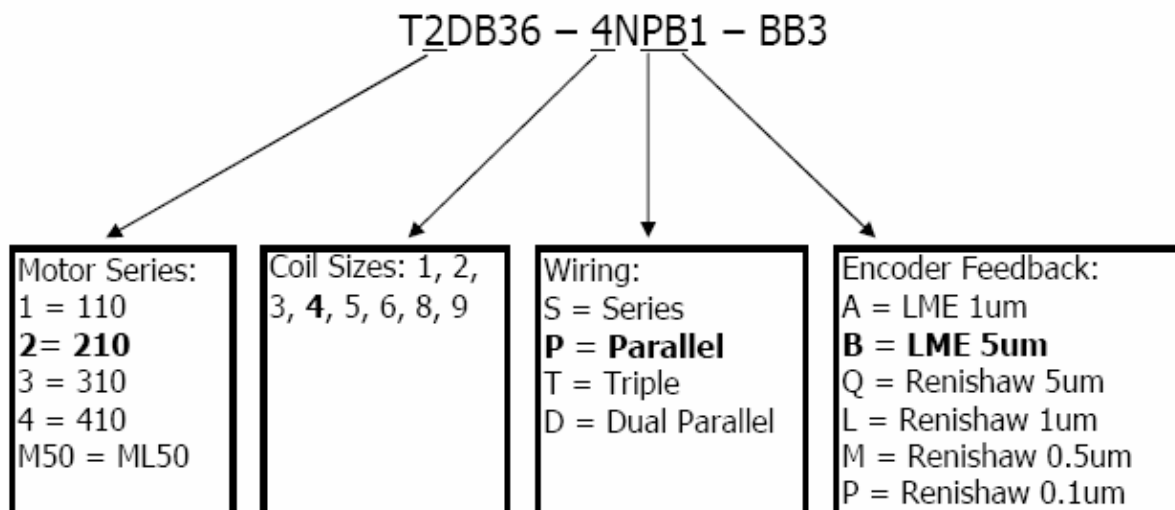


Product: Trilogy coils & Positioners with Aries drive and 6K
Rev: 1.1
Subject: Aries to Trilogy connections

This applications note clarifies the connections with the Trilogy motors and positioners to the Aries drives with 6K controller. Trilogy coils and positioners are supplied with flying lead cables as standard. The new Connector Box option is also shown that quick disconnects on the Trilogy positioners with connectorized cables.

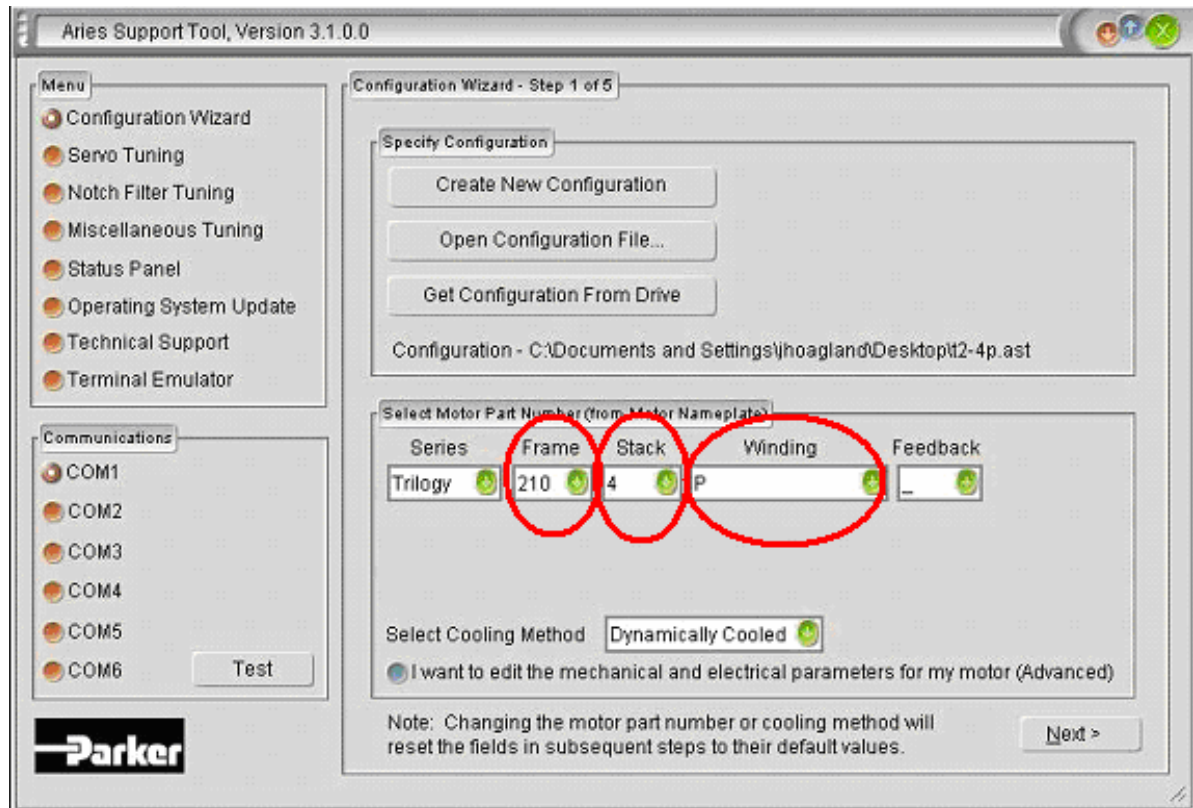
Step 1: Aries Drive Configuration

Aries Support Tool's Configuration Wizard allows quick drive configuration using the I-Force and Ripped series coil part numbers. The Trilogy positioner part numbers contain the coil part numbers. Below shows an example of the I-Force T2 positioner and the information pertinent for Aries configuration.

