Product Overview

P-Series Pulse Drive

Compact Servo Drive

Indexer Capabilities Overview

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Welcome to the P-Series Indexer Product Overview presentation.

Presentation Objectives

High level introduction to the P-Series Drive

- Understand basic features of the P-Series **Indexer**
- Be able to setup a Index table with the P-Series Drive Support Tool software

Doesn't discuss

- Tuning
- Product Specifications
- P-Series EtherCAT Drive

Prior knowledge assumptions

- Already familiar with servo drive technology

The objective of this presentation is to provide a high level overview of the P-Series drive and its accompanying software. This module doesn't cover tuning, product specifications, or the P-Series EtherCAT drive in detail. However, there may be other modules in the future to address those specific topics. This information is also covered in detail in the user manual and the product's data sheet. This module also assumes that you are already familiar with servo drive technology.

Agenda

- Product Overview
  - P-Series Servo Drives
  - Front Panel
  - System Configuration
  - "Drive Support Software" Brief Summary
- Applications
  - Example Application Feed-to-Length
    - Calculating scaling parameters, Setup Wizard, Test with I/O
    - Using with an XPR2 HMI running Interact Xpress
- Other Features
  - Other Index Types
  - Homing
  - End-of-Travel Limits
  - Point-to-Point Motion and Jogging
  - Touch-probe (high speed input position capture)
- Conclusion and Where to Find More Information

The agenda is as follows, I will be giving a brief product overview about the P-Series product family and will be covering the P-Series Pulse Drive in detail. Then I will go through a feed-to-length example application, which includes setting up the software and testing the drive. I will also discuss some of the key features such as the various index types, homing, end-of-travel limits, point-to-point motion, jogging and the touch probe feature. Finally, the presentation will be concluded with where more information can be found.

Product Overview
P-Series Family

- Two Versions of P-Series Drives
  - Pulse Drive (with indexing capabilities)
    - PD-04P, PD-10P, PD-35P
  - EtherCAT Drive (CANopen over EtherCAT)
    - PD-04C, PD-10C, PD-35C
- Direct drive motors
  - PM-DD Series
- Rotary servo motors
  - PM-FAL, PM-FBL, PM-FCL

The P-Series is a new product family which currently consists of two different model of drives, some direct drive motors and some rotary servo motors.

The P-Series drive comes in two different versions. One version, is the Pulse Drive series. Notice, that it has a “P” at the end of the part number. The second version is the EtherCAT version, which has a “C“ at the end of its part number.

The P-Series motors are available with high resolution absolute encoders that have the capability of automatically sending motor configuration parameters up to the drive. The drives will also work with other motors as well.

This presentation will focus on the Pulse Drive and its indexer’s functionality. However, the same software is used for the EtherCAT version of the drive and shares many of the same features.

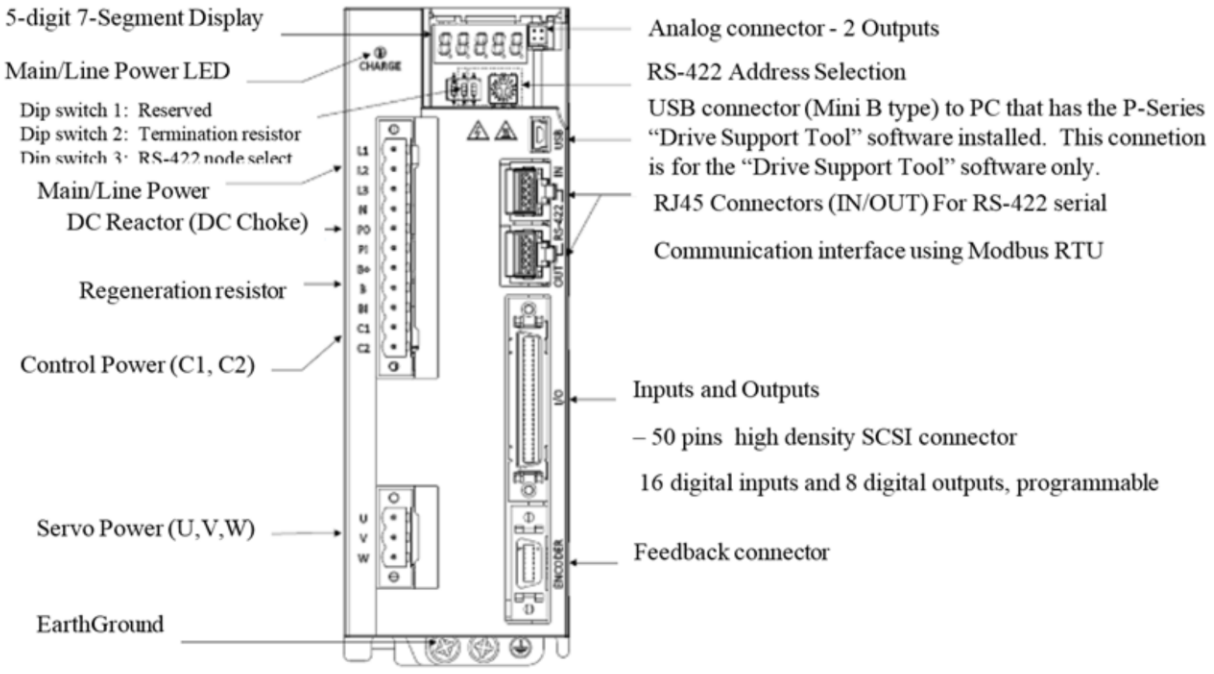
Product Overview
P-Series Pulse Drive: PD-xxP

- Pulse Drive – all command mode functionality listed below comes standard
  - Traditional +/- 10 Volts analog torque or velocity control modes
  - Traditional Step/Direction control mode
  - Indexing Capabilities
- Compatible with various encoders: BiSS-C, Endat 2.2 absolute, quadrature encoders
- Auto-inertia detection for simple one-step tuning
- Auto motor configuration – drive auto-configures when used with P-Series motors

The P-Series Pulse Drive has several different types of command interfaces. It can be commanded with a traditional +/- 10 Volt analog signal or with a step and direction signal, or it can be operated as an indexer. Various encoders may be used with the drives, and some of the compatible ones are listed here. The drive also features auto inertia detection, which makes tuning easy.

Product Overview
P-Series Pulse Drive Front Panel

1000 W Drive Front Panel Description

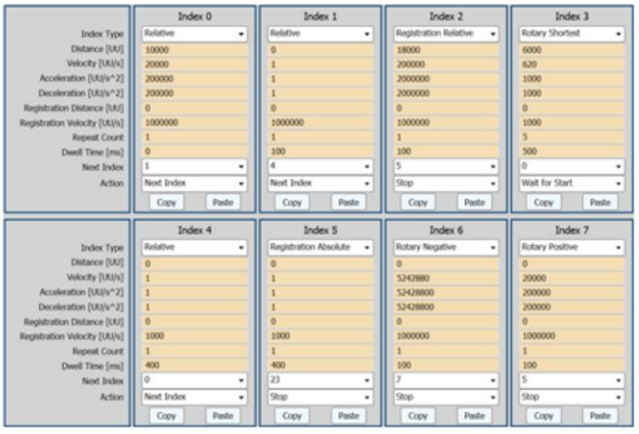


This slide shows the front panel of the P-Series Pulse Drive. There is a 5 digit 7-Segement display that shows the drives status. There is a 4-pin connector that provides 2 analog inputs and 2 analog output signals. The computer is connected to the drive over the USB mini connector. There are two RJ45 ports that are used for RS-422 serial communication. This does not take a standard Ethernet cable and you will need to make your own to interface to other devices, such as a Parker HMI. There is a 50-pin high density SCSI port for the programmable digital inputs and outputs. This port provides 16 digital inputs and 8 digital outputs. This drive has a built-in regeneration brake corresponding to the drive's power. Alternatively, you may add an external regeneration resistor.

The lower power 400 W drive can be powered with 120VAC or 230VAC. See the data sheet for the higher power drives and other specification details.

Product Overview
What is an Indexer?

- Servo motor drive with basic positioning functionality
- No "programming" in traditional sense (no variables, program flow, logic)
- "Program" an index table
- PLC/host controller required for logical decisions



Index Table

HOST CONTROLLER
- Single or multi-axis motion-controller
- Programmable Logic Controller (PLC)

PLC

Discrete I/O Control

Or

Serial Control

P-Series Indexer

First of all, what is an "indexer"? In this context, it is a servo motor drive with basic positioning functionality. Some old stepper controllers may be referred to as an "indexer drive" as well.

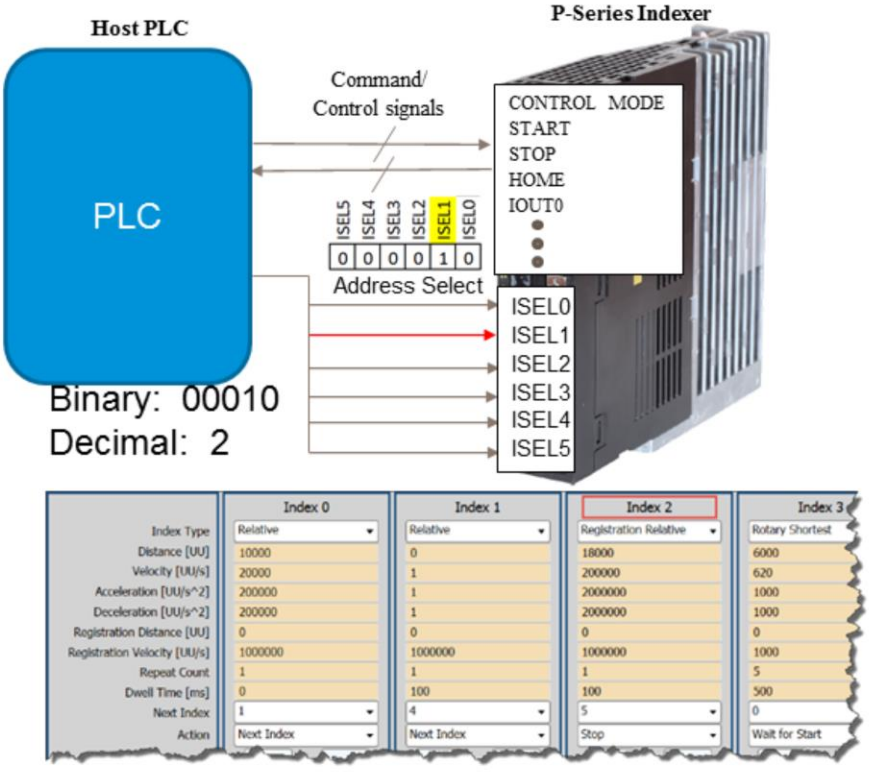
With a servo indexer, there is no programming in the traditional sense. You don't have any variables, program flow, and the Indexer can't perform any logic.

You set up your moves by setting up the index table, which is shown on this slide. The index table has different move types, distance, speed acceleration, deceleration and move time. These parameters define the motion profile.

With a servo indexer, a programmable logic controller (PLC) or another host controller is required to make logical decisions.

Product Overview
System Configuration: Discrete Inputs/Outputs

- PLC controls Indexer via discrete I/O



	Index 0	Index 1	Index 2	Index 3
Index Type	Relative	Relative	Registration Relative	Rotary Shortest
Distance [UU]	10000	0	18000	6000
Velocity [UU/s]	20000	1	200000	620
Acceleration [UU/s^2]	200000	1	2000000	1000
Deceleration [UU/s^2]	200000	1	2000000	1000
Registration Distance [UU]	0	0	0	0
Registration Velocity [UU/s]	1000000	1000000	1000000	1000
Repeat Count	1	1	1	5
Dwell Time [ms]	0	100	100	500
Next Index	1	4	5	0
Action	Next Index	Next Index	Stop	Wait for Start

Since the indexer doesn't perform any logic, they are typically used with a host controller or a PLC. The PLC can interface to the indexer via discrete inputs and outputs.

The PLC would send various output signals to the Indexer to command the start of a move, or to put it into jog mode, or to home it.

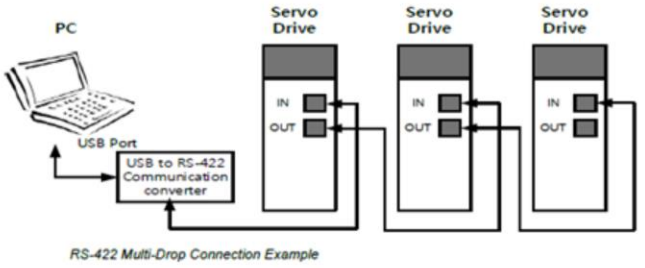
The PLC also needs to select which index number in the table to select. This is done with the digital input address select bits ISEL0 through ISEL5.

The value of the 5 inputs is read as binary by the indexer and the decimal conversion determines the index number. For example, if ISel1 is on and all the other bits are off, that is equivalent to binary zero, zero , zero, one, zero which is 2 in decimal, and therefore selects Index #2. This means that PLC is addressing the index table at index 2. The PLC can choose any of the 64 index numbers by turning on the correct ISEL inputs.

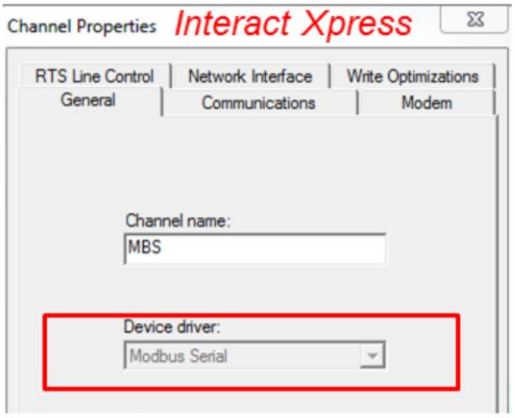
Various output signals from the Indexer is used by the PLC to sequence other events. This means that no encoder wiring is required back to the PLC.

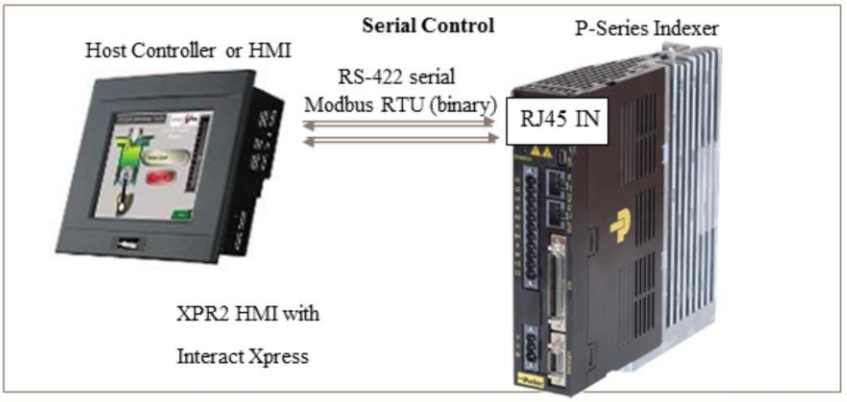
Product Overview
System Configuration: Serial Communication

- *Modbus-RTU*
- *Up to 32 servo drives can be multi-dropped*
- *RS-422*
- *Binary communications*
- *Easy to Use with Parker's HMIs*



RS-422 Multi-Drop Connection Example

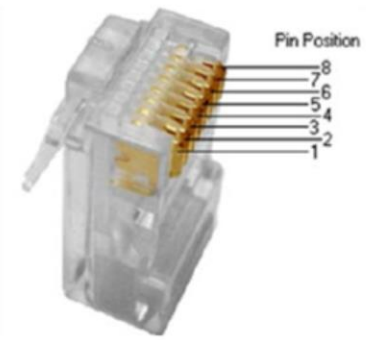




Alternatively, if the host controller has a Modbus-RTU Serial driver, then it can communicate to the indexer over RS-422 connected to the RJ45 port. A network connection like this dramatically reduces the I/O wiring points, especially if several indexers will be wired to the host controller. Up to 32 indexers can be connected on one RS-422 network. Parker's Interact Xpress software (that runs on the XPR2 HMI), includes a Modbus-RTU Serial driver. An example Interact Xpress project for the P-Series Indexer may be downloaded from our website and you can tailor this example project to meet your specific needs. You will need to build a cable to connect these devices together, and the user guide has the pin-out information, which I will briefly show on the next slide.

Product Overview
Interfacing P-Drive to Parker's HMIs

Product	P-Series Pulse Drive		IPX HMI		EPX/EPX2/XPR/XPR2/PA? HMI		IX or XT HMI	
Connector Type	RJ45		9-Pin D-Sub, Female COM2		9-Pin D-Sub, Female COM2		9-Pin D-Sub, Female COM1	
	Description	Pin #	Description	Pin #	Description	Pin #	Description	Pin #
	Not Used	1						
	Not Used	2						
	RXD+	**3**	**TX+**	**3**	**TXD+**	**2**	**TXD+**	**4**
	TXD-	**4**	**RXD-**	**4**	**RXD-**	**4**	**TXD+**	**2**
	TXD+	**5**	**RXD+**	**2**	**RXD+**	**3**	**RXD+**	**1**
	RXD-	**6**	**TXD-**	**1**	**TXD-**	**1**	**TXD-**	**3**
	Not Used	7						
	Not Used	8						



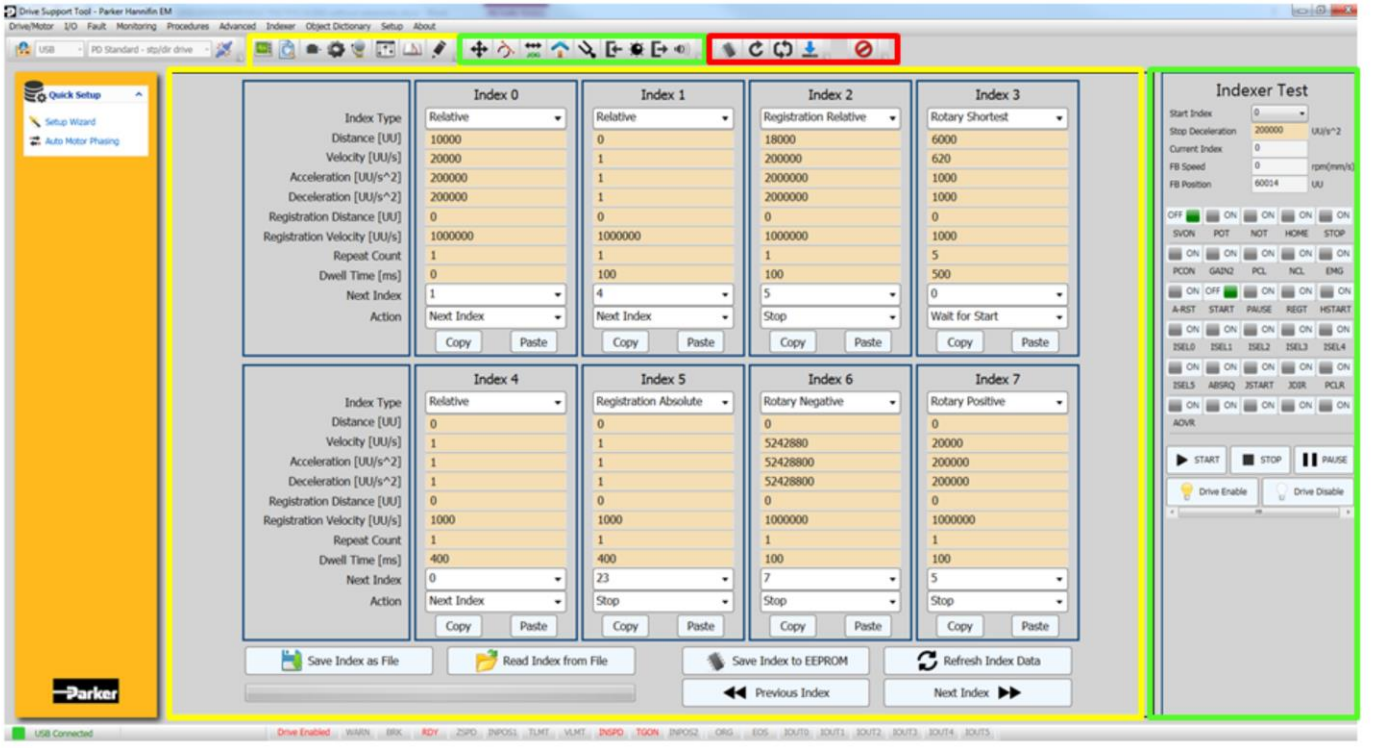
RJ45 connector

9-PIN D-Sub connector
Back view
(showing solder cups)


9-Pin D-Sub connector
Front view (to HMI)

Currently, we don't have premade cables to connect the P-Series Pulse Drive to Parker's HMI. However, you can quickly and easily create your own cable. The P-Series drive has a RG45 connector and the Parker HMIs have a 9-Pin female D-Sub connector. Only four wires are required. It is recommended to use twisted pair cables.