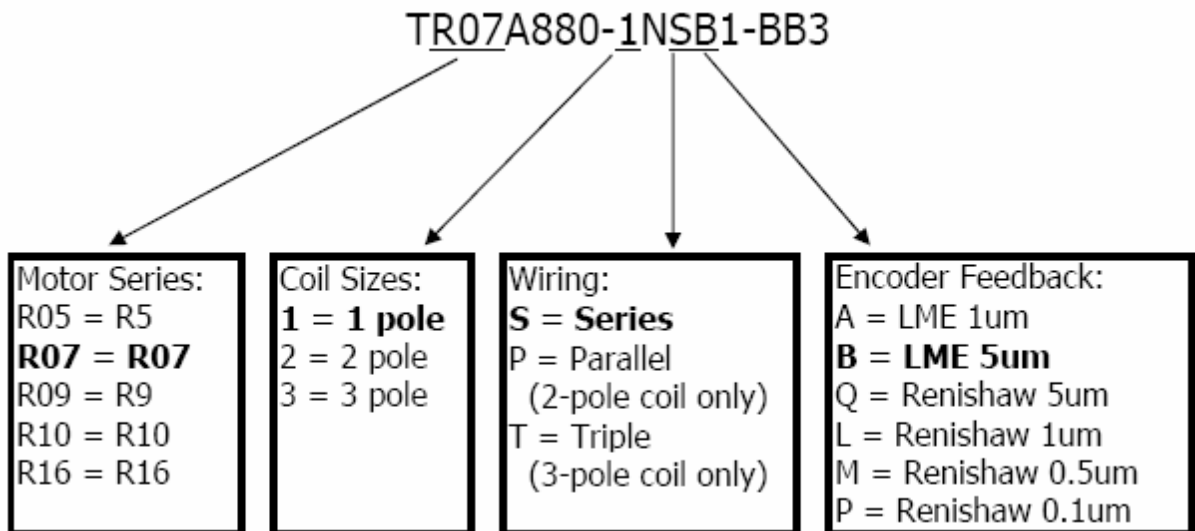


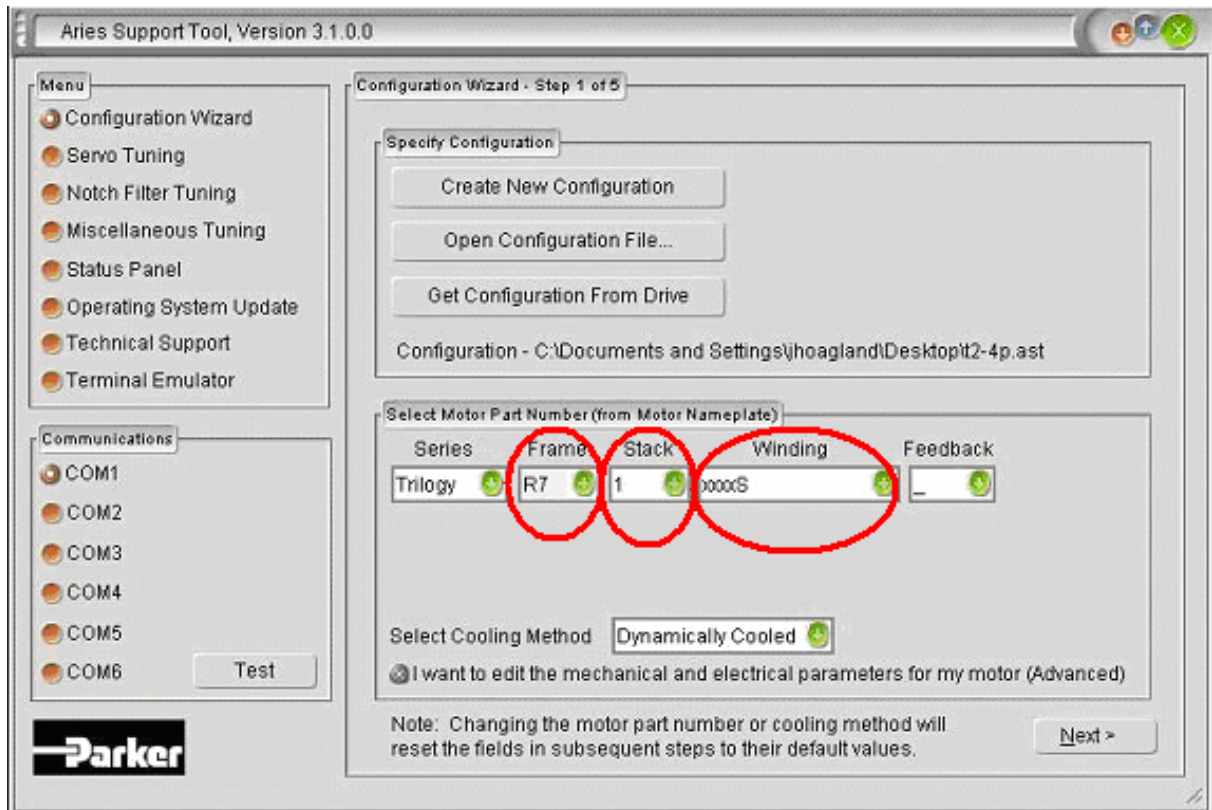
Simple pull-down selections in the Aries Support Tool's (AST) Configuration Wizard configure the amplifier.

Step 1a: Select Motor Part Number.



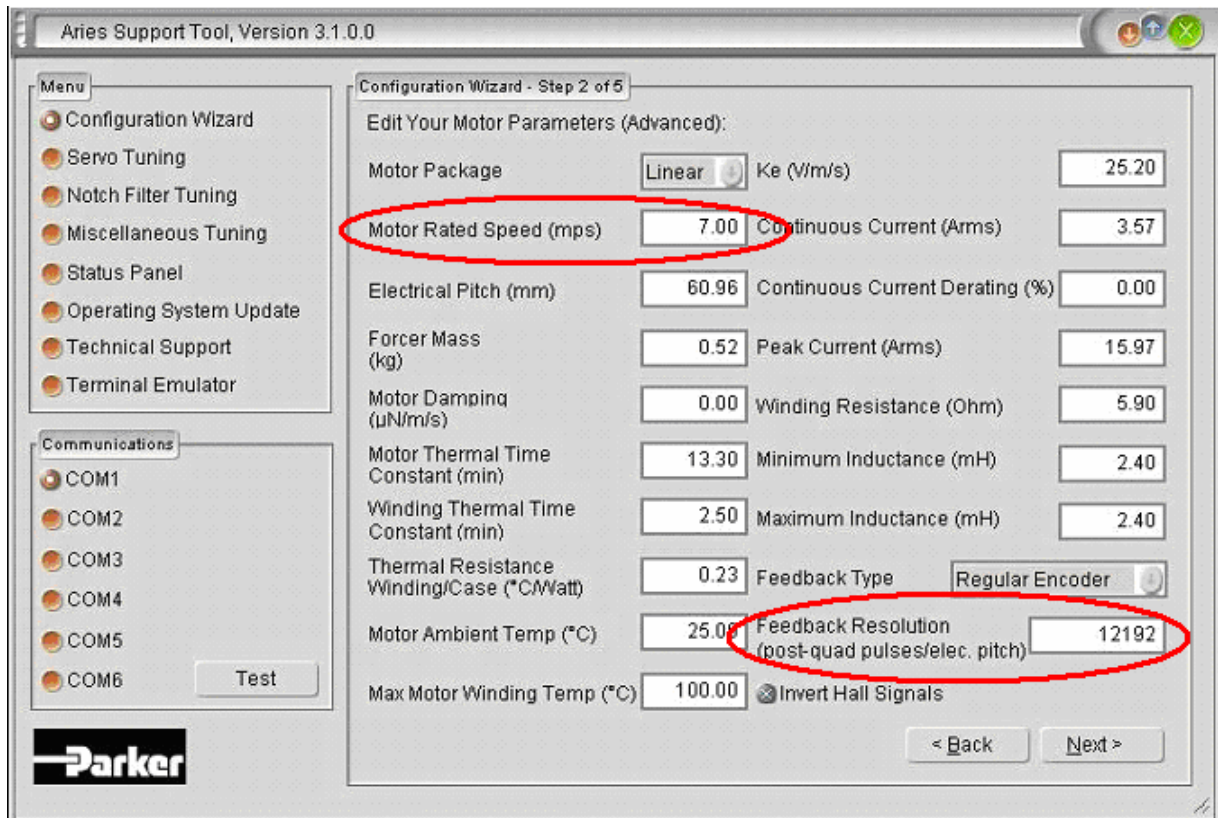
Ripped Example:





Step 1b: Setting Feedback Resolution and Motor Rated Speed

The Encoder's Feedback Resolution sets the number of counts over an electrical cycle for the Aries to commutate. This is set in step 2 of the Aries Support Tool. The screen shot below shows the T2 example's feedback resolution setting of 12192 encoder counts per electrical pitch.



Note that the halls are inverted for both I-Force and Ripped series coils for Aries configuration.

The R7-1 with 5um magnetic would be set to 8000 counts/electrical pitch.

Standard resolutions are listed below:

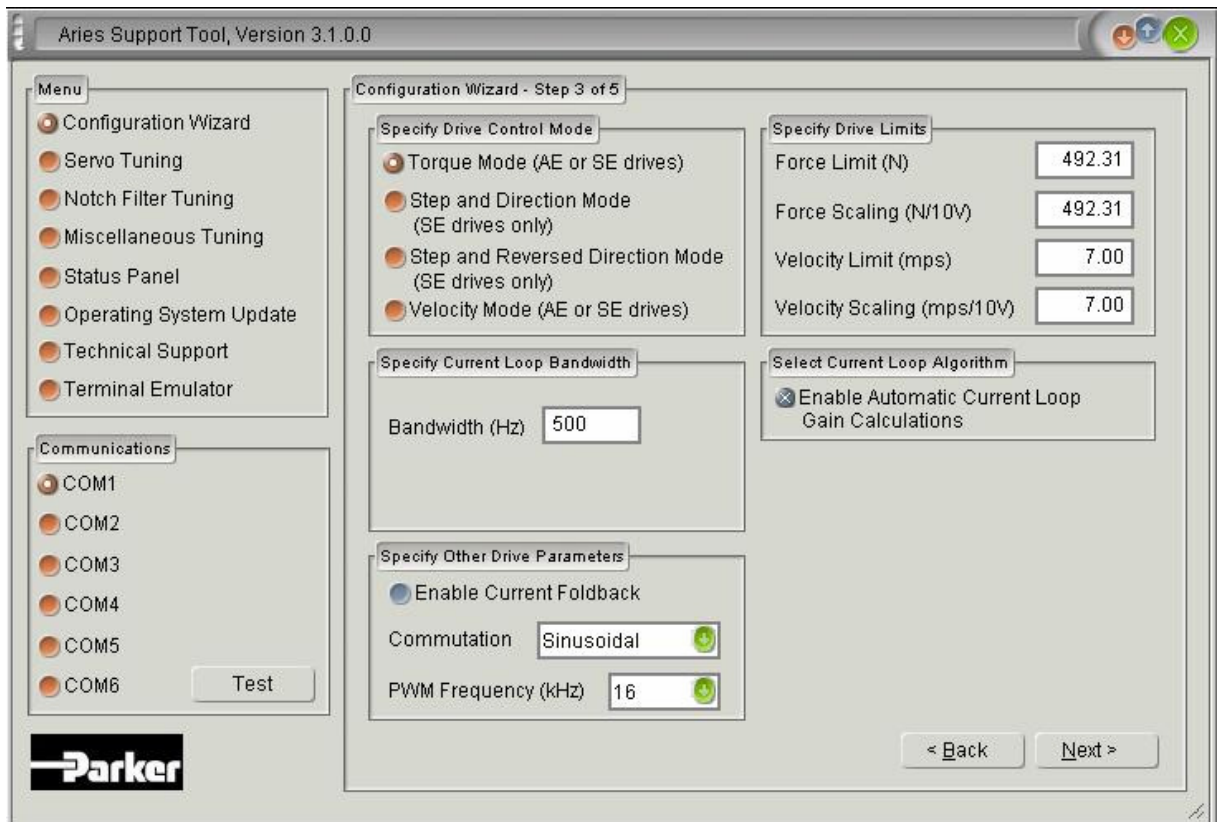
Motor Series	5um	1um	0.5um	0.1um
110 / 210 / 310	12192	60960	121920	609600
410	17068	85340	170680	853400
ML50	12000	60000	120000	600000
R5 / R7 / R9	8000	40000	80000	400000
R10 / R16	12000	60000	120000	600000

This sets the number of encoder counts (post-quad) over one electrical pitch (two magnet widths on the track). This number can be calculated by the electrical pitch divided by the post-quadrature resolution. i.e., $60.96\text{mm} / 5\mu\text{m} / \text{post-quad pulse} = 12192 \text{ post-quad pulses} / \text{pitch}$

The motor rated speed can be used to limit maximum speed commanded for higher resolution encoders. Below are the maximum speeds for the encoder options.

	B 5um LME	A 1um LME	Q 5um Renishaw	L 1um Renishaw	M 0.5um Renishaw	P 0.1um Renishaw
Max Speed (m/s)	7	2.5	5	5	3	0.4