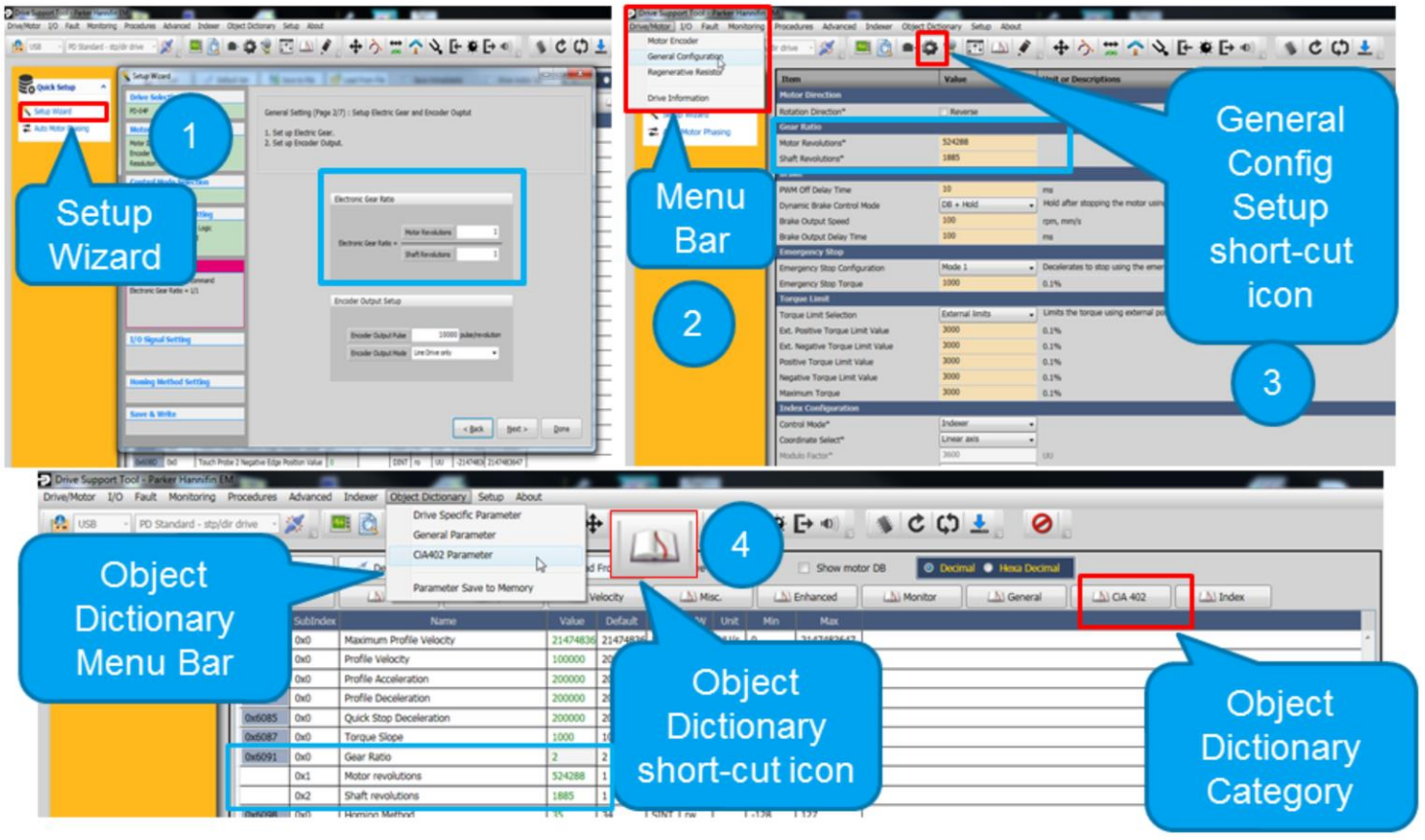
Product Overview
Drive Support Tool Software Layout



To configure the drive and to create the index table, you need to use the P-Series “Drive Support Tool”. This software is a free download from the parkermotion.com web site. I am going to give a brief overview of the software interface before I go through the example application.

Notice the yellow, green, and red boxes that I drew on top of the software interface that is shown on this slide. When selecting the icons inside the yellow rectangle, these features are shown in the large middle window, which also has a yellow rectangle drawn around it. When selecting the icons shown in the small green rectangle, these features are shown in the right most window, and it also has a green rectangle drawn around it. The icons shown in the red rectangle, are system parameters and they have their own pop-up window. The items from the menu bar will either open up in the main middle window or the smaller right hand window. These windows cannot be moved.

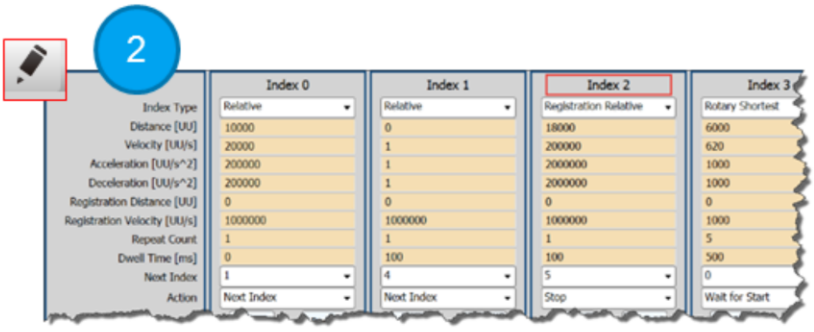
Product Overview
Drive Support Tool Software Accessing Parameters

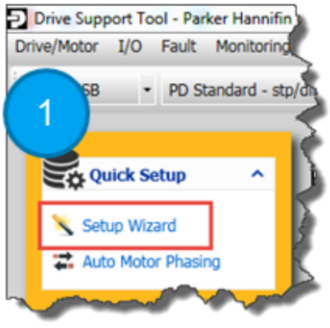


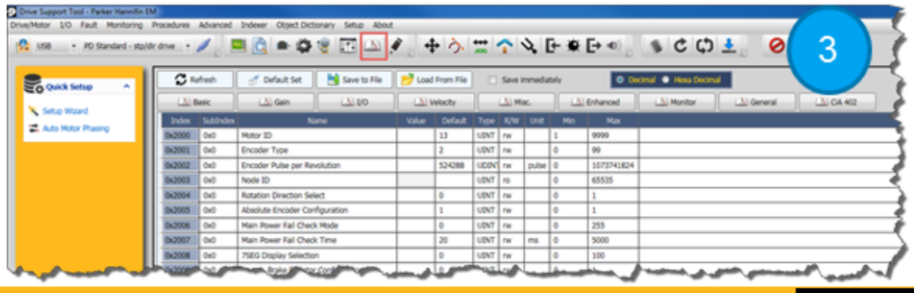
There are many areas in the software to view and set various parameters. Most parameters can be accessed and set from several locations such as from the “Setup Wizard” menu, the menu bar, the short-cut icons from the menu bar, and from the “Object Dictionary” table. Some parameters can be accessed from all 4 places. Above is an example that shows the 4 different ways to access the “Gear Ratio” parameters, which is used to set up the drive’s scaling. When accessing the “Object Dictionary”, the proper category must be selected from one of the “Object Dictionary’s” tabs.

Product Overview
Drive Support Tool Software - 3 areas of focus

- Used to configure/setup drive and to create the Indexing Table
- Three areas I will focus on today
  1. Setup Wizard
  2. Indexing Table
  3. Object Dictionary







There are going to be 3 main areas of the software that I will be focusing on during this presentation. I will use the "Setup Wizard" to configure the drive, then I will use the "Index Table" to program the motion, and when I am discussing some of the other features, I will show how those parameters can be accessed and set via the "Object Dictionary" table. The P-Series drives adheres to the CANopen device profile (CiA402). However, only the EtherCAT version uses CANopen over EtherCAT. The "Object Dictionary" table shows all the drive's parameters. It lists the CANopen index number, the current value, the default value, the data type, if the parameter is read or write, and the units.

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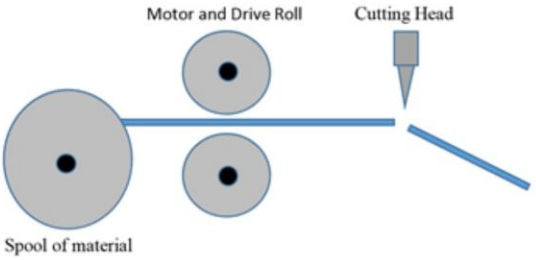
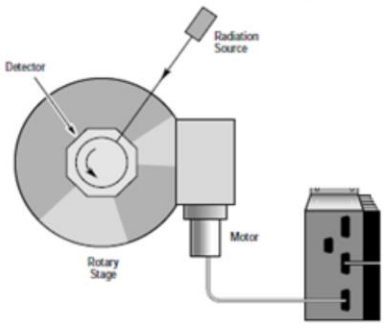
  - Touch-probe (high speed input position capture)
- Conclusion and Where to Find More Information

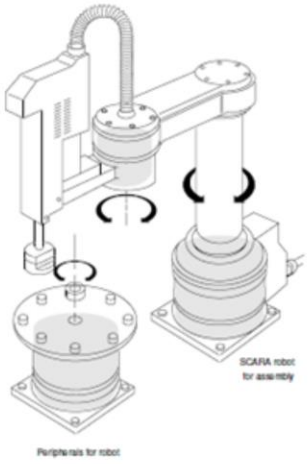
Now I am going to discuss some applications where the indexer may be used and I will go over a feed-to-length example in depth.

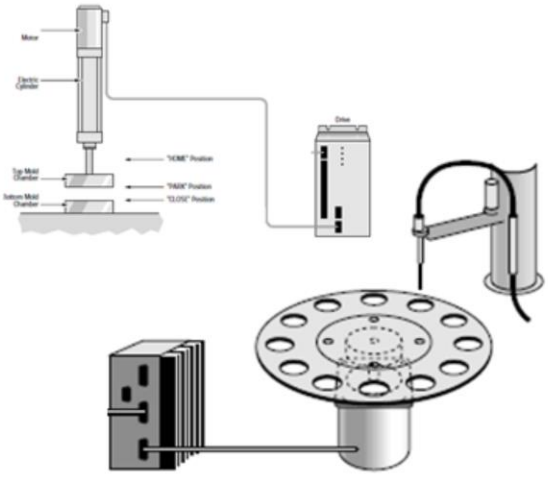
Applications
Example Applications

- Feed-to-length/Cut-to-length
- Rotary indexing
- Registration moves
- Linear/Rotary Moves





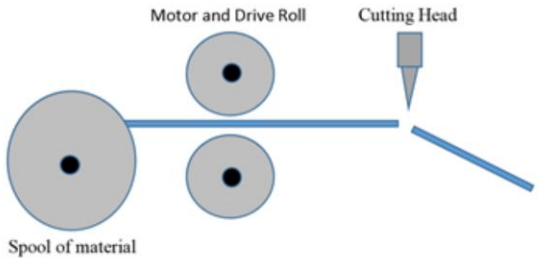


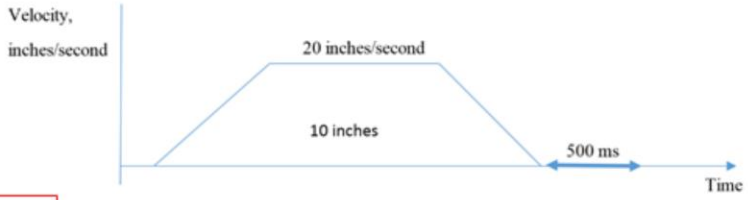


The indexer can be used in various applications and examples of them are shown on this slide. They are commonly used in linear feed-to-length and rotary indexing applications.

Example Application
Feed-to-Length Application Requirements

- **Application Requirements**
  - Gearbox: 10:1
  - Drive roll: 6" diameter
  - Movement: 10 inches
  - Maximum speed: 20 inches/sec
  - Minimum to max speed acceleration time: 100 ms
  - Stop: 500 ms for cutting head
  - Cutting head trigger: 100 ms





Three Steps:
1. Calculate scaling parameters
2. Setup Wizard
3. Fill-out Indexing table and test

The example that I am going to discuss next is a linear feed-to-length application. A feed-to-length application is one where a continuous web, strip, or strand of material is being indexed to a specific length, most often with pinch rolls or some sort of gripping arrangement. The index stops and then some process occurs, such as cutting, stamping, punching, labeling, etc.

My application requirements are as follows: a 10:1 gearbox will be used, the drive roll diameter is 6 inches, and 10 inches of material is fed to the cutting head at a maximum speed of 20 inches per second. When the material has been fed 10 inches, then the Indexer will stop for 500 ms. A 100 ms signal will be sent by the indexer that will be used as a trigger signal by the cutting head.

Basically there are three steps that I will go through to setup this application example. The first step is to calculate the scaling parameters, then go through the "Setup Wizard" to configure my drive, and finally program the indexing table and then test the move.

Example Application
Scaling Calculations

Step	Procedure	Feed-to-Length Application Example
1	Check your motor's feedback resolution/increments.	2^19 = 524288 encoder counts This value can be used for Motor Revolutions.
2	Check your mechanic's specifications, such as the ball screw lead, gearhead ratio, etc.	Gearbox: 10:1 ratio Pulley: Diameter: 6 inches Circumference: 6 inches * PI
3	Determine the user unit you want to use, taking into consideration the machine specifications and the positioning accuracy. This is chosen by the user.	.001 in = 1 user unit 1000 user units = 1 inch travel
4	Calculate the linear or rotary distance traveled based on the mechanical specifications	1885 user units / 1 rev motor shaft
5	Make sure the value for the Motor Revolutions/Shaft revolutions is between 1000 and 1/1000	524,288/1885 = 278.14 < 1000
6	Set the "Electronic Gear" ratio in the "Drive Support Software".	Motor Revolutions: 524288 Shaft Revolutions: 1885

**A technical note about "Scaling for the P-Series Drive" may be downloaded from our website. It includes more examples.*

First we need to calculate the scaling parameters. There is a detailed technical note that can be downloaded from our website that shows several examples on how to do this and may be a useful reference tool.

Axis scaling specifies the distance the load will move for 1 increment of change of the motor shaft position. This takes into account factors such as gearing, ball-screw pitch, drive roll diameter/circumference, etc.

If no scaling factor is applied to the axis, the positioning values are based on the unscaled encoder feedback units. By applying a scaling factor, this enables you to program position, acceleration, deceleration, and velocity values in user units. User units are the minimum units you would use for positioning.

Scaling is done on the P-Series Drive by setting the "Electronic Gear Ratio" in the "Drive Support Tool" software. This converts encoder units into user units. Once we have worked through the calculations, then we will enter these values into the software. Notice in the table shown on this slide, I have this procedure broken down into several steps, which I will cover in further detail.

Example Application
Scaling Calculations

Step 1: Determine Encoder Count

$$\frac{524{,}288\ encoder\ counts}{1\ revolution\ of\ motor\ shaft} = Motor\ Revolutions = 524,288$$ Value entered into setup Wizard

Step 3: Determine User Units

$$\frac{1\ revolution\ of\ motor\ shaft}{.001\ in\ User\ Units} \times \frac{1\ inch\ of\ travel}{1\ revolution\ of\ motor\ shaft} = 1{,}000\ user\ units\ for\ 1\ inch\ of\ travel$$

The value in step 3 will be used when setting distance traveled parameters. For example, to go 10 inches, you'd enter **10,000 user units value entered into the Index Table.**

Step 4: Calculate Distance Traveled

$$\frac{6\ inches * PI}{1\ rev\ of\ load\ shaft} \times \frac{1\ user\ units}{.001\ in} = \frac{18{,}850\ user\ units}{1\ rev\ of\ load\ shaft}$$

$$\frac{18{,}850\ user\ units}{1\ rev\ of\ load\ shaft} \times \frac{1\ rev\ load\ shaft}{10\ rev\ motor\ shaft} \approx \frac{1{,}885\ user\ units}{1\ rev\ of\ motor\ shaft} = Shaft\ Revolutions = 1,885$$

Value entered into setup Wizard

10:1 gearbox

First, we need to determine what the encoder count is for our specific encoder. I am using a P-Series motor that has an absolute encoder with 524,288 encoder counts per motor revolution. This value will be used for the "Motor Revolutions" field in the drive software. All the values I am putting into blue text, will be eventually entered into the Drive Support Tool software.

Next, we will decide on the user units we will want to use. For my application, I am going to arbitrary choose .001 user units. You can see from this calculation, that 1000 user units equals 1 inch of travel. This value is used when setting the distance traveled in the Index table. Recall we want the material to be fed 10 inches, thus this would be 10000 user units.

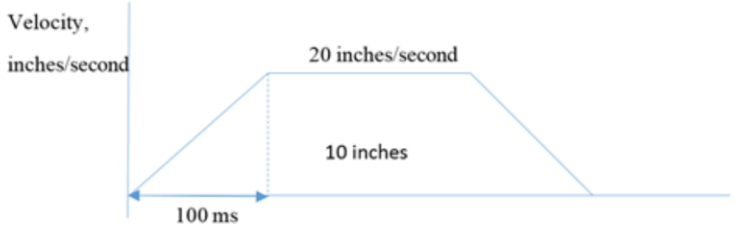
Now we will calculate the distant the output shaft travels. Recall that we had a 6" drive roll. We were also using a 10:1 ratio gearbox. Using this information, we calculate the "Shaft Revolutions" to be 1,885 user units. This will be entered into the "Shaft Revolutions" field in the drive software.

Example Application
Scaling Calculations

Calculate speed: Desired 20 inches per second.

$$\frac{20\ in}{1\ second} \times \frac{1\ user\ units}{.001\ in} = 20{,}000 \text{ user units / second = velocity to be entered into the Index Table.}$$

Calculate acceleration/deceleration:



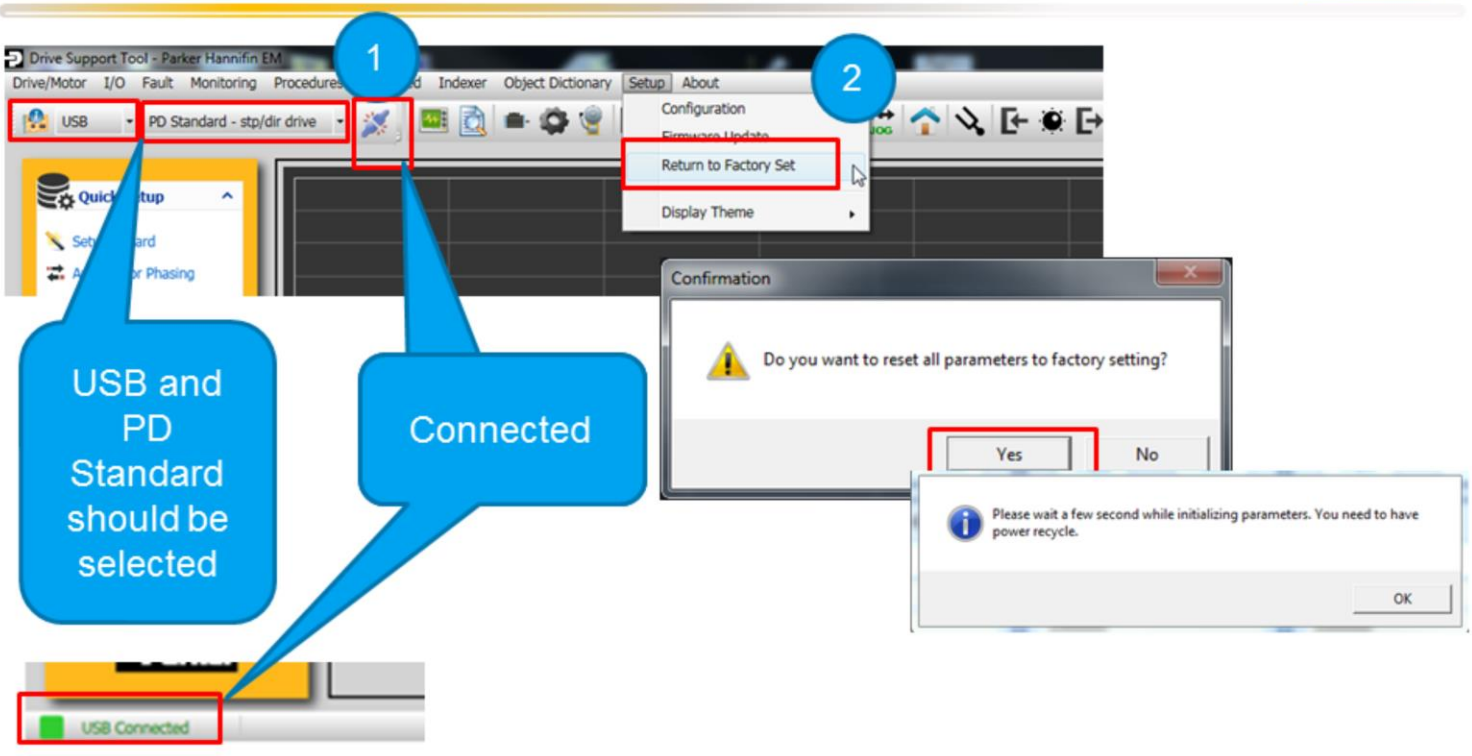
$$\frac{20{,}000\ user\ units}{\frac{sec}{100\ ms}} = 200{,}000\ user\ units/second^2 \text{ = acceleration to be entered into the Index table.}$$

Three Steps:
1. Calculate scaling parameters ✓
2. Setup Wizard
3. Fill-out Indexing table and test

We also need to calculate the speed. Since we want to go 20 inches per second, multiplying this by the user units equates to 20,000 user units per second. Next, I need to calculate the acceleration. Since it is desired to accelerate to 20,000 user units per second in 100 ms, that would make the acceleration 200,000 user units per second squared, which I will also use as the deceleration value.

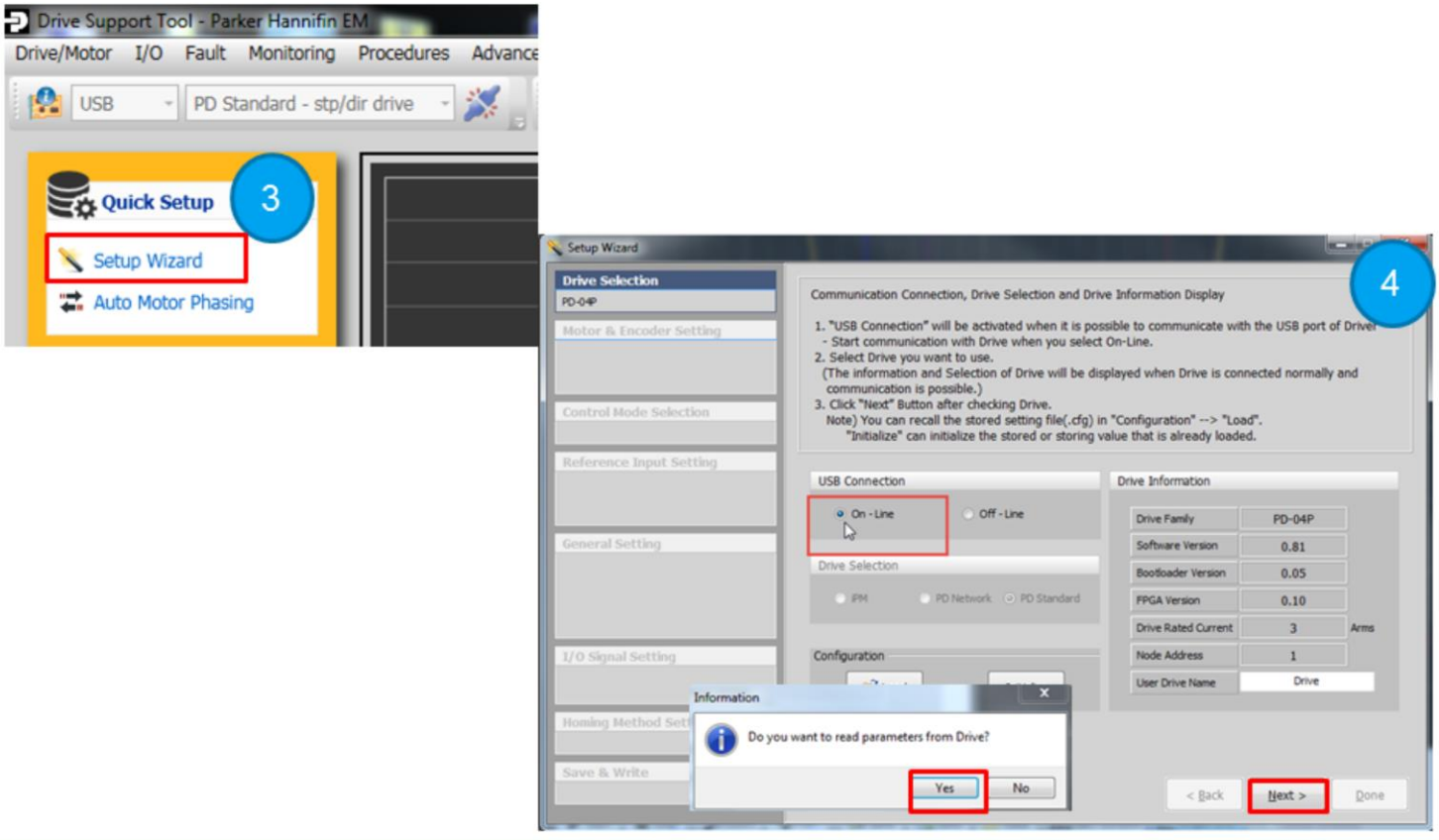
Now that all the calculations are complete, we will go through the "Setup Wizard" in the software.

Example Application
Setup Wizard: Connect & Reset Drive



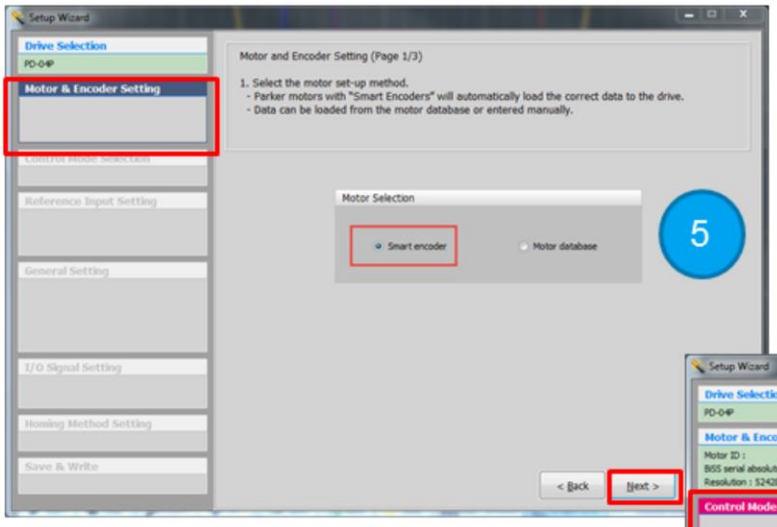
First, I will connect my computer to the drive with a mini-USB cable. Next, I will launch the Drive Support Tool software. I will then click on the "connection" icon. When connected, this icon will change and a status at the bottom of the software will say "USB Connected". Next, to get the drive to a known starting state, reset the drive back to factory defaults by selecting "Setup" from the menu bar and then select "Return to Factory Set". A pop-up dialog box will ask if you want to reset all parameters to factory settings.

Example Application
Setup Wizard: Start Setup Wizard & Go Online

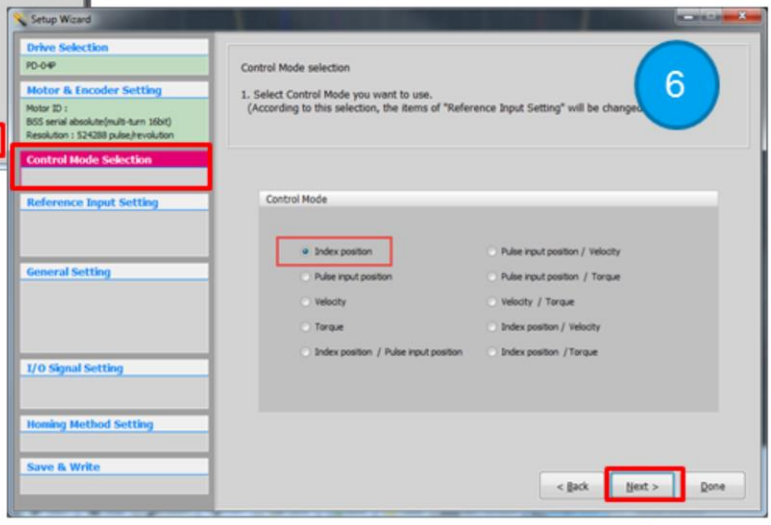


Next, I select the “Setup Wizard. Then for the “USB Connection”, I will select “On-line” with the servo drive, which means that I will be reading the current parameters uploaded from the drive. Notice that the “Drive Information” is automatically uploaded. The “Next” button is then selected go to the next configuration menu in the “Setup Wizard”.

Example Application
Setup Wizard: Motor/Encoder and Control Mode



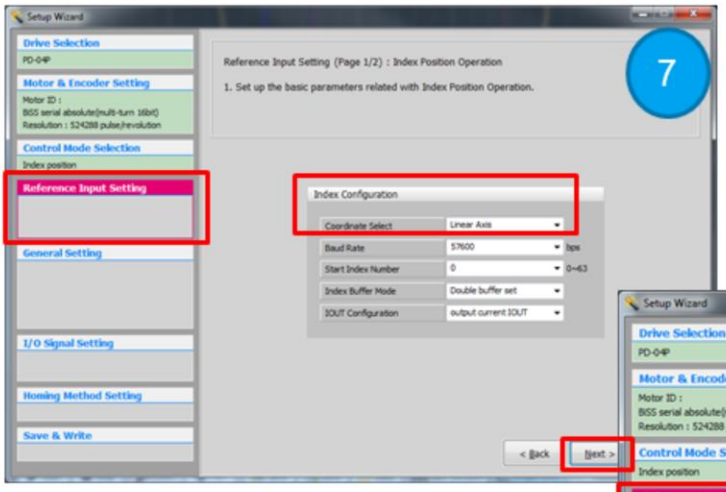
Motor & Encoder Setting: Smart Encoder is default, so leave it if using a P-Series Motor



Control Mode Selection: Change the control mode to: Index position (Indexer mode)

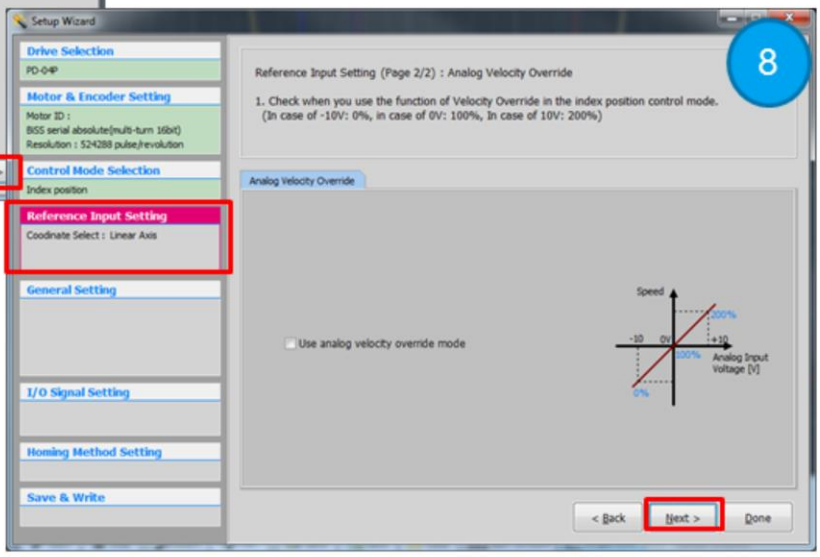
Next, for the "Motor Selection", I will select the "Smart Encoder". Recall that the P-Series motors have "smart encoders" and the P-Series drive can automatically upload the motor information from P-Series motors. The next setting is for the "Control Mode". We want to use the drive as an indexer, so we select the "Index position" setting. If we wanted the drive to be in step/direction mode, then we'd select the "Pulse input position", or if we wanted the drive to be in velocity or another mode, then we'd make that selection. All the various control modes are explained in the user manual. Later in the presentation, I will show how the "Index position/Velocity" mixed mode can be used.

Example Application
Setup Wizard: Reference Input Setting



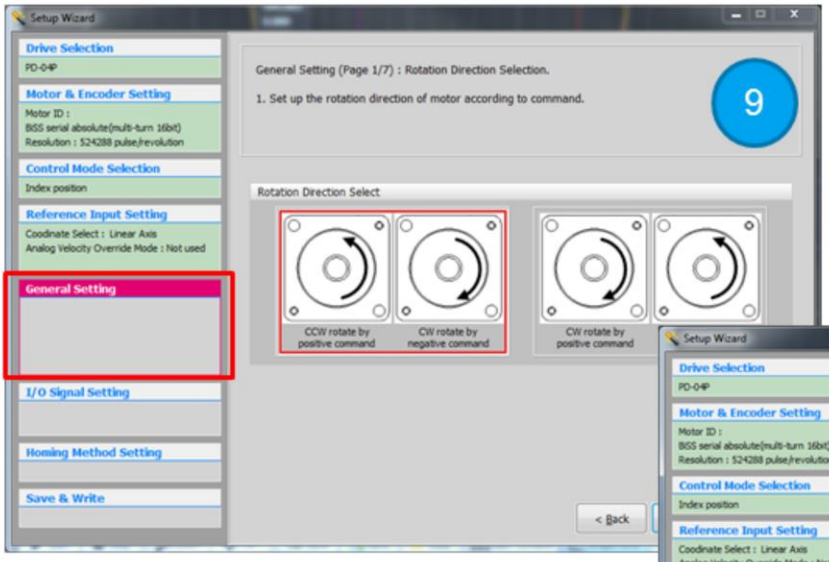
Reference Input Setting:
Coordinate Select: Leave as default settings for this example

Reference Input Setting:
Analog Velocity Override Mode:
Leave unselected

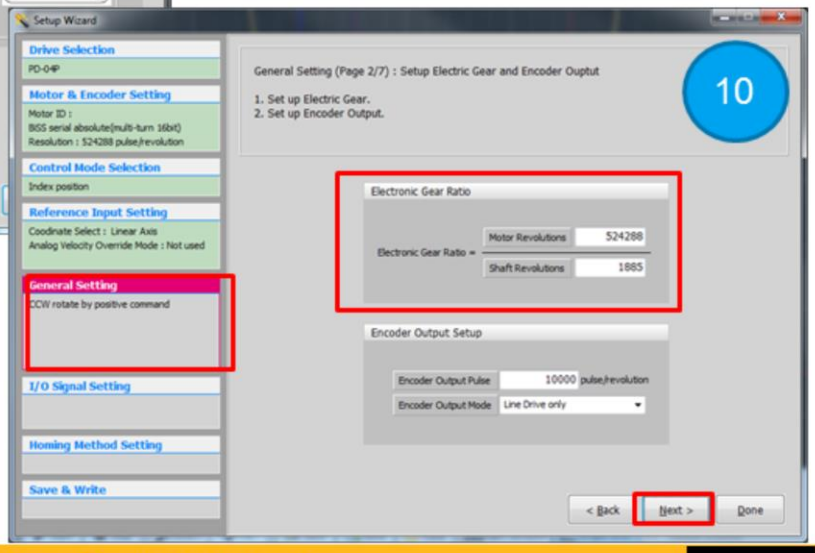


Now we will go through the “Reference Input Setting” section of the “Setup Wizard. First we will configure the “Index Configuration” “Coordinate Select” field as a “Linear Axis”, which is the default setting. If you were making rotary motion, you’d select “Rotary Axis” from the drop down menu. For the next menu, leave the “Analog Velocity Override Mode” the same as default, which is unselected.