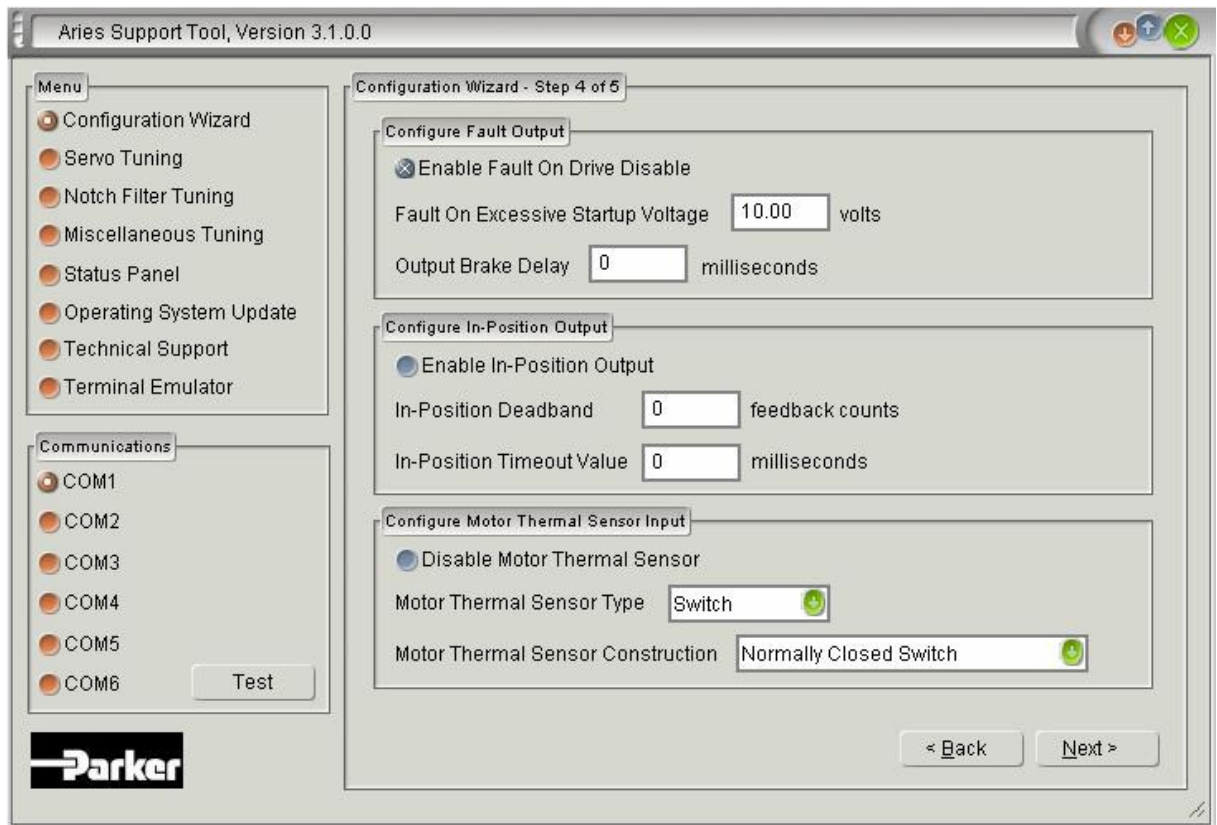
Step 1c: Setting Current Bandwidth



When using the Aries with a 6K, in step 3 of 5 of the AST's Configuration Wizard set the drive in torque mode. Set the current loop bandwidth to 500Hz. This can be increased in current loop tuning if necessary. As the drive is in torque mode the velocity limit in this screen can be left as the default; this value is not used in torque mode.

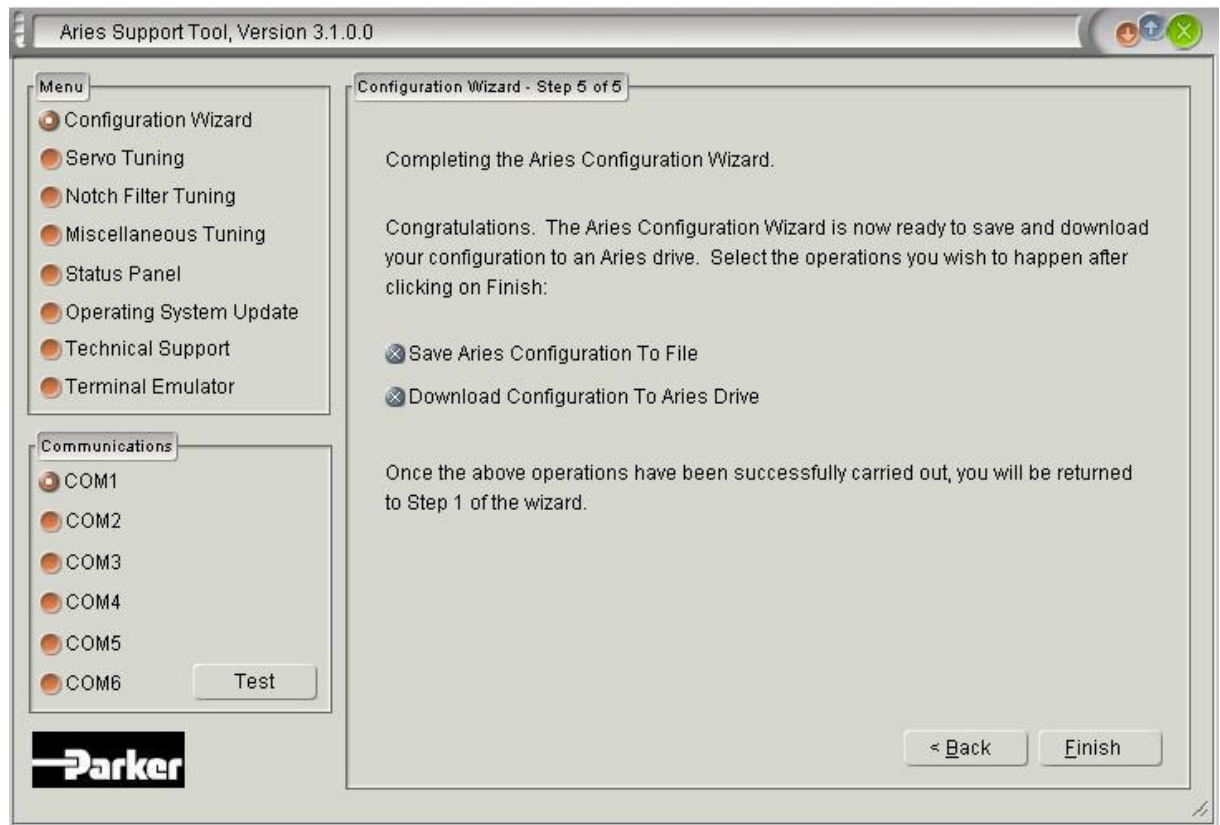
Step 1d: Configure inputs and outputs.

The defaults in the configuration wizard shown below are correct for configuring the Aries with the 6K.



Step 1e: Save and Download.

Save configuration and download to the Aries drive.



Step 2: Wire Trilogy to Aries

The Trilogy coils have different color codes based upon the wiring option (such as WD3 or WD7 in the part number). The Trilogy I-Force positioners (T1, T2, T3 and T4) use coils with WD2 wiring option, a separate MHED module that includes optical limits/ home sensors and magnetic hall-effect feedback, and the encoder readhead and scale. The Trilogy Ripped positioners (TR05, TR07, TR09, TR10, TR16) use HED connector modules that include both magnetic limits/home and hall-sensors feedback, and encoder readhead and scale. The cable part numbers are printed on the cable.