Example Application
Setup Wizard: General Setting



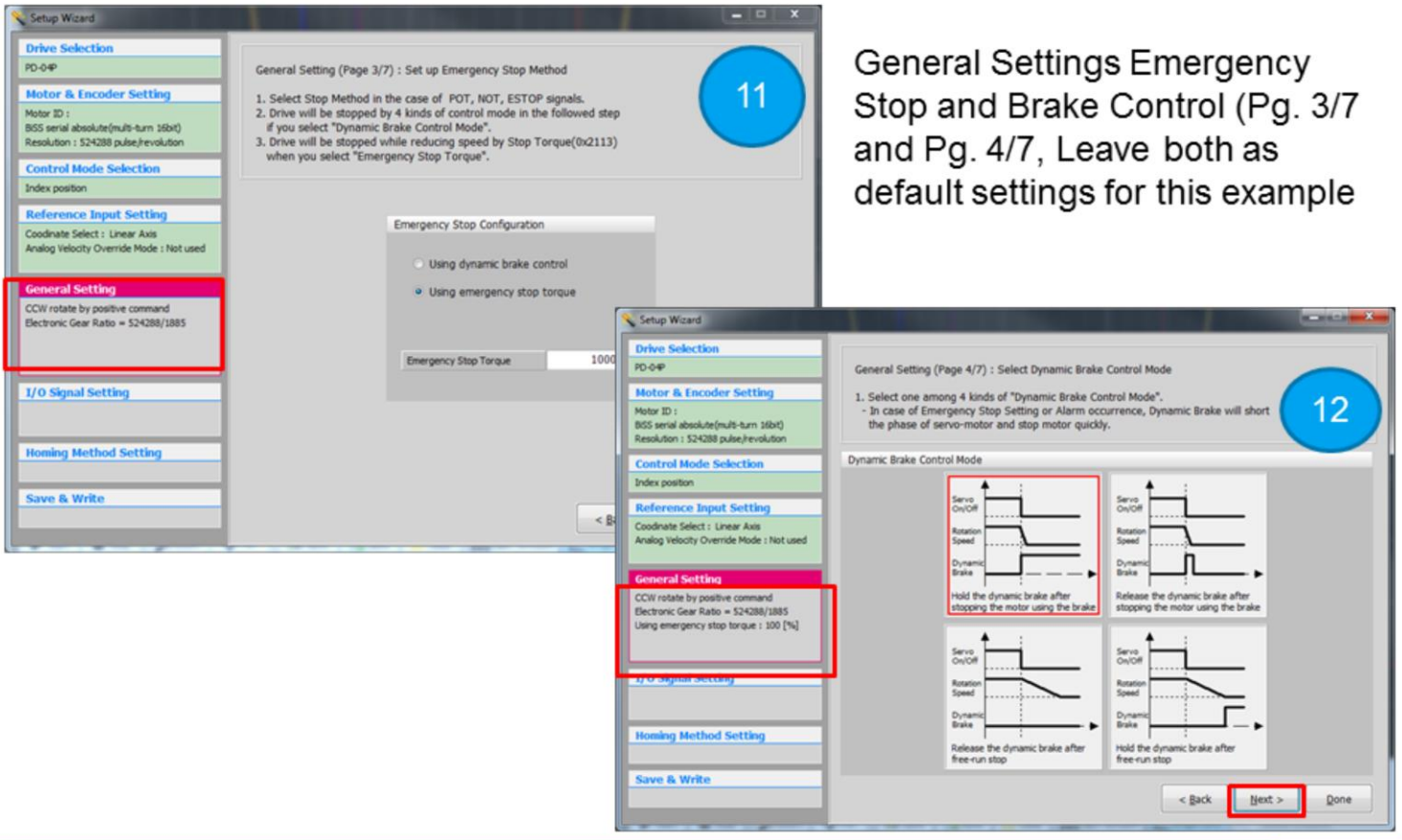
General Setting Rotation Direction Selection: (Pg. 1/7): Leave rotation direction as default



General Setting (Pg. 2/7):
Electronic Gear Ratio:
Motor Revolutions: 524,288
Shaft Revolutions: 1885

Next, we will set the “General Settings”. For the “Rotation Direction Select”, I am going to leave the rotation direction as the default value of counter-clock wise. Most of our other drives’ default direction is clock-wise (CW) as a positive direction (viewing the motor from the shaft end). This can be easily changed here if desired. Next, we will set the “Electronic Gear Ratio” fields. This is where I enter the scaling values I calculated previously. Recall that these values were 524,288 for “Motor Revolutions” and 1885 for “Shaft Revolutions”. Leave the “Encoder Output Setup” at the default values.

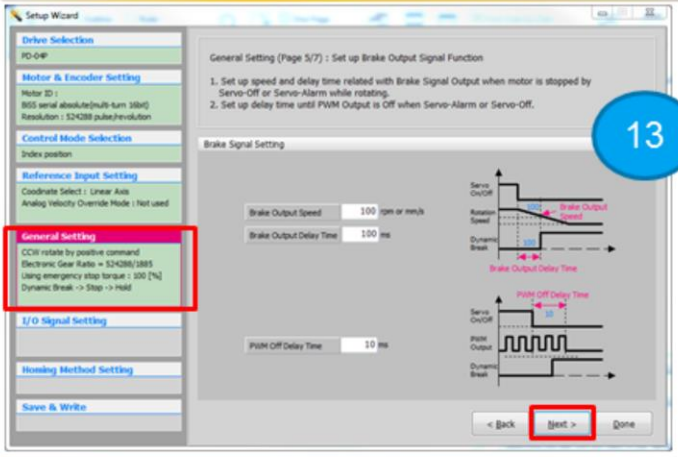
Example Application
Setup Wizard: General Setting (cont.)

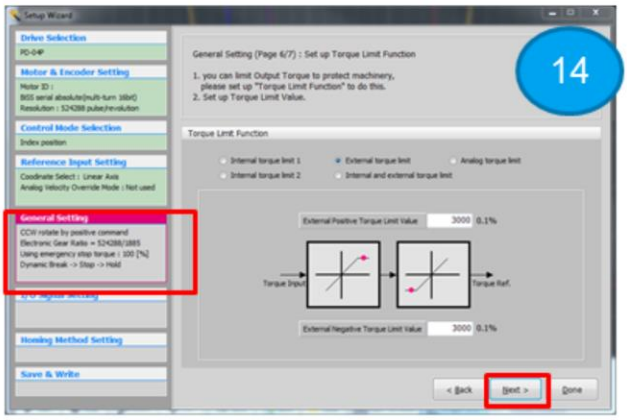


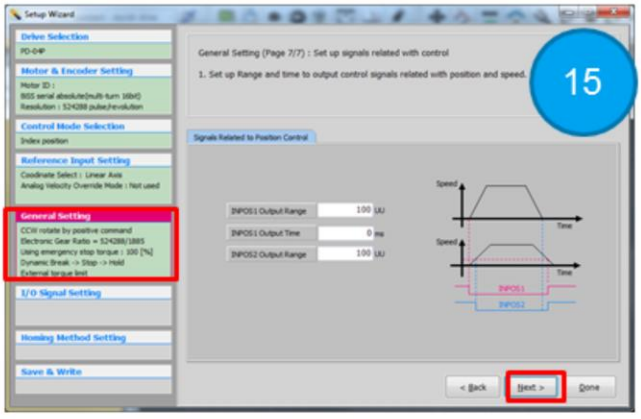
General Settings Emergency Stop and Brake Control (Pg. 3/7 and Pg. 4/7, Leave both as default settings for this example

The next configuration screens are for “General Settings” are for the Emergency Stop and the Dynamic Brake configuration, and I will leave these as the default values.

Example Application
Setup Wizard: General Setting (cont.)



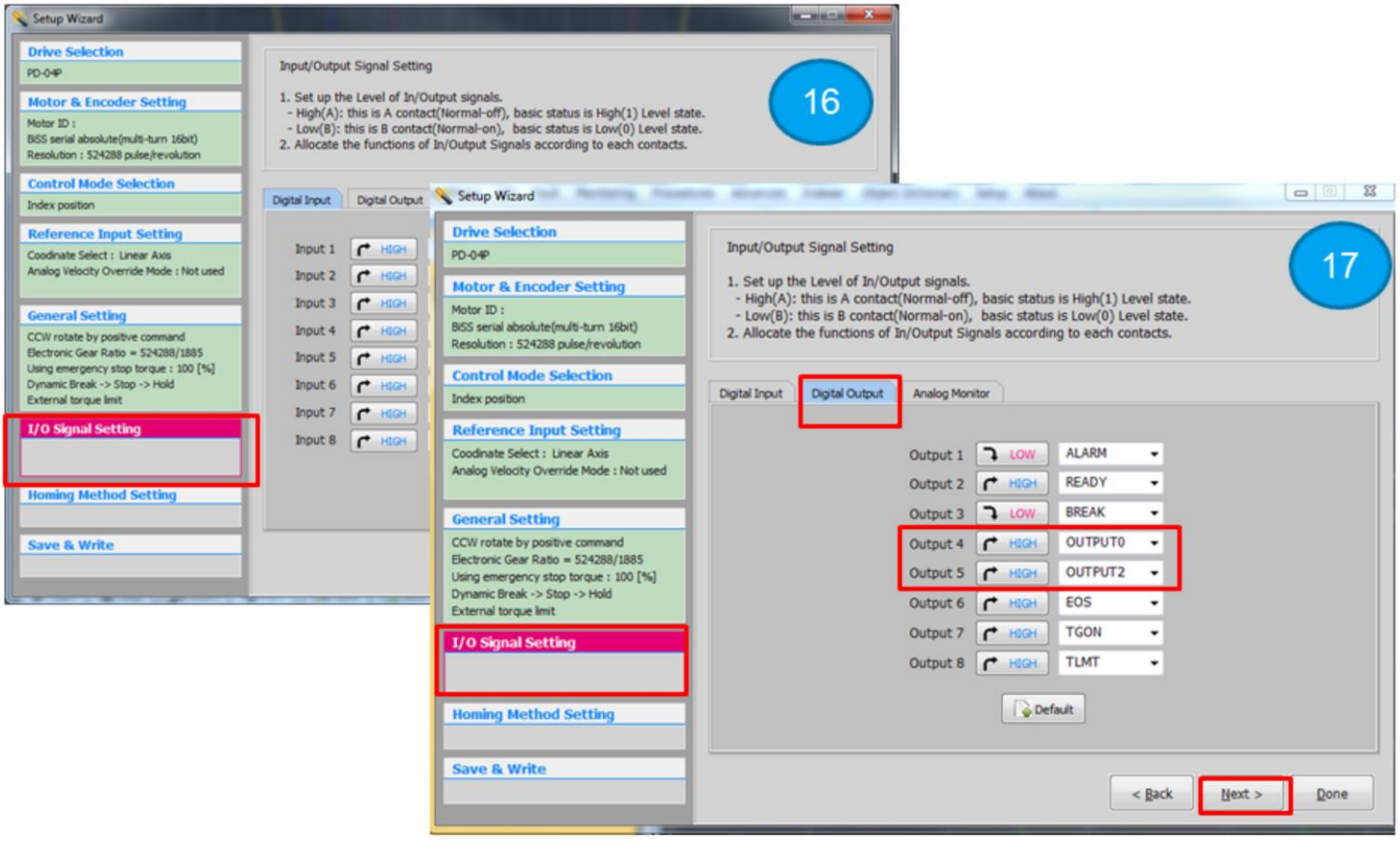




General Setting (Pg. 5/7, Pg. 6/7, and Pg. 7/7, Leave as default settings for this example

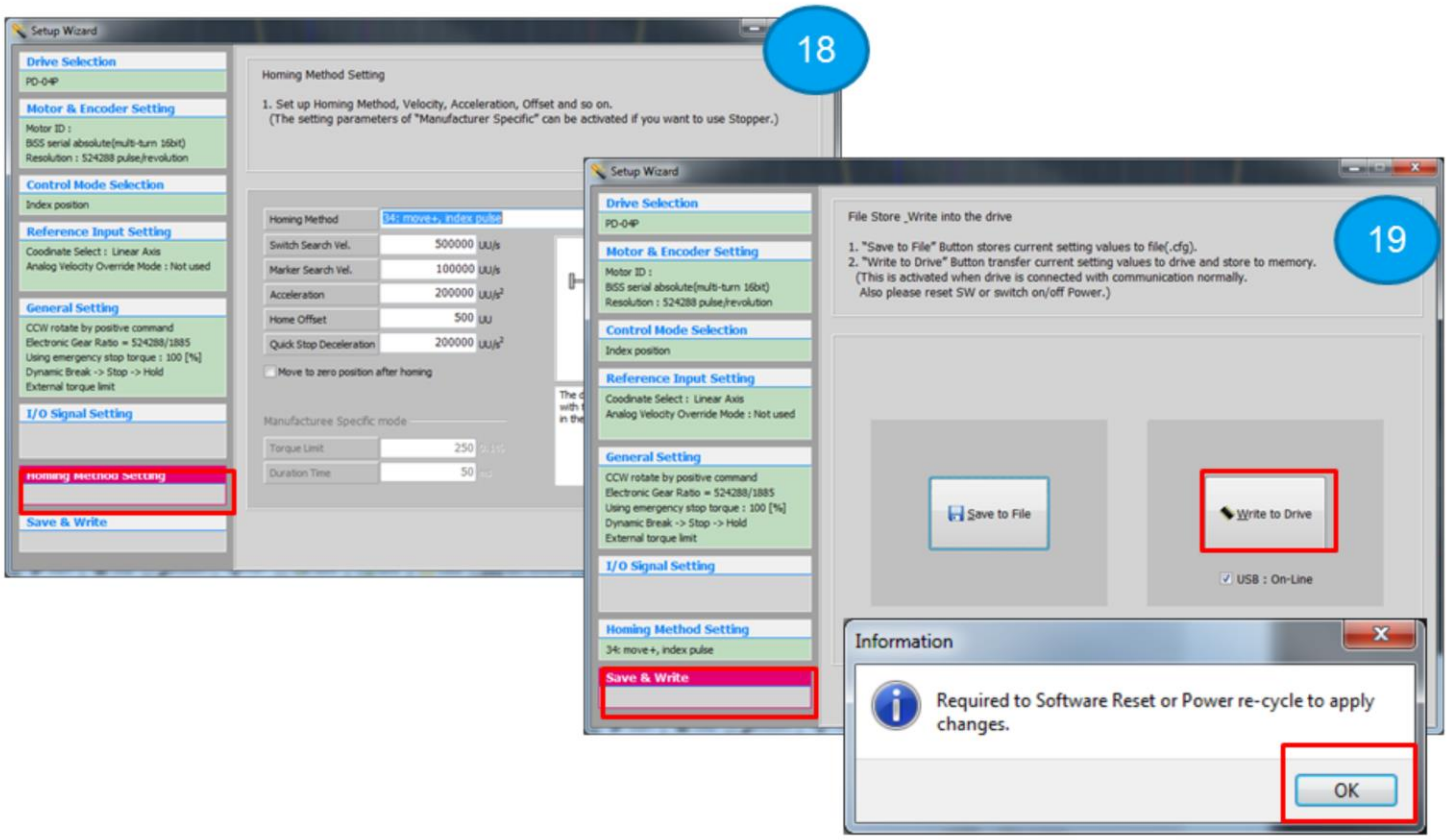
The following "General Setting" screens are for the Brake signal, the Torque Limits, and the INPOS output settings. I will leave these at their default values.

Example Application
Setup Wizard: I/O Signal Setting



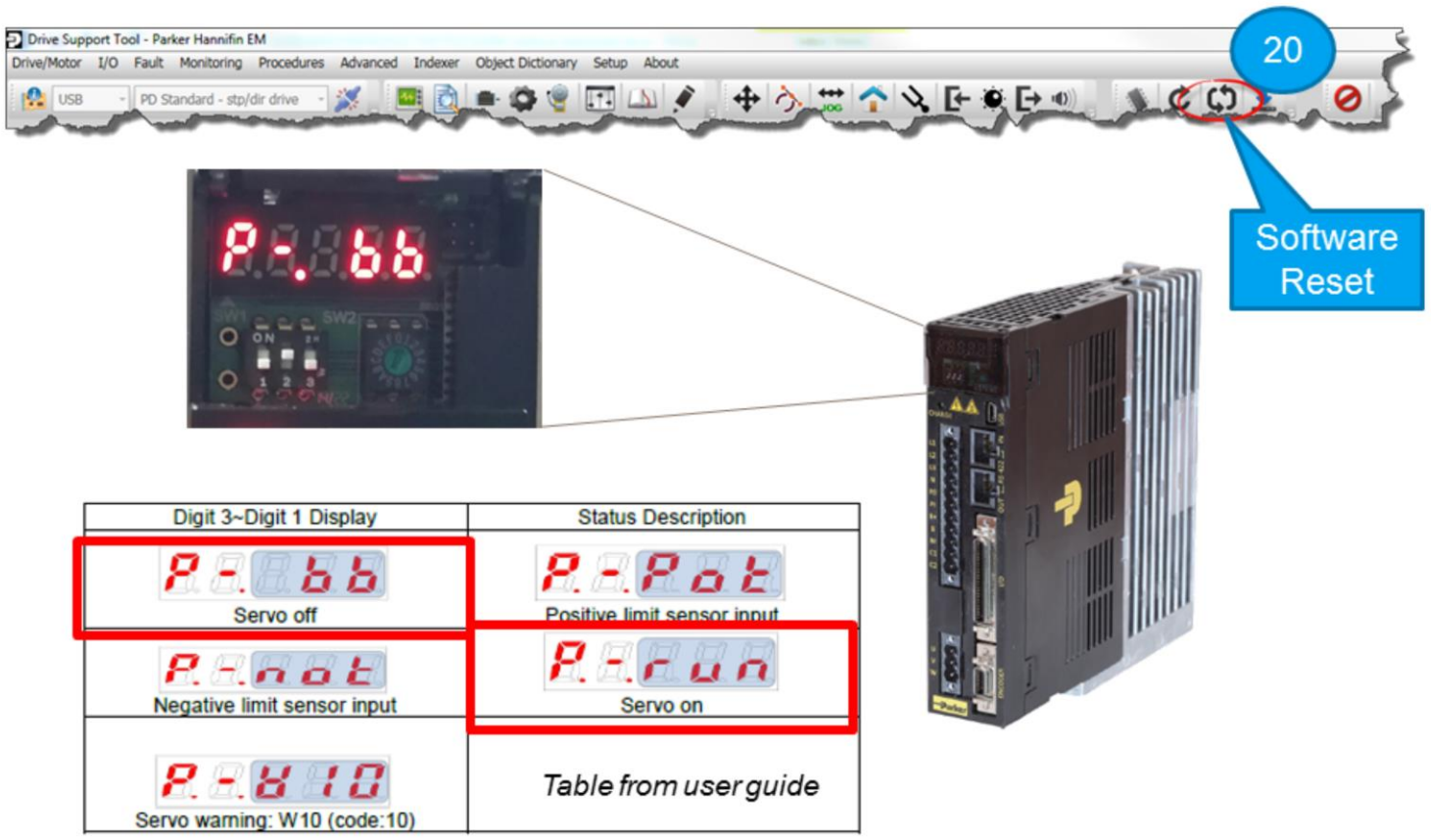
The next screen is the “Input/Output Signal Setting”. The inputs and outputs are configurable. I am going to leave the “Digital Inputs” at the default settings and modify the digital outputs by selecting the “Digital Output” tab. I am going to assign Output 4 to “OUTPUT0 “signal and assign Output 5 to the OUTPUT2 signal. These signals will be sent to the cutting head as a trigger signal and as a “dwell time complete” signal back to the PLC. These signals will be shown in more detail on slide 31.

Example Application
Setup Wizard: Homing and Write to Drive



Finally, the "Homing Method Setting" menu is shown. We will leave this as the default settings. Homing will be discussed later in this presentation. We are now done with configuring the drive for the example application. Now we are going to select "Write to Drive" and click okay on the pop-up window that states that a "Software Reset" is required. This message pops up twice. Then we will exit out of the "Setup Wizard".

Example Application
Setup Wizard: Software Reset and Drive Status



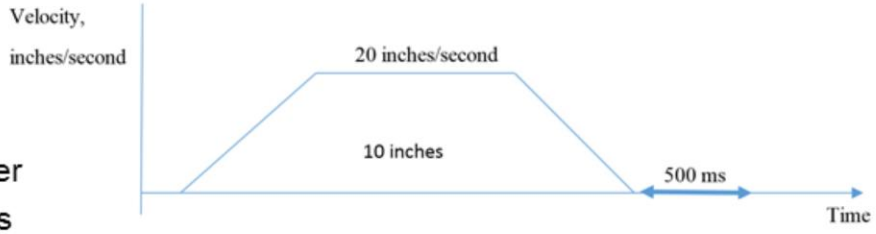
To do a “Software Reset”, go to the top menu bar and select the icon that has two arrows. This applies to all the changes we just made.

When I look at the 5-digit 7-segment display on my drive, it should say “P-.bb”. This means that the drive is powered on but the servo is not enabled. “P” stands for positioning mode and “bb” stands for base blocked. Base blocked means that the base current to the power transistor in the drive is blocked.

After I’ve setup my index table and am ready to test my drive, I will enable the drive and the drive status will change to “P.-.run”, which means that the servo is enabled and is capable of running as soon as I command it to do so. Other status messages, warnings, and alarms will be shown here. A detailed list of the meanings may be found in the manual.

Example Application
Feed-to-Length Application Requirements

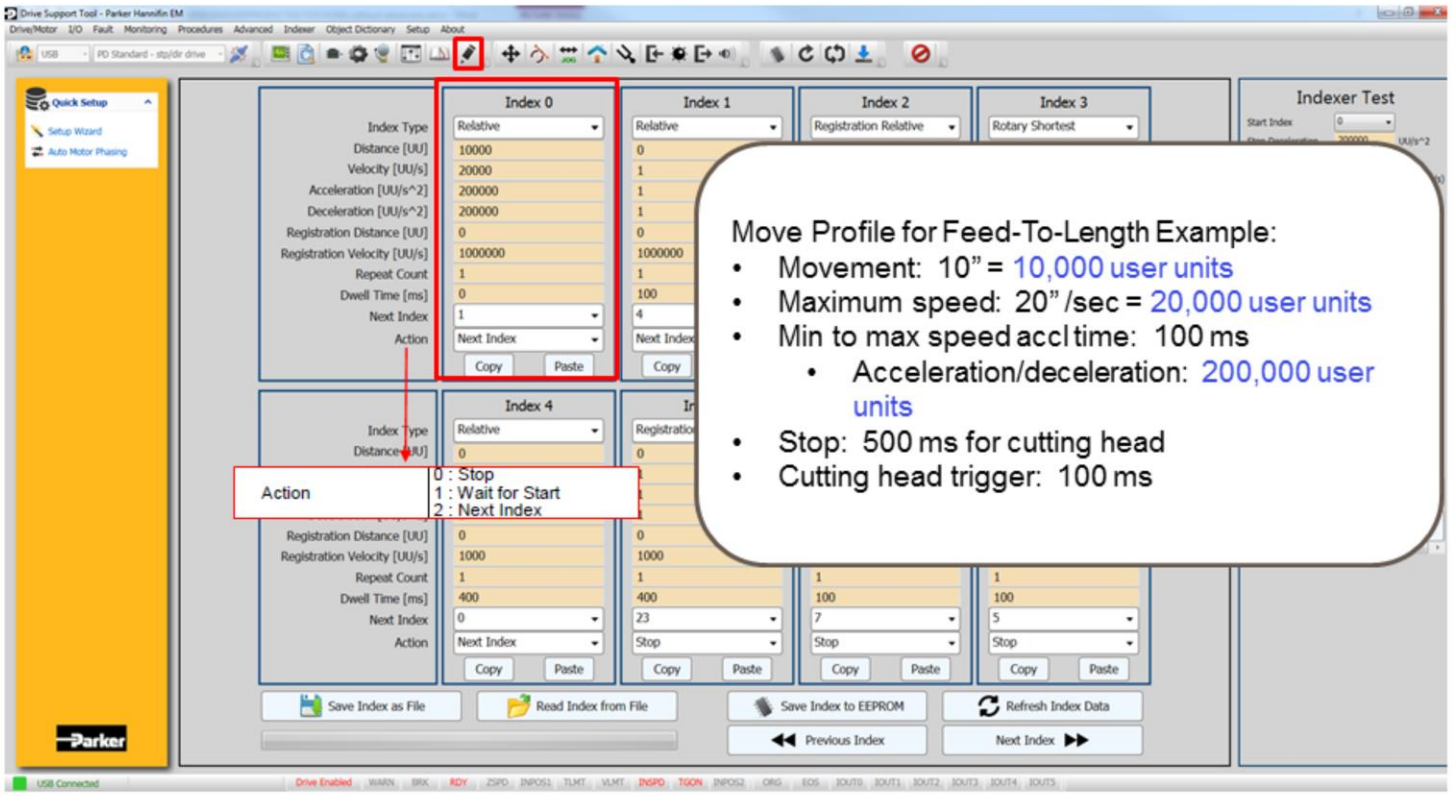
- **Application Requirements**
  - Gearbox: 10:1
  - Drive roll: 6" diameter
  - Movement: 10 inches
  - Maximum speed: 20 inches/sec
  - Minimum to max speed acceleration time: 100 ms
  - Stop: 500 ms for cutting head
  - Cutting head trigger: 100 ms



Three Simple Steps
1. Calculate scaling parameters ✓
2. Setup Wizard ✓
3. Fill-out Indexing table and test

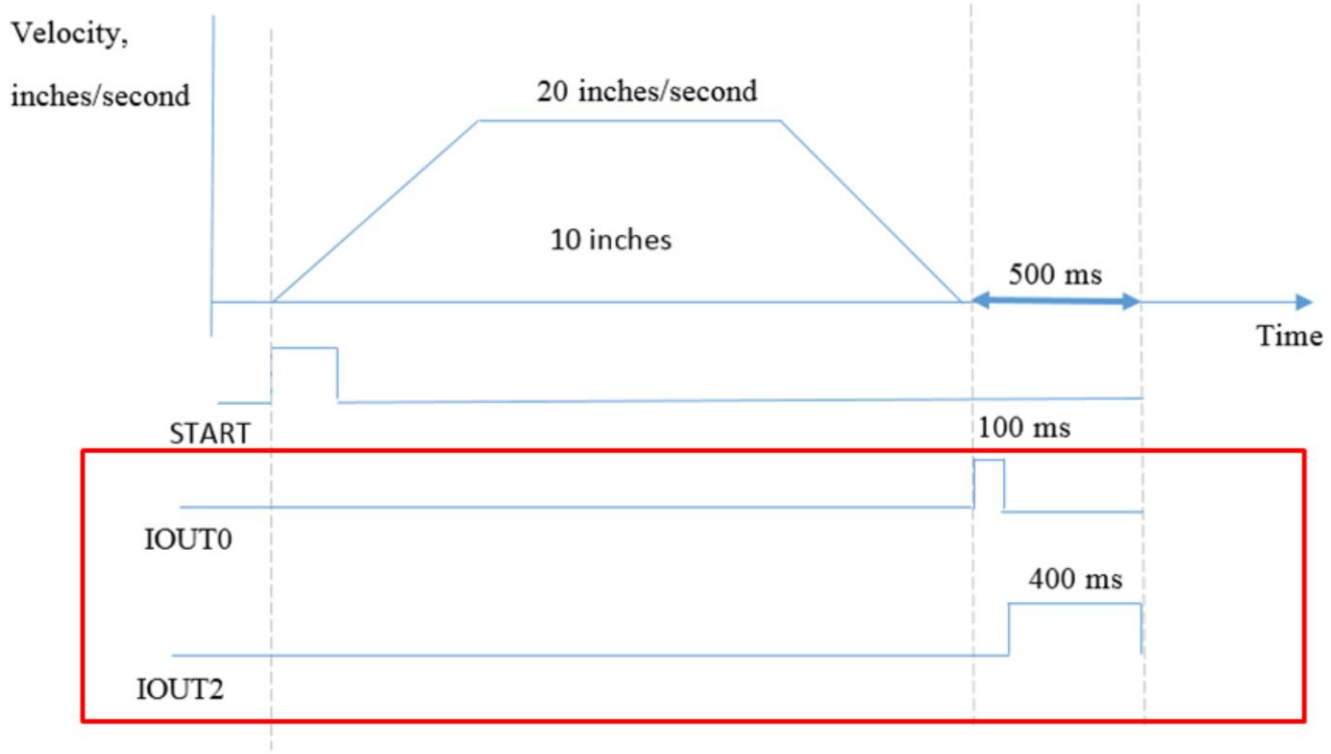
So we just went through calculating the scaling parameters, configuring the drive with the "Setup Wizard", and now we are ready to fill-out the indexing table with our move parameters.

Example Application
Index Table Setup: Setting up the Move



To view the index table, click on the icon that looks like a "pencil" I have copied my application requirements into a box on this slide as a reference. First, I will setup my move. All the units are in user units. I will use "Index 0". I will set the "Index Type" to a "Relative" move. Next, I will set the "Distance" to 10,000 user units. The "Velocity" is set to 20,000 user units. The "Acceleration" and "Deceleration" will be both set to 200,000 user units. Since I am not going to use a "Registration" move in this example, I will skip the registration rows and that will be covered later in the presentation. The "Repeat Count" field determines how many times that the move will repeat and since I only want it to move one time when triggered, I will leave that value to "1". The "Dwell Time" represents how long the drive stays at "Index 0" before it completes another action, such as going to the "Next Index". Since I am creating my own timing signals, I am setting this time to "0". The "Next Index" field indicates which index to go to next. Since I want to go to "Index 1" next, I have set this value to "1". The last field to setup is the "Action" field. This setting describes what the action should be once each index has completed its action . There are three choices for the "Action". You could run the "Index 0" one-time , and then "Stop", or "Wait for Start" signal, or move to the "Next Index". Since I want this to move to "Index 1" when the move is complete, I have selected "Next Index"

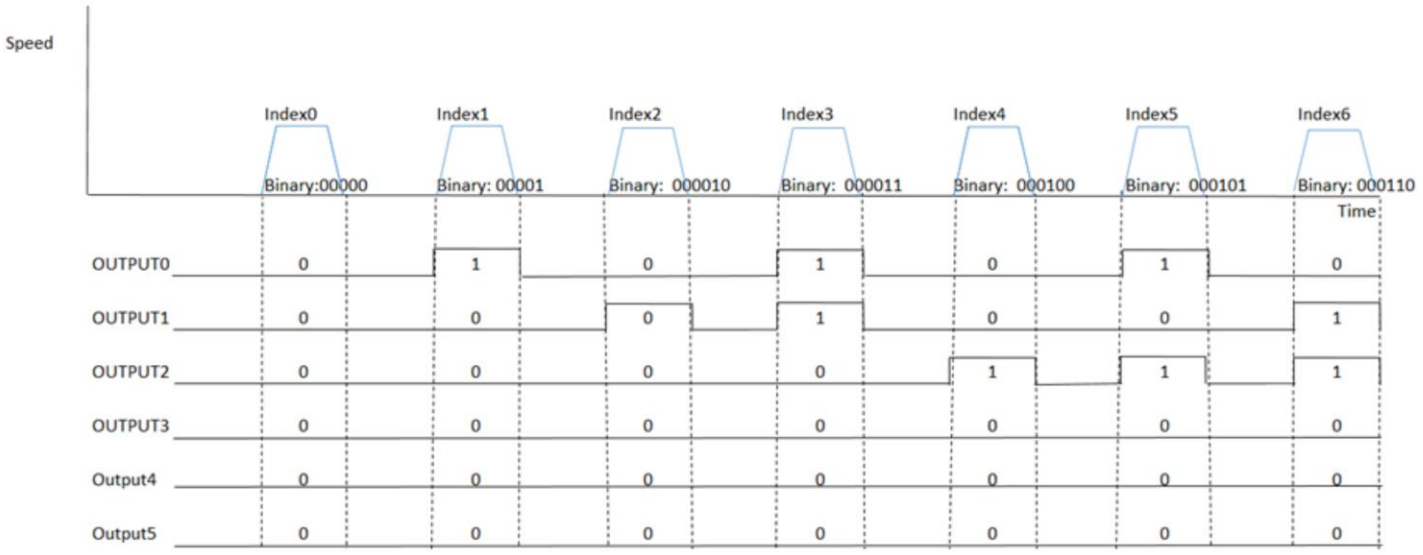
Example Application
Index Table Setup: Feed-to-Length Timing



Now I am going to discuss the timing signals for my application. Recall that we also wanted the indexer to generate a 100 ms trigger signal that will be used by the cutting head. Also the indexer needs to dwell for a total of 500 ms. We will also go through the process of creating these specific timing signals. The IOUT0 and the IOUT2 output signals will be created using the Index table and they were already mapped to my physical outputs in the "Setup Wizard". These signals will be used as timing signals by the cutting head and by the PLC.

Example Application
Index Table Setup: Index Output Signals

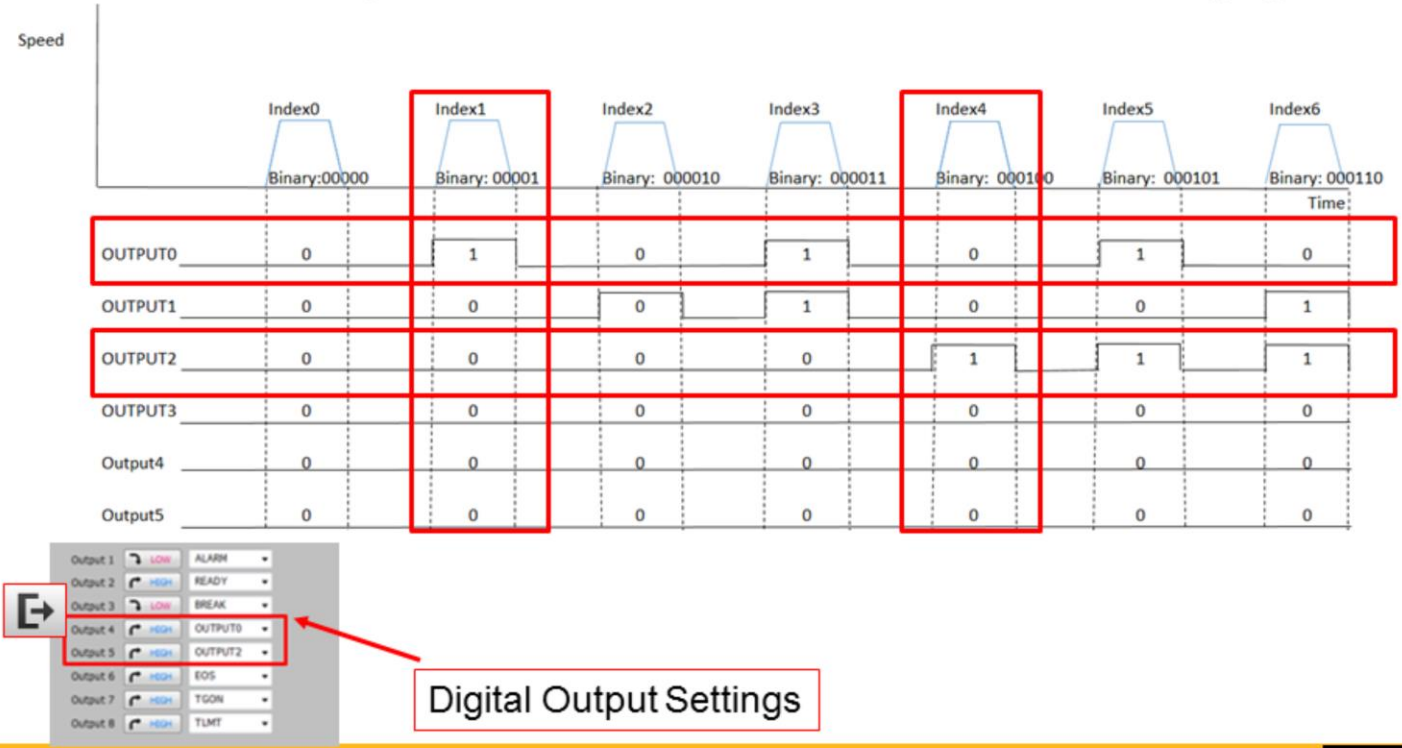
- OUTPUT0 through OUTPUT5 signals indicate the Index number currently performed
- Timing diagram shows the outputs for Index0 through Index6



There are 5 “Output” signals that can be used as timing signals. Output0 through Output5 indicate the Index number that is being currently executed by the drive. The timing diagram shows Index0 through Index 6 and all 6 output signals. Notice that none of the Output signals are ON for Index0. For Output 0, this comes ON for Index1, and Index5. For Output1, it comes on for Index2 and Index3. This gives you an ideal of how the OUTPUTS work.

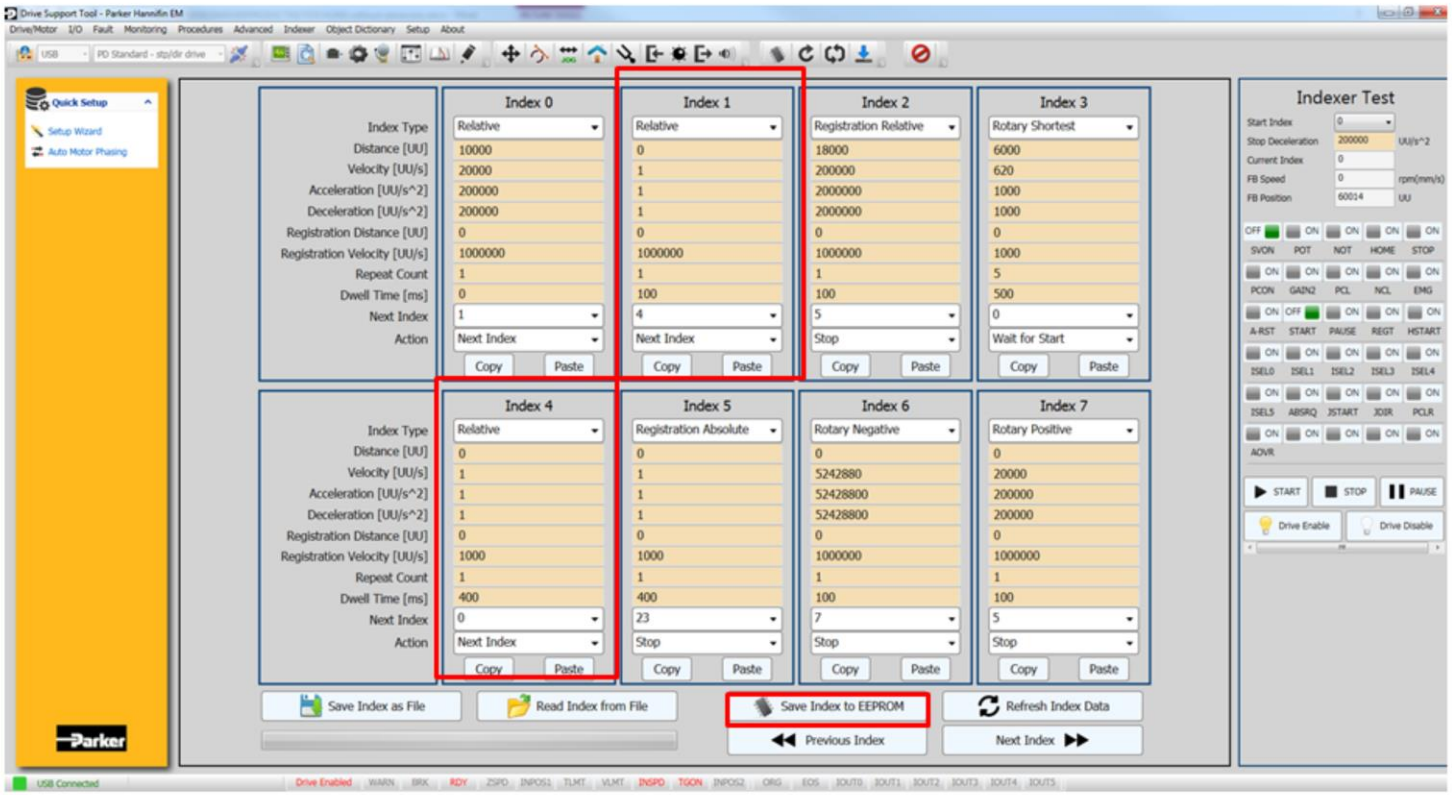
Example Application
Index Table Setup: Selecting Indices for Timing

- These signals are going to be "repurposed" to make them general purpose timing signals needed for the example application requirements
- Index0 is the move, now need to select which two indices to use for the timing signals



I need to have two Outputs, one for the 100 ms signal and one for the 400 ms signal. I wanted to select an Index# and an Output# that were only ON for one pulse duration. I arbitrary chose Index1 and Index4. Notice that I could have also chosen Index2.