Trilogy positioners are now available with connectorized cables for plug & play operation. See Page 14.

See the following page for Trilogy Coil and Positioner to Aries Wiring. Limit and home sensor connections:

Trilogy	Color Code Trilogy Positioners Ripped & I-Force	6K Connection for Axis 1
Limit Power	Orange	User Supplied +24vdc
Limit Gnd	Purple	any even pin
Home	Brown	19
+Limit	Light Green	23
-Limit	Light Blue	21

Trilogy Coil and Positioner to Aries Wiring

Aries Motor Feedback Connector - HD DB15 Male

Pin	Encoder		Temperature		Halls		Function
	LME Magnetic	RGH Optical	Positioners or WD0/1/2/7	WD3/4	All Trilogy Positioners & Coils	except 210 310 410 WD7/C	
4	Brown	Brown					+5V
3	White	White					Ground
8	Yellow	Yellow					A/
7	Green	Green					A
12	Blue	Blue					B
11	Red	Red					B/
1	Black	Pink					C
2	Orange	Grey					C/
10			Yellow				+ Thermo
15			Orange	Grey			- Thermo
5					Black	Black	+5V
6					White	White	Ground
9					Yellow	Brown	HED C
13					Blue	Blue	HED B
14					Green	Green	HED A
Case	Shield				Shield	Shield	Shield

NOTES:

Halls C/B/A are reversed at the Aries, Hall 1/2/3 respectively.

The encoder's A+ and A- are reversed at the Aries drive, A/ and A respectively.

Thermal sensor is not polarity sensitive.

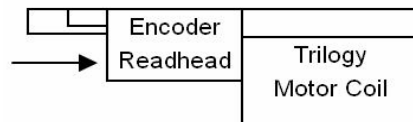
Strip all cables back about 12-inches. Put all wires going into the Feedback connector through one piece of heatshrink

Put all limit/home wires (Orange, Purple, Brown, Lt Green, Lt Blue) through another piece of heatshrink unconnected.

Valid for all Trilogy T1D and T1S positioners built after 12/1/2007. Contact factory for T1S and T1D built before 12/1/2007.

Bellows positioners are same as standard positioners. ex. For B3 positioner, see T3 positioner.

Connect motor cable ground to Aries chassis shield using P-clip.



The above connections presumes the motor, readhead and hall cables exit the same direction.

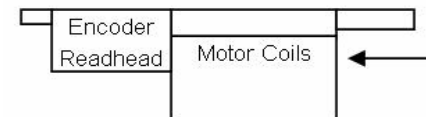
For positioners, this is the standard orientation. If the HED is reversed in a custom positioner, consult factory.

Aries Motor Connection

Using Old Color codes			
Pin	T1, T2, T3 Positioners 110 210 310 WD0/1/2/7 coils	T4, TR7, TR10, TR16 Positioners R7, R10, R16 Coils ML50 Coils 110 210 310 WD3/WD4 coils	Function
1	Red & Blue	Red	U
2	White & Green	Brown	V
3	Black & Brown	Orange	W
4	Drain wire (Coils) or Green/Yellow (Positioners)	Drain wire Ground wire	PE

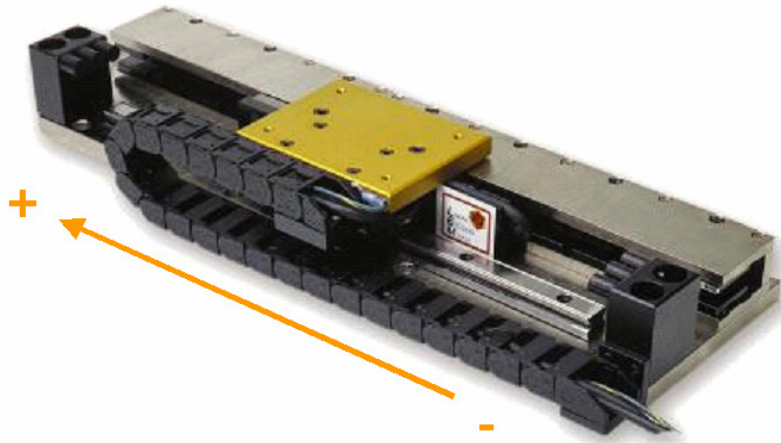
For safety ground for the Ironless linear motors, install a ground wire from Aries ground to the coil bar as per 88-028449-01A installation instructions. New cables include this ground wire in the motor cable and are shown below.

Using New Color codes			
Pin	T1, T2, T3 Positioners 110 210 310 WD0/1/2/7/A/C coils	T4, TR7, TR10, TR16 Positioners R7, R10, R16 Coils 410 and ML50 Coils 110 210 310 WD3/4/B coils	Function
1	Red/Yellow & Blue/Yellow	Red/Yellow	U
2	White/Yellow & Violet/Yellow	Brown/Yellow	V
3	Black/Yellow & Brown/Yellow	Orange/Yellow	W
4	Green/Yellow	Green/Yellow	PE



In coil only applications, if the encoder's cable exit faces opposite the opposite way, switch A and A/.

The encoder A+ and A- are reversed at the drive for Trilogy positioners. Note that the positive direction is away from the cable exit and the encoder counts positively.



Aries Thermal Model Protection and Power Installation

Note that the Aries drive uses a thermal model of the motor to estimate the coil temperature rise and is much faster than a thermal switch. If the internal thermal model is to be relied on to protect the motor, do not power off or reset the amplifier during use. During an e-stop or jam, keep the amplifier alive using the separate C1 & C2 power, and shut off only L1 & L2 power. **Do not reset the amplifier or power off.** Use the enable/disable commands or signals. Repeatedly resetting the drive can thermally damage the motor. If the temperature switch is to be relied on to protect the motor, the peak current should be reduced to twice the continuous current. This is necessary as the temperature switch is not fast enough to protect the motor for peak currents above two times continuous current.