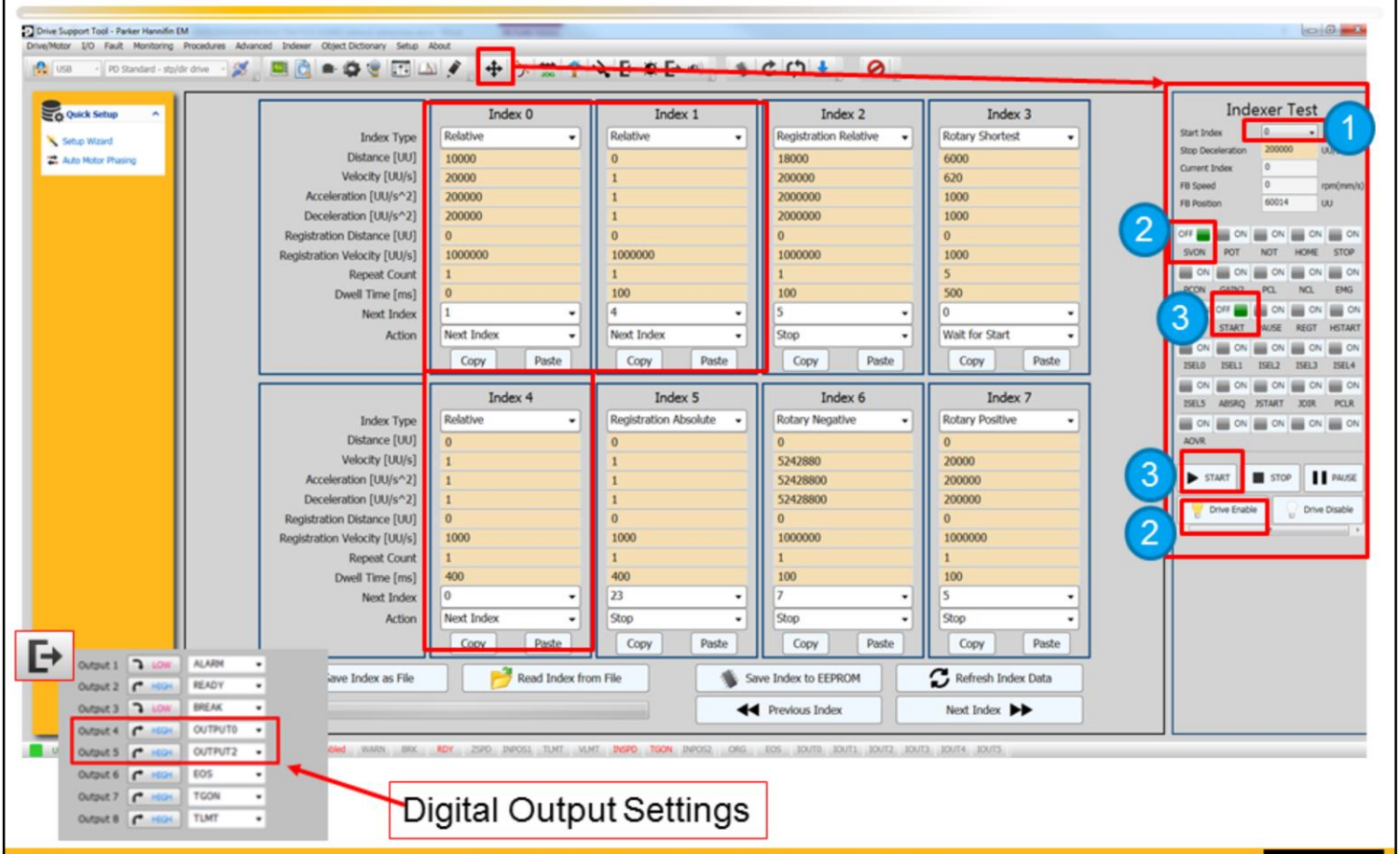
Example Application
Index Table Setup: Creating the Timing Signals



To create the two timing signals that I need, I will create two other index steps to build a sequence that will consist of three indices: which will be “Index 0” (the move), “Index 1” (the 100 ms timing signal), and “Index 4” (the 400 ms timing signal).

For the timing signals, I don’t want any movement, so I will set the “Distance” for each to 0 and leave “Index Type” as “Relative”. For “Index 1”, I have set the “Dwell Time” to 100 ms, which will be my 100 ms cutting head trigger signal. Since I need another delay signal, I will set the “Next Index” to “4”, and use “Index 4” to create the other timing signal. I have set the “Index 4” “Dwell Time” to 400 ms and have set the “Next Index” to “0” for the indexer to go to “Index 0” when complete. I could have set this to “Stop” as well, but since I am going to be testing my sequence, I will have it loop through this sequence during my testing. We are done setting up the index table, so I will click on the “Save Index to EEPROM” button to save to memory.

Example Application
Index Table Setup: Indexer Test

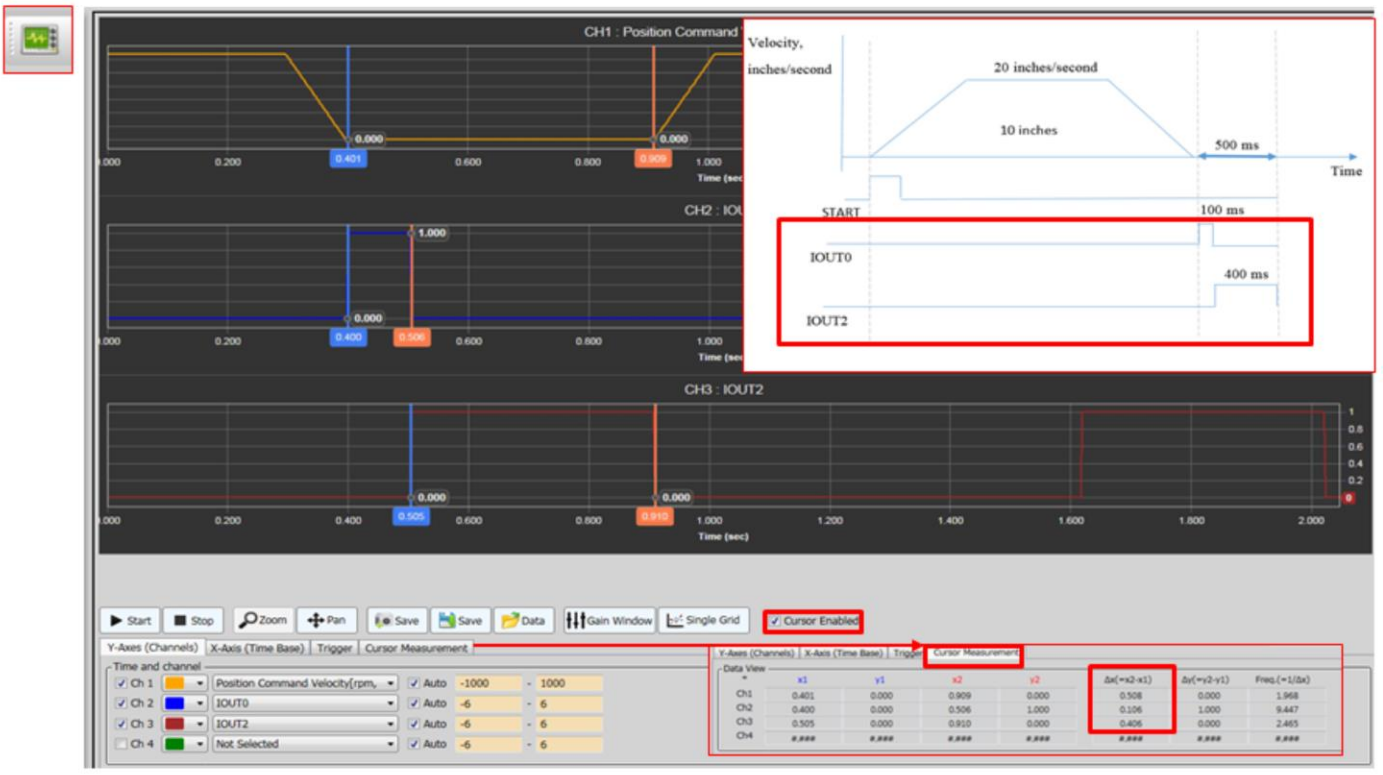


Now we will test the sequence we just created. The icon at the top with the four cross-arrows will open up the "Indexer Test" menu shown on the right. This feature enables you to force on digital input signals for testing, that way you don't need to physically toggle the digital inputs using a break-out board.

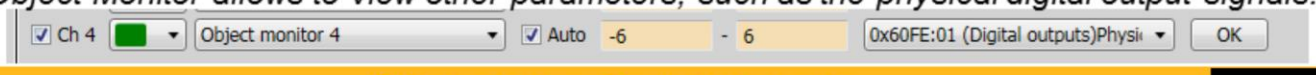
In the "Indexer Test" menu, I set the "Start Index" to 0. Next, I enabled the servo drive by selecting the "SVON" (servo on) button, which then turns green to indicate that it is enabled. Alternatively, I could have selected the "Drive Enable" button near the bottom of the menu, which does the same thing. Now the 5 digit 7-segment display on the drive should say "P-.run". Next, I will start the sequence by either by selecting the "START" button with the box beside it, or the START button with an arrow at the bottom of the menu. When you press START, the box change to green to indicate that the drive is running the index "program". The motor should now move its specified distance, then the drive will produce a 100 ms signal out the physical digital output #4 and a 400 ms signal out the physical digital output #5.

I can stop the move at any time by pressing the "STOP" button.

Example Application
Trace/Trigger Graph: Multi-grid & Cursor Enabled



Note: Object Monitor allows to view other parameters, such as the physical digital output signals.

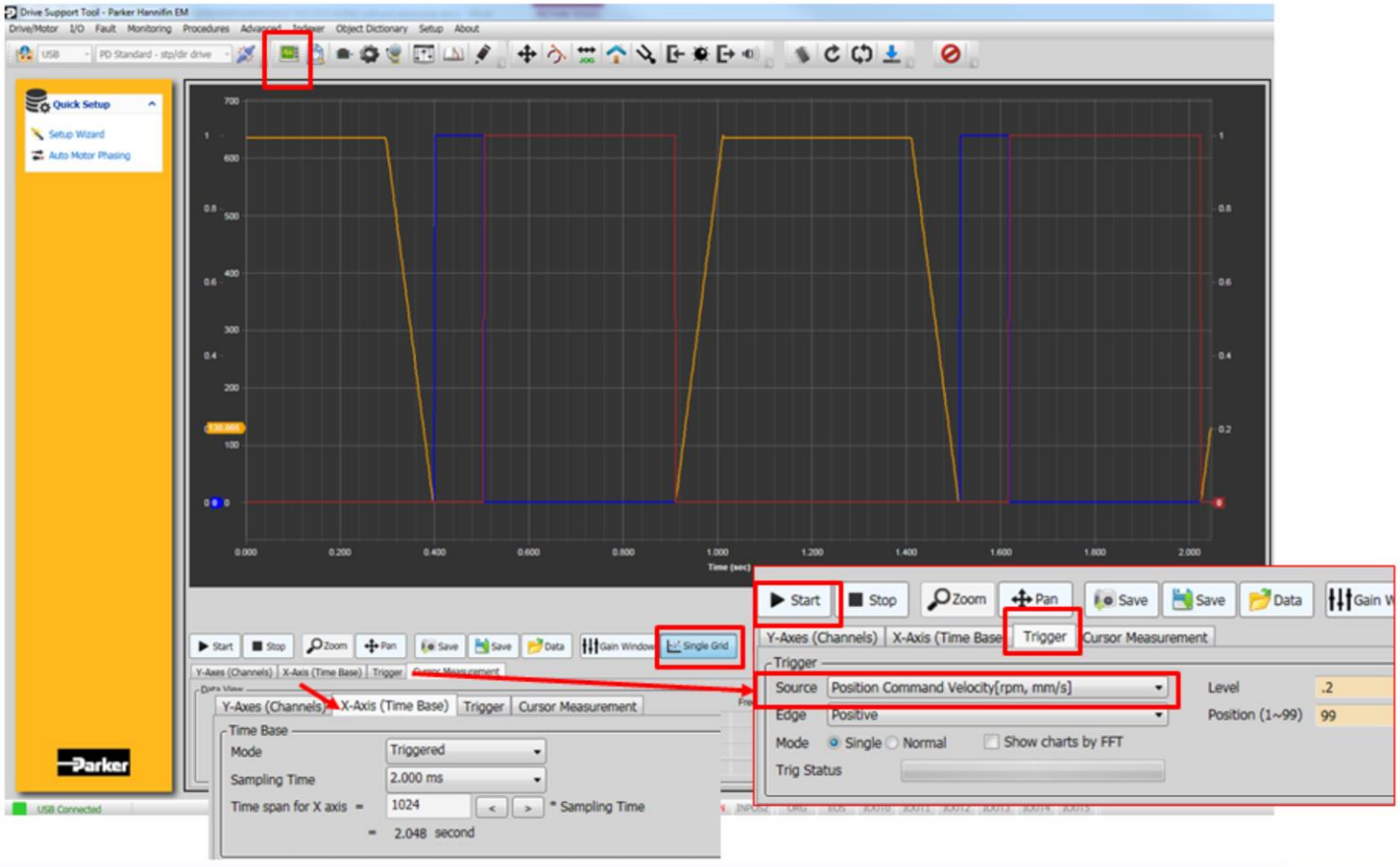


I've selected the "Trace/Trigger" icon to display the oscilloscope so that I can see the signals I've just created. First, I will setup the oscilloscope channels. I've set "Ch 1" to be "Position Command Velocity", which shows my move profile, and set "Ch 2" to "IOUT0" which is mapped to digital output 4 and "Ch 3" to "IOUT2" which is mapped to digital output 5. IOUT0 is my 100 ms trigger signal and IOUT2 is the 400 ms delay signal.

This view shows all signals on separate graphs and with a "Cursor Enabled", which shows a couple of cursors that enables me to make timing measurements of my signals.

Note, there are many different parameters you can view. If you wanted to see the actual physical digital output signals, you'd select "Object monitor x" as the channel, and then select what "object" you want to view, and then click on okay. Since this only shows all Digital Output signals superimposed onto one graph, and not just Output 4 and Output 5, I chose not to show this for this example.

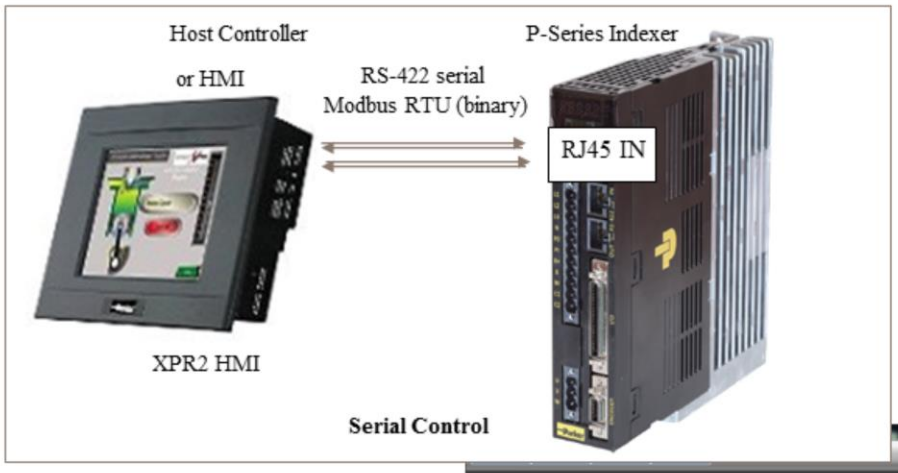
Example Application
Trace/Trigger Graph: Single Grid



This view shows the signals on the oscilloscope on a “Single Grid”. The oscilloscope tool is useful for showing timing relationships and trouble-shooting.

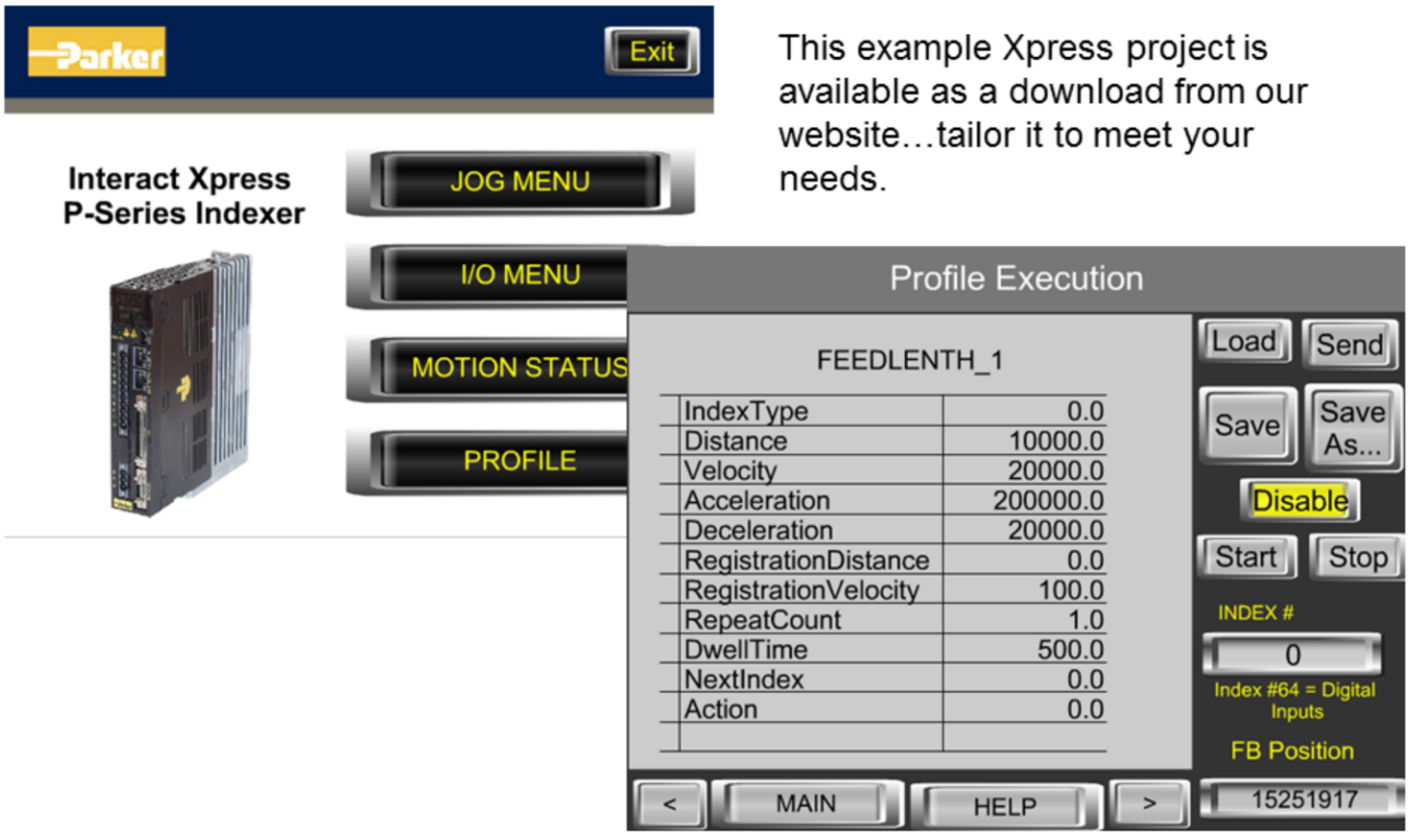
For these measurements, I used the Trigger mode by selecting the “X-Axis(Time Base)” tab. Then for “Mode” I selected “Triggered” and changed the “Sampling Time” to 2 ms. Next, I needed to change the Trigger “Source” by selecting the “Trigger” tab and set the “Source” to “Position Command Velocity”. To start the single trigger, click on the “Start” button and you will see the “Trig Status” progress bar change to green.