Step 3: Setup 6K

1. For servo axes, set AXSDEF1
2. Set the home sensor to normally closed with the LIMLVL command, i.e. LIMLVL001 for axis1.
3. ERES should be set the same as the Aries Feedback Resolution. See Step 1b of this procedure for the proper setting based on Trilogy model and encoder resolution.

i.e. ERES12192 counts for T2 positioner with 5um encoder

4. Set scaling. This is calculated by (user units) / (encoder resolution/ count) = counts / user units

i.e., for millimeters for 5um resolution encoders, $1\text{mm} / .005\text{mm/count} = 200\text{ counts / mm}$

Set SCALE1, SCLD200, SCLV200, SCLA200

i.e., for inches for 1um resolution encoders, $1\text{inch} / .001\text{mm/count} * (25.4\text{mm/inch}) = 25400\text{ counts / inch}$

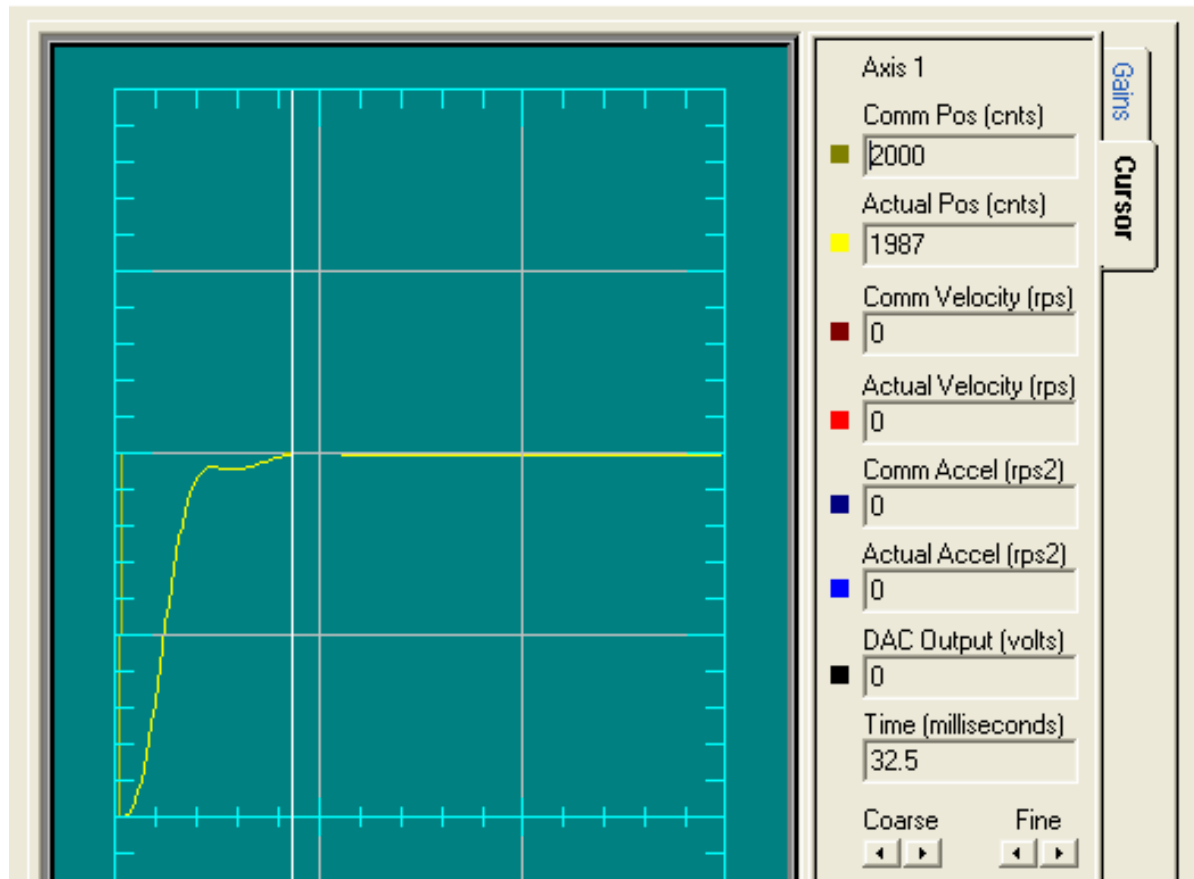
Set SCALE1, SCLD25400, SCLV25400, SCLA25400.

5. For the 6K controllers, Motion Planner software includes the 6K Servo Tuner.

Basic tuning gains for 6K control are SGP3, SGV1 for an unloaded positioner at 5um resolution.

The above steps are for basic 6K setup. For full settings, please see 6K Programmer's Guide.

As an example T2D-4P with 5um encoder gains were SGP7 SGV7 SGI0.2 SGILIM1. Move and settle in 32.5msec for a 2000 count step.



Troubleshooting Steps

Miswired linear motors will not run correctly and may exhibit hard-poling, cogging during motion, excessive tracking errors or runaway conditions. Double-check the wiring if you are experiencing these conditions and that all cable screw lugs are tightened.

If dealing with extended cables or connectorized cables and needing to troubleshoot a 6K and Aries with Trilogy linear servo motor system, to confirm that the motor and encoder direction match:

1. Hardware enable the Aries (Drive I/O connector, jumper pins 1 & 21)

If using a 6K controller this can be done in the MotionPlanner's terminal window by setting the axis to stepper via AXSDEF0. This requires the drive to be disabled (DRIVE0).

This will also disable the servo gains.

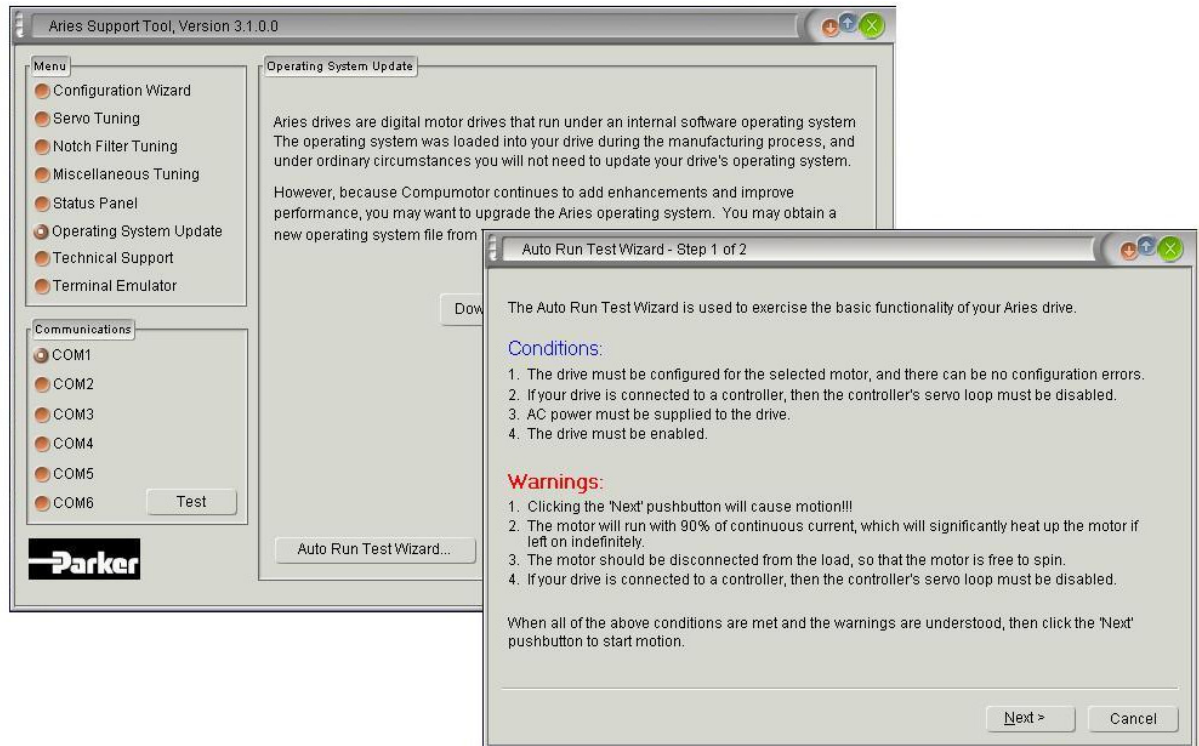
Enable encoder counting with ENCCNT1

Set default encoder polarity with ENCPOL0

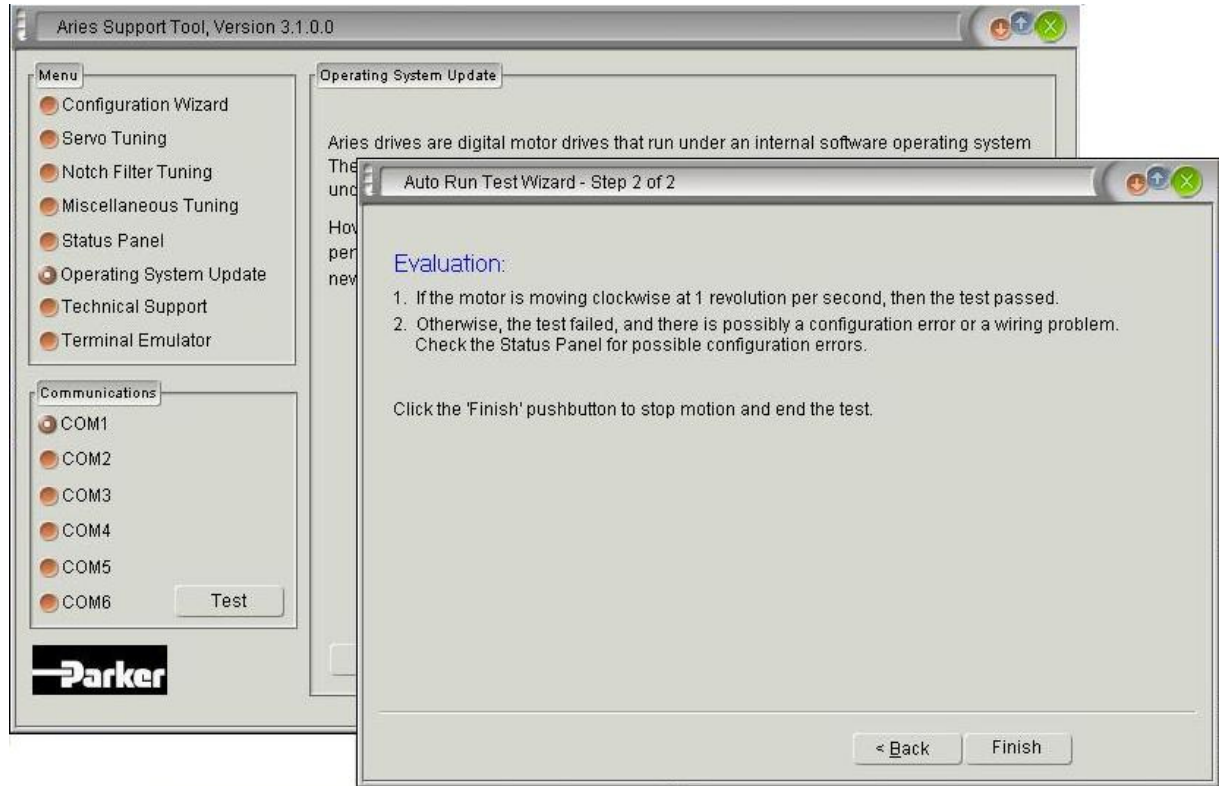
Set DRFEN0 to disable drive fault checking and DRIVE1 to enable. The axis light will be off and the Aries will be enabled (green light) but the linear motor will not have holding force.

Reset the encoder counter by setting PSET0

2. In the Aries Support Tool software, confirm the encoder direction as well by first resetting the encoder counter in the terminal window with the PSET0 command. If necessary, software enable the Aries drive with DRIVE1 in the AST's terminal window or in Miscellaneous Tuning click Enable Drive. Note that if the hardware enable input is not set, the software enable will not function.
3. Put the Aries drive into auto-run mode in Aries Support Tool > Operating System Update > Auto Run Test Wizard. The Trilogy motor will start moving in the motor's positive direction. As the motor is running in open loop, cycling through the hall sequence, the motion will be rough; this is normal.



4. Let the Trilogy coil run a short distance and then stop motion by clicking Finish.



Note if the Trilogy motor does not run in Auto Run, the hall sensors and/or motor phases may be miswired. To troubleshoot the hall sensors and commutation problems (hard-poling, run-aways, cogging), first confirm the motor and hall wiring (page 8-10). As the forcer moves in the positive direction (away from its cable exit), the proper Aries hall sequence will be 6 2 3 1 5 4. Check this in the terminal window using THALL. A user button in the terminal window can be configured, making it easier to click than repeatedly type THALL. The halls will change every 1/6 of the pitch distance.

i.e., $60.96\text{mm}/6 = 10.16\text{mm}$ for the 110/210/310 motors. If the halls are miswired

Secondly, confirm the ERES setting for the Aries. As the Aries uses the encoder to sinusoidally commute after the halls are used on power-up, if the ERES setting is not correct, the commutation will not be correct. To confirm, type PSET0 and move the forcer 2 magnet widths (which is one pitch distance) and type TPE to report the position of the encoder. This should be close to the ERES setting. If it's not check the encoder resolution or check that the readhead is working properly. One easy way to confirm the readhead is working is to leave the forcer disabled and move the forcer by hand from one end to another back and forth and checking TPE at a known mechanical position to see if the encoder is repeatable.

5. In the AST terminal window, check the encoder feedback with TPE command; it should be counting up. If not, invert with setting with ENCPOL1.
6. In the MotionPlanner terminal window, check the encoder feedback with TPE command; it should be counting up. If not, invert with setting with ENCPOL1.