Example Application
Parker XPR2 HMI with Interact Xpress



As mentioned before, Interact Xpress has a Modbus serial driver that enables you to communicate to the P-Series Drive. I also created an Interact Xpress project that will run the motion profile on my indexer.

Example Application
Parker XPR2 HMI with Interact Xpress



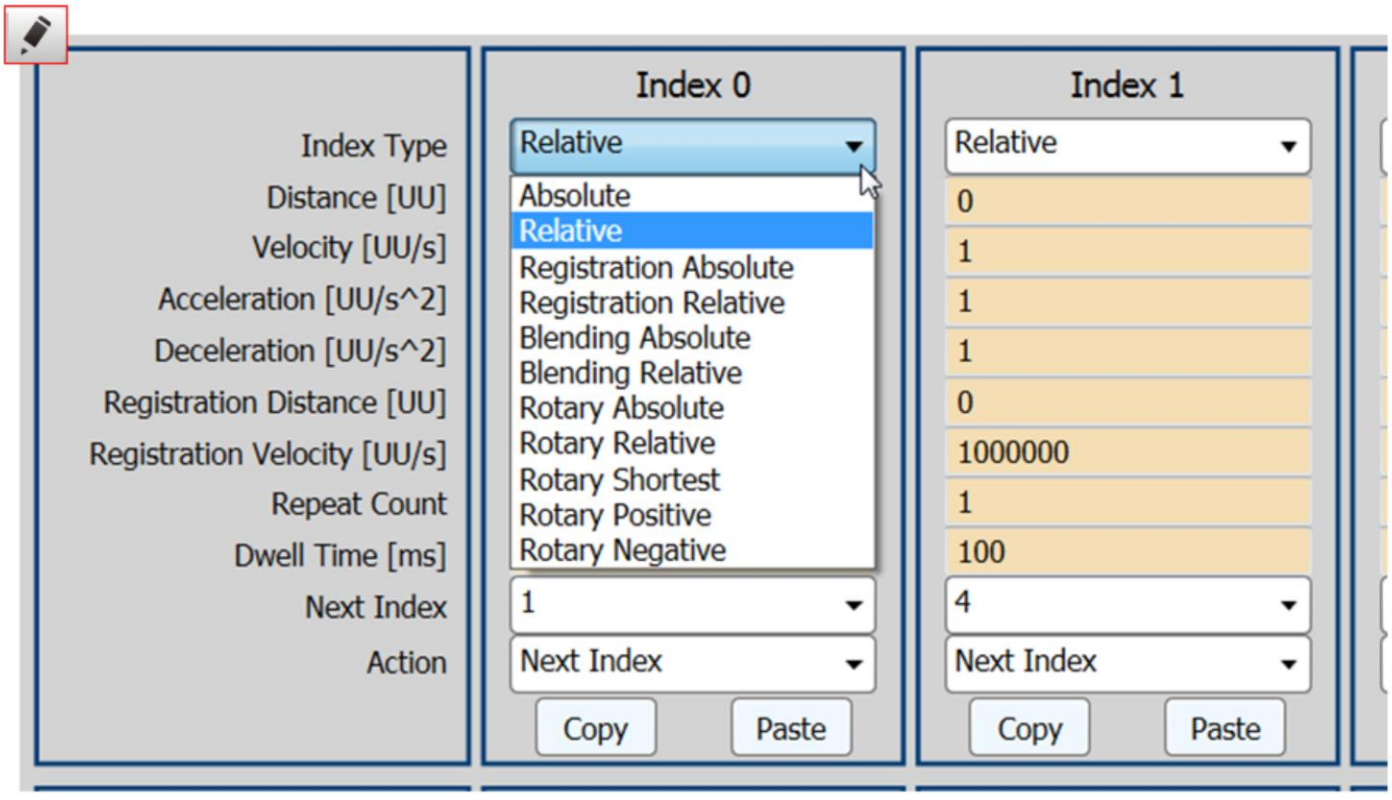
This is a screen shot of the Interact Xpress example project that I created. I set up a “Jog Menu”, “I/O Menu”, a “Motion Status” menu and a “Profile” menu. I can set up each material that I run in my process as a “recipe” in Interact Xpress. A “recipe” is a set of values and parameters, such as those that are used in the “Index Table”. If I have other material than has a different feed distance and different parameters, then I can save this as a new recipe, and load the recipes based on the material I want to run through the cutting head.

Agenda

- Product Overview
  - P-Series Servo Drives
  - Front Panel
  - System Configuration
  - "Drive Support Software" Brief Summary
- Applications
  - Example Application Feed-to-Length
    - Calculating scaling parameters, Setup Wizard, Test with I/O
    - Using with an XPR2 HMI running Interact Xpress
- Other Features
  - Other Index Types
  - Homing
  - End-of-Travel Limits
  - Point-to-Point Motion and Jogging
  - Touch-probe (high speed input position capture)
- Conclusion and Where to Find More Information

Now I will be covering some other features that haven't been discussed yet such as the other index types, the homing functionality, end-of-travel limits, point-to-point motion, jogging and the touch probe feature.

Other Features
Other Index Types: 11 Available



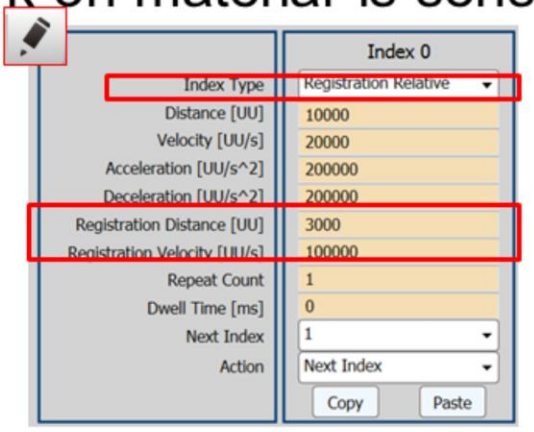
For my application example, I used a “Relative” move as the “Index Type” This was a linear move. There are 11 different “Index Types” that may be selected such as absolute, registration, various blending moves, rotary, etc. I will discuss a few of the key ones.

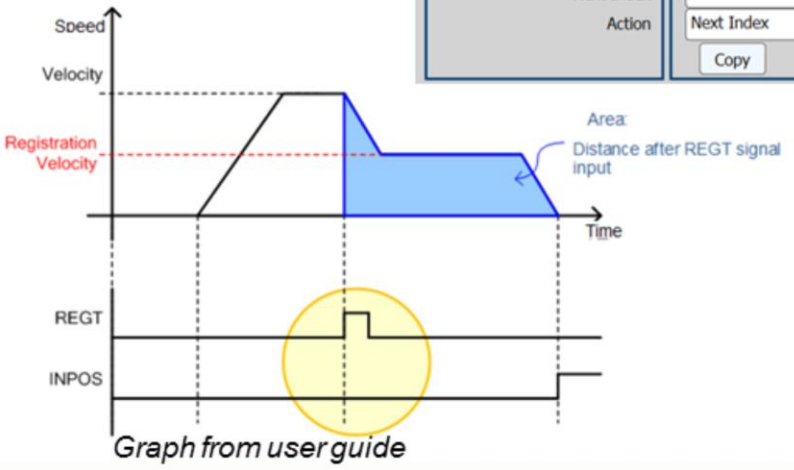
Since I was doing a relative move, it didn’t matter exactly where the motor was when it started or where it ended up, as long as it pulled 10 inches of material.

In other applications the position does matter. And so it is often easier to position the motor based on an absolute position rather than relative distance. In those cases, the servo must have a known starting position or reference point, which is commonly referred to as position zero. This is done by homing the motor. This topic will be discussed later in this presentation.

Other Features
Other Index Types: Registration

- Printed mark on material is sensed by the Indexer





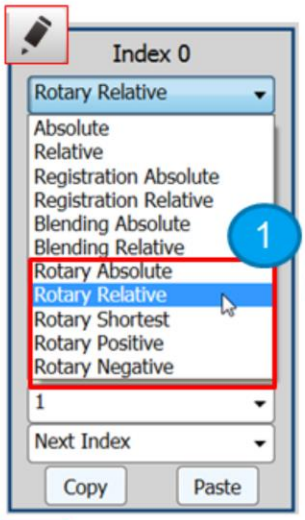
Graph from user guide

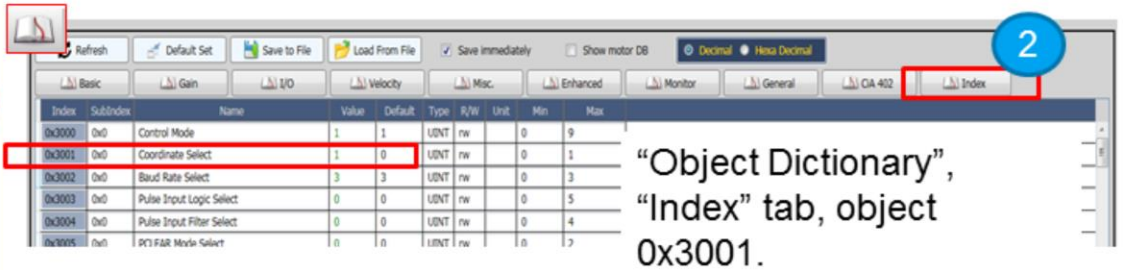
One “Index Type” I want to discuss more in depth is “Registration”. In many feed-to-length applications, the length of the feed is not specifically defined at the start of the move. This is often the case when cutting or performing other operations on material that has some sort of registration mark printed on them. On-the-fly adjustment to the final positioning is called registration and can help compensate for any material slippage during the feeding process. Instead of the move stopping at a preset position, it is positioned to a registration mark on the material itself. This mark is detected by an optical sensor that is connected to the digital input REGT. Registration provides the ability to execute a preset move with reference to an external event while the motor is executing another mode. This is done by beginning with the execution of a long preset move which would, under normal circumstances, cause the index to go beyond the registration mark on the material (original move). As the move proceeds, the sensor detects the presences of the registration mark. It then aborts the current move and, without stopping, begins the Registration move to precisely position the material to be cut (or printed or whatever post processing needs to be performed).

If the “Index Type” is “Registration Absolute” or “Registration Relative”, when the REGT signal is on, the speed and distance is changed to the preset speed and distance.

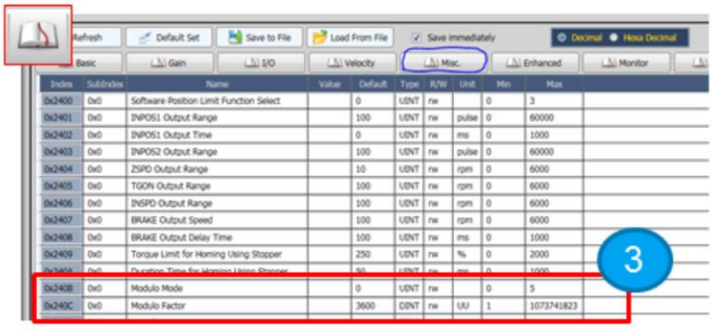
Other Features
Other Index Types: Rotary Moves

1. For “Index Type”, select a “Rotary ….” move
2. Change “Coordinate Select” value to 1 for “Rotary Axis”
3. Set “Modulo Mode” and “Modulo Factor”





“Object Dictionary”, “Index” tab, object 0x3001.
Value 0 = linear
Value 1 = rotary



Modulo setup from “Object Dictionary”, “Misc.” tab, objects 0x2048B and 0x240C

Set Value	Modulo Mode Documentation
0	Do not use Modulo function
1	Move forward using Modulo function
2	Move reverse using Modulo function
3	Mote in the direction of the shortest distance using Modulo function

Table from user guide

Another “Index Type” that is commonly used with an indexer is a “Rotary” move type. In order to use “Rotary” as an “Index Type”, after you have selected the desired rotary move, you will then need to set the “Coordinate Select” to “Rotary Axis”, which is value “1”. This can be accessed from the “Setup Wizard”.

The “Module Mode” and “Modulo Factor” parameters should also be set. These parameters can be accessed from the “Object Dictionary” table under the “Misc” tab.

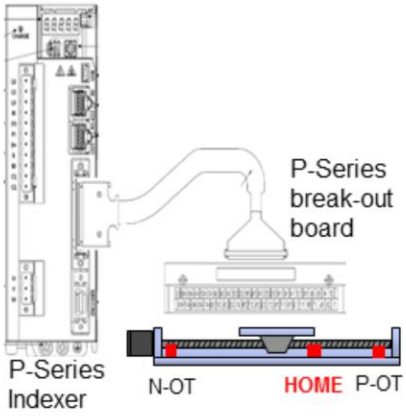
Rotary machines require special attention with indexing applications because positioning can be accomplished by moving in either direction. Consider a rotary table as a typical example, with positions from 0 to 360 degrees, where 0 and 360 are the same position. You can think of this as the rollover position.

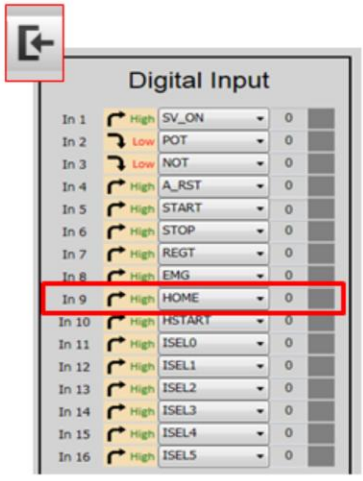
Because of this rollover, a rotary load can reach a final position by travelling either direction.
The indexer has various Index Types for rotary motion such as: Rotary Absolute, Rotary Relative, Rotary Shortest, Rotary Positive, and Rotary Negative.

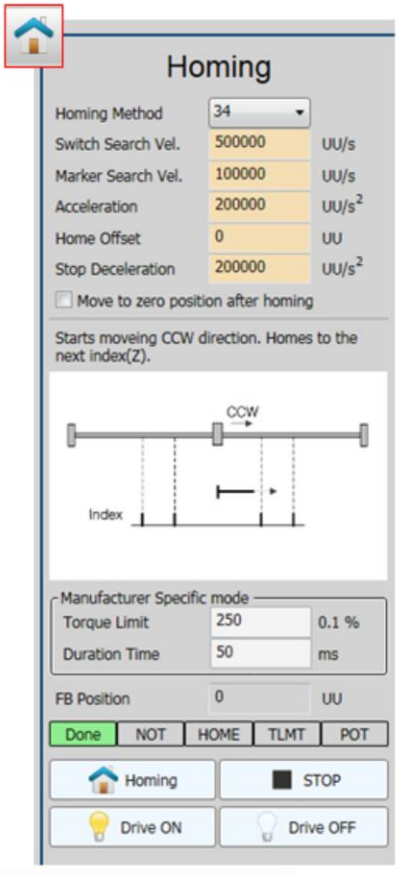
A rotary load also implies that some absolute positions are out of the logical range. In this illustration, there is no position greater than 360 or less than zero.

Other Features
Homing : Setup

- 16 different Homing Methods
- Configurable Digital Input for Home.
  - Default is Input 9







*Physical home switch not required with absolute encoders

As mentioned previously, before you use an absolute move, you've got to establish the zero position with "Homing".
The "Homing" menu can be access from the icon that looks like a "house".

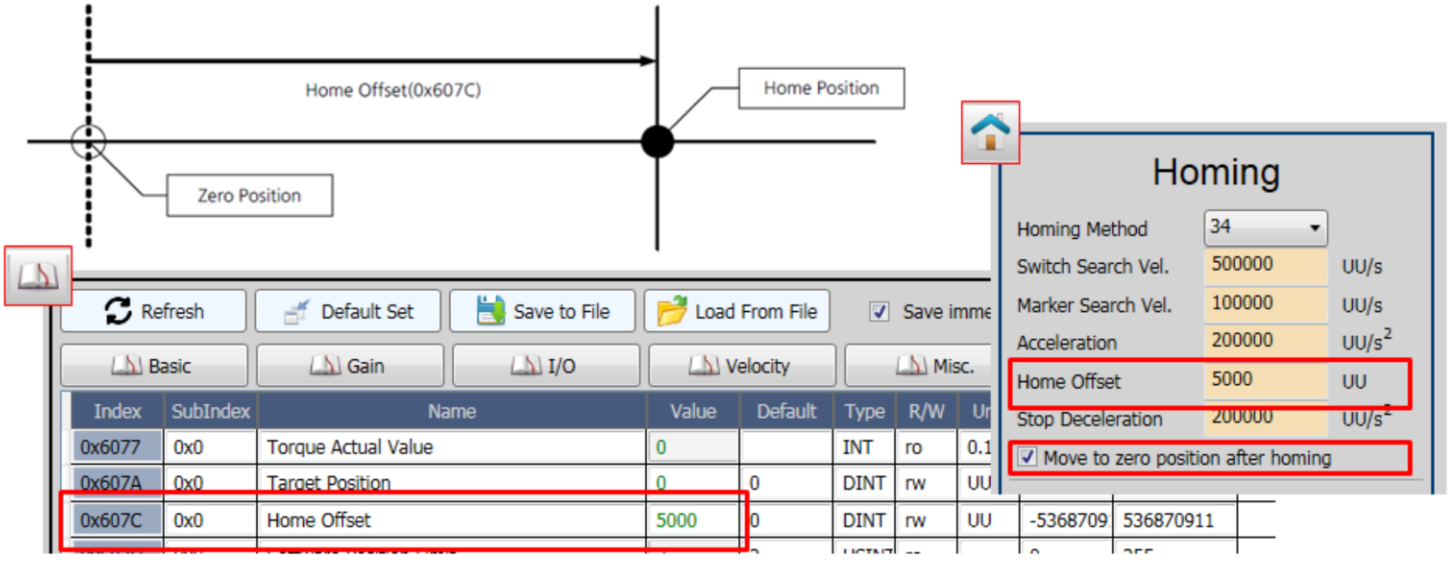
The zero coordinate position for a motor with an incremental encoder can be found using a homing routine after every power up. Homing involves moving the machine slowly until a sensor is found, and establishing that as the zero position.

If using an incremental encoder, anytime the machine is repowered, the position information is lost and the homing routine will need to be executed again to reestablish the 0 reference point. The indexer includes 16 built-in homing methods, including homing to a hard-stop or to an index pulse, which is also sometimes referred to as a Z-pulse.

If using an absolute encoder, a cable with a battery backup is needed. Because the encoder's battery will retain its position when the machine is powered off, the machine will only need to be homed one time to calibrate its zero reference. Then you will only need to recalibrate the home position with an absolute encoder when you change the mechanics, move around the sensors, disconnect the motor to the load, or reset it.

Other Features
Homing: Home Offset

- Jog axis to the machine “Zero Position” (home position)
- Read the encoder count
- Set the “Home Offset” value (0x607C) in Object Dictionary
- Or Set the “Home Offset” value in the Homing window



You can set a “Home Offset”, which is an offset between the “home position” and the “zero position” of the machine, where “zero position” means the position where the Position Actual Value (0x6064) is 0.
Setting an offset is useful if homing to a limit switch or a hard stop where the zero location is not right on the limit or hard stop. This feature is also useful if the home sensor cannot be physically located where the machine zero location needs to be mechanically. This avoids having to physically align the motor's index location (motor reference point - Z channel) with the desired mechanical home location.
The selection called “Move to zero position after homing" is designed to make an automatic offset move after locating the home location. This option may be used to do an offset from the established mechanical home location and depends on the “Home Offset" value for that offset distance.
There are two cases where this is used and I will discuss each.

Case 1

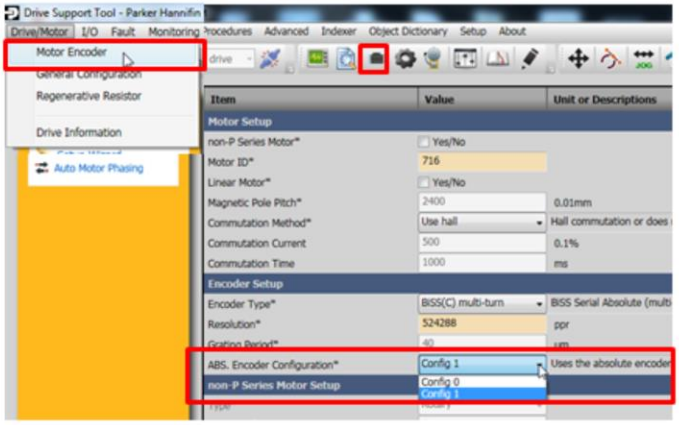
When the “Home Offset" value is 0, the home location and the machine zero locations will be the same. After a successful homing the Actual Position will be at 0. No additional offset move is made regardless of the “Move to zero position after homing" setting as you are now at the 'machine zero' location.

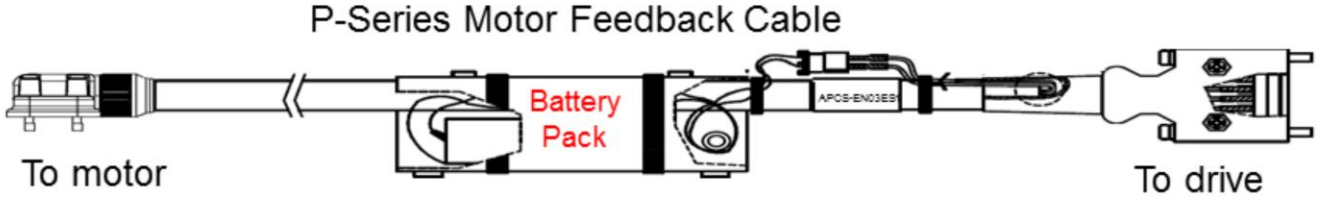
Case 2

When the “Home Offset" value is non-0, after a successful homing the “Actual Position” will be set to the “Home Offset" value.
Then if the “Move to zero position after homing" is selected, the axis will then make an 'absolute' offset move to the 0 location and “Actual Position” will be 0 when it is complete.
If the “Move to zero position after homing" is not selected, then the axis will not make an offset move and your “Actual Position” will reflect the “Home Offset” value.

Other Features
Encoder: Configuration

- Encoder Configuration
  - Config 0:
    - Absolute encoder
    - Requires cable with battery
  - Config 1:
    - Use absolute encoder as an incremental encoder.
    - No battery cable required



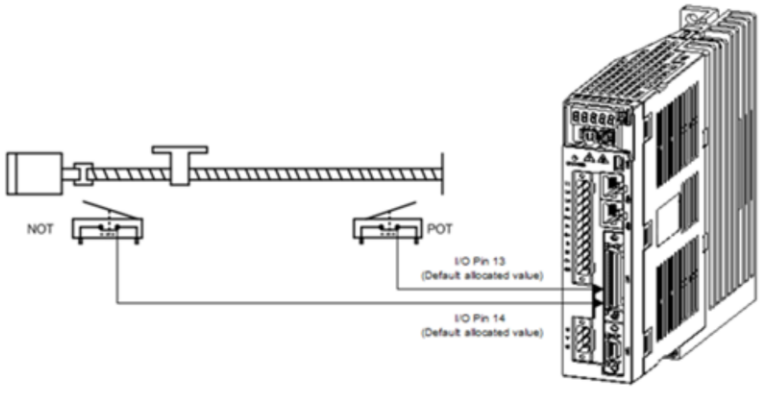


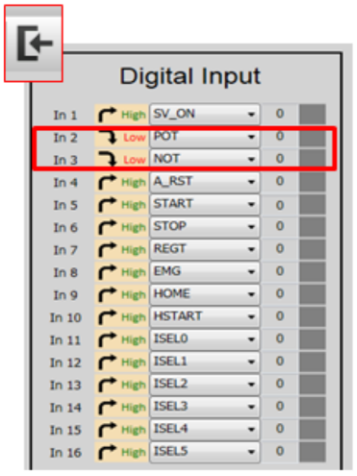
As mentioned previously, to use the absolute encoder, you need to use the Motor Feedback cable that has the battery pack. Alternatively, you can configure the encoder to be a incremental encoder, then a cable with a battery pack is not required.

You will need to configure your Motor's Encoder configuration by selecting the "Drive/Motor selection" from the Menu bar or the short-cut icon that looks like a "motor".

Other Features
End-of-Travel Limits : Hardware Sensors

- Configurable Digital Inputs for end of travel limits
  - P-OT= positive over travel
  - N-OT =negative over travel

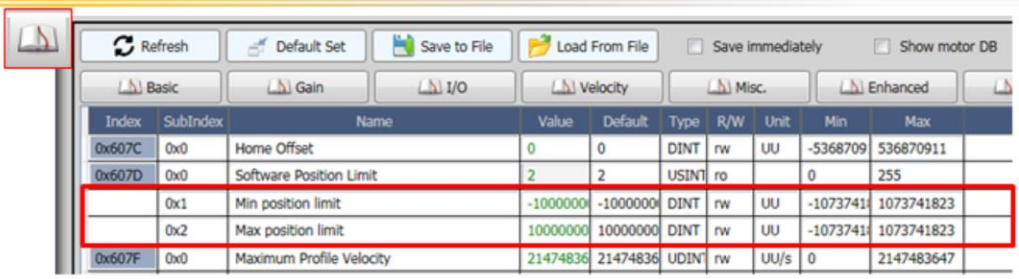




For linear applications, in addition to a home sensor, you will likely want to add positive end-of-travel limit and a negative-end-of- travel limit. This function allows you to safely operate the motor within the movement range that you set.

Other Features
End-of-Travel Limits: Software Limits

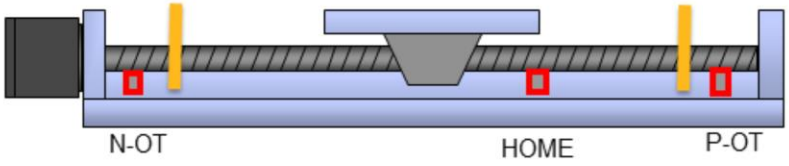
Object Dictionary



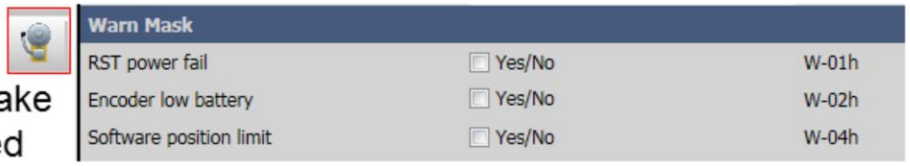
Must HOME first before take effect

Parameter 0x607D:01
Minimum Software Limit

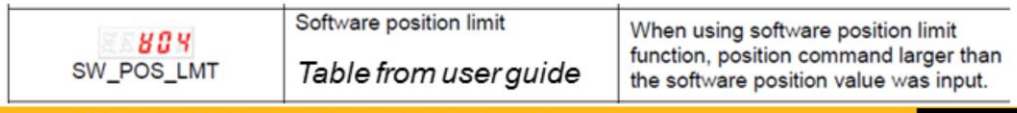
Parameter 0x607D:02
Maximum Software Limit



Alarm Menu, make sure not checked

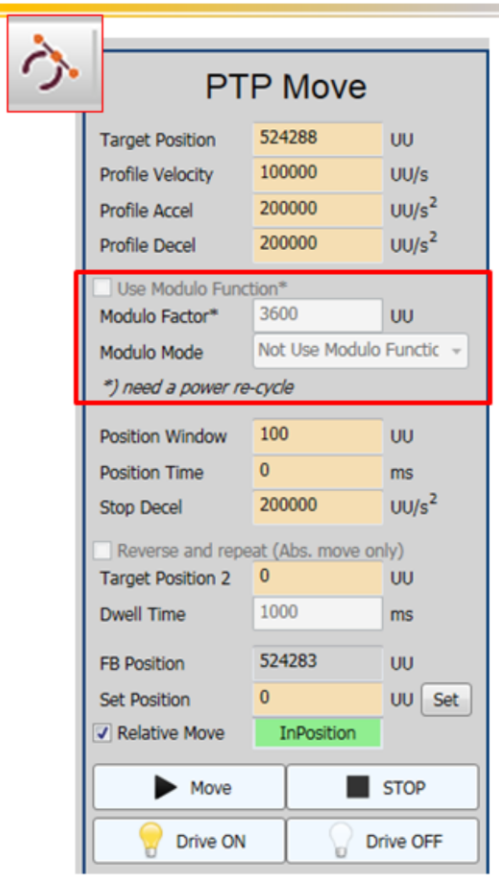


Drive 7-Segment Display Indicator



The indexer also supports software limit functionality. You can set these parameters from the “Object Dictionary” from the “CiA(402) tab.
You will need to define a maximum and minimum position to the range of motion. Software limits don’t replace hardware-level over-travel sensors, but instead offer protection against miscalculated commands issued from the PLC. Software limit prevents the axis from attempting a move that would move the machine outside the allowed positioning range. You will also want to turn these on in the “Alarm” menu. Go to the “Alarm” menu by selecting the icon that looks like an “alarm”. For the “Warning Mask”, make sure there is not a check mark in the Yes/No box to turn on the “Software position limit” warning. This status message will be displayed on the drive when the soft limit is encountered. Must HOME first, before software limits take effect.

Other Features
Point-to-Point Move: Using the software interface



Modulo Mode

Set Value	
0	Do not use Modulo function
1	Move forward using Modulo function
2	Move reverse using Modulo function
3	Mote in the direction of the shortest distance using Modulo function

Table from user guide

During setup and commissioning your motor, it is likely that you will be using the point-to-point (PTP) move menu. With the “PTP Move” menu, you can make an absolute or relative move, a linear or a rotary move. You can also view the feedback position. If making a rotary move, you will need to set the “Modulo Factor” and “Modulo Mode”. This was previously discussed on “Other Index Types: Rotary Moves” slide.

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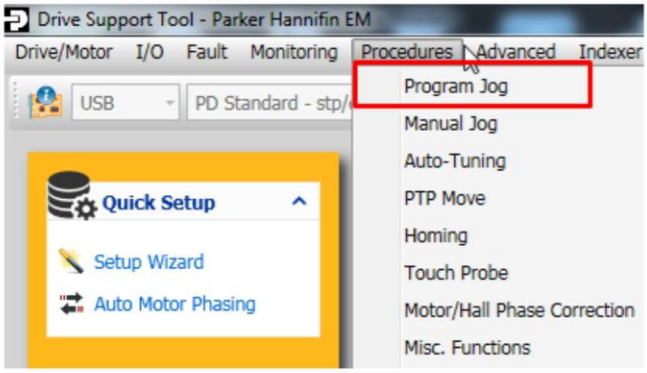
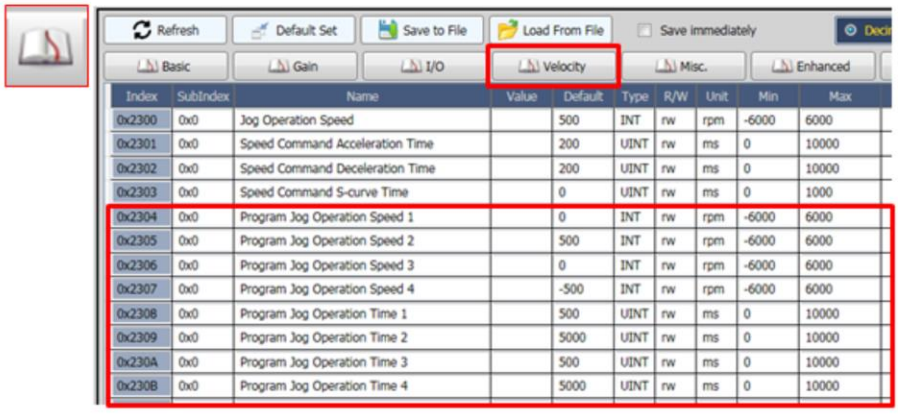
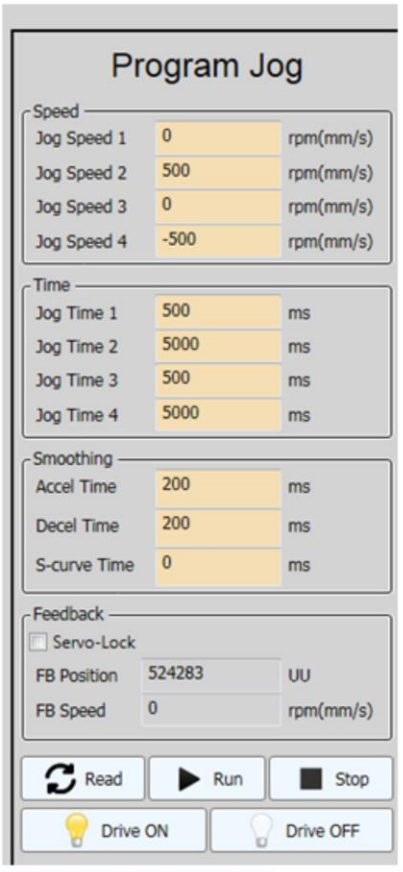
Other Features

Program Jog: Using the software interface

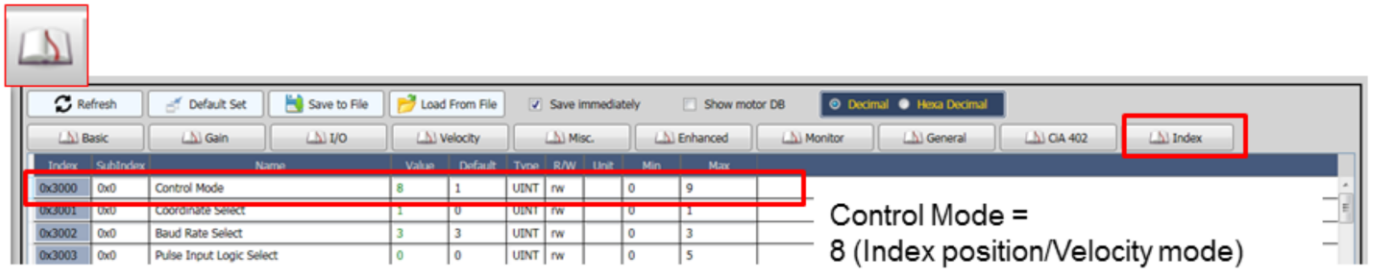


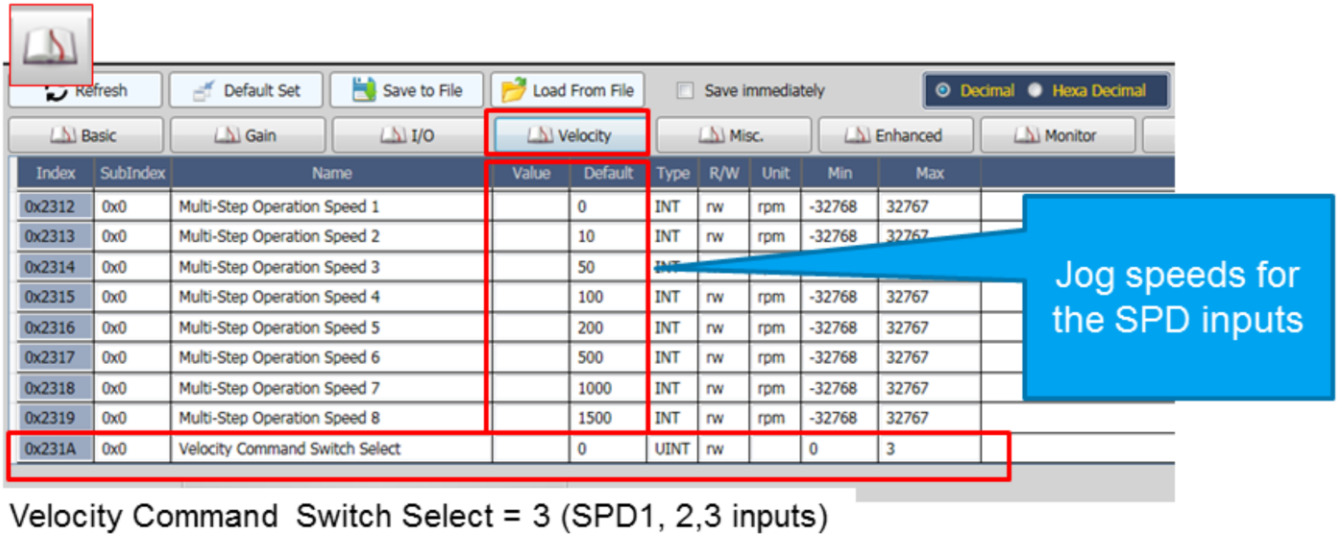




The indexer has the ability of running in Jog mode at any of up to 4 preset speeds or 4 preset jog times using the software. This can be accessed from the “Procedures” menu selection. The “Program Jog” speeds and times can be either set from the “Object Dictionary” table, or from the “Program Jog” menu.

Other Features
Multi-step Jog Speed: With digital inputs - Setup

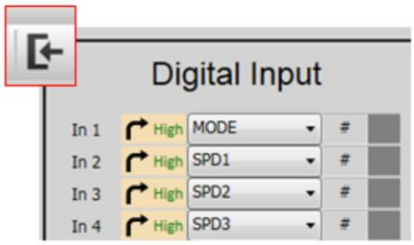