Note, the Aries encoder output polarity to the 6K controller is not affected by ENCPOL; the encoder output is a pass-through for the encoder inputs. Thus the need to set this both in the Aries (for commutation) and 6K controller.

7. Now that the encoder and motor directions have been confirmed as the same, configure the axis as a servo and command a short move.

To change the 6K from the test configuration above back to servo:

Disable the drive with DRIVE0.

Set AXSDEF1. Servo gains are now enabled again.

Preliminarily set the SGP3 and SGV1.

Turn on position monitoring with setting SMPER to 5mm or .2inch in case of run away.

Enable the drive with DRIVE1

Command a short slow move from the terminal window:

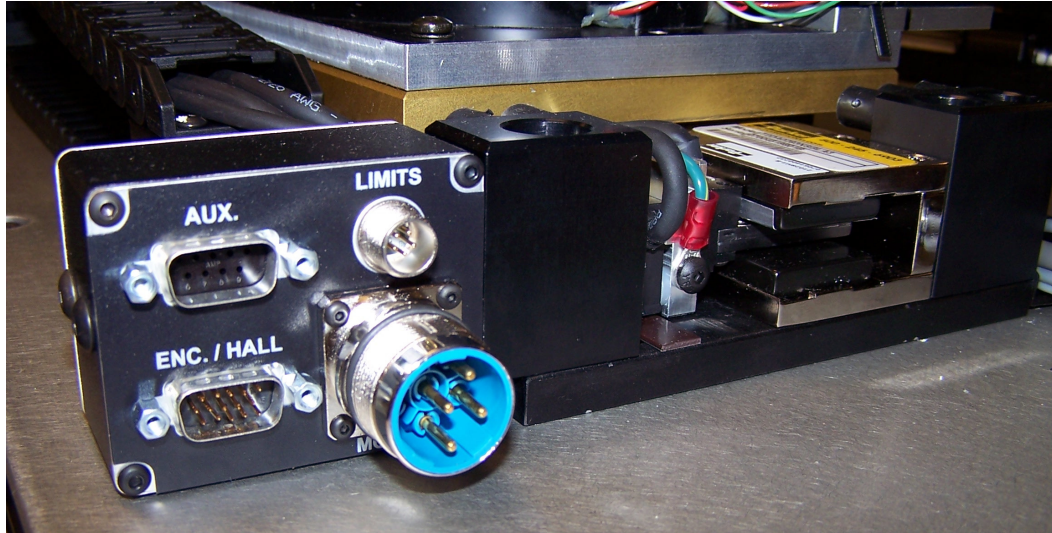
<i>Millimeters:</i>	<i>Inches:</i>
PSET0	PSET0
A100	A4
V10	V.4
D50	D2
GO1	GO1

If no motion is observed, type TPER to check the position error. If the move was not successful, the position error will be close to the commanded distance. One possible cause is that tuning gains are not high enough. Use the 6K ServoTuner to adjust. If the 6K is faulted or TPER is close to 0, check axis status and error report with !TASF, !TASXF, !TERF commands. If limits are not connected, you may software disable with LH0

If the direction is opposite from desired, CMDDIR1 command can be used. This inverts both the 6K's analog DAC command output and encoder feedback direction.

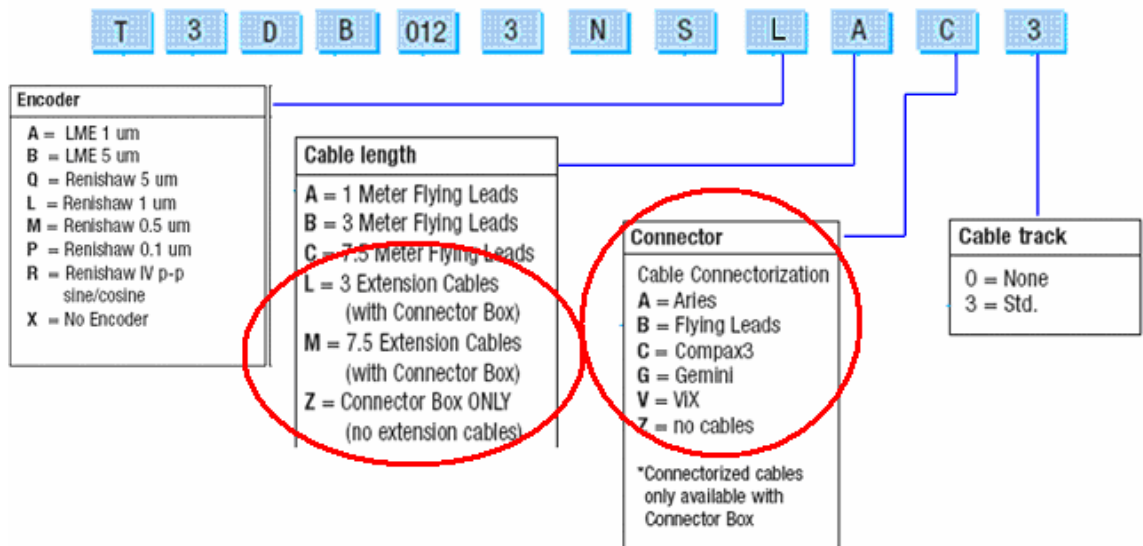
To limit force output while using the above troubleshooting steps, use the DACLIM command for the 6K or Force Limit in step 3 of the AST's Configuration Wizard (or DMTLIM in the AST's terminal). For example, use DACLIM2 to set the maximum DAC output to 2volts, limiting current/force commanded to 20%. Or, in the Aries Support Tool limit the force output of the Aries & coil by setting maximum force to 20% of the default. For the 210-4P example, this would be 20% of 294N = 98.4 Newtons. See step 1c above for screen-capture. After confirming basic motion, raise this to the default before tuning for full performance.

Trilogy Positioner Connector Box Option



Trilogy positioners have a connector box option as a standard option. Daedal LXR users will recognize this as similar to the LXR connector box. This allows users to be able to quickly connect Trilogy positioners to standard Parker drives with connectorized cables. The connector box is available with Flying leads or Parker-drive connectorized cables in 3 or 7.5 meter (10 or 25-foot) for Aries, Compax3, Gemini or ViX servo drive/controllers. Note that the Connector Box is available on all positioners except parallel and triple wound Ripped Positioners.

Order Example:



This applications note is intended as a quick setup guide. For further information on the 6K, see the 6K Programmer's Guide and Command Reference, and for the Aries see the Aries User Guide.

If you have any questions, please contact:

- Technical Assistance, Applications Engineering Department (e-mail: emn_support@parker.com or call 800-358-9070 North America, 707-584-7558 International)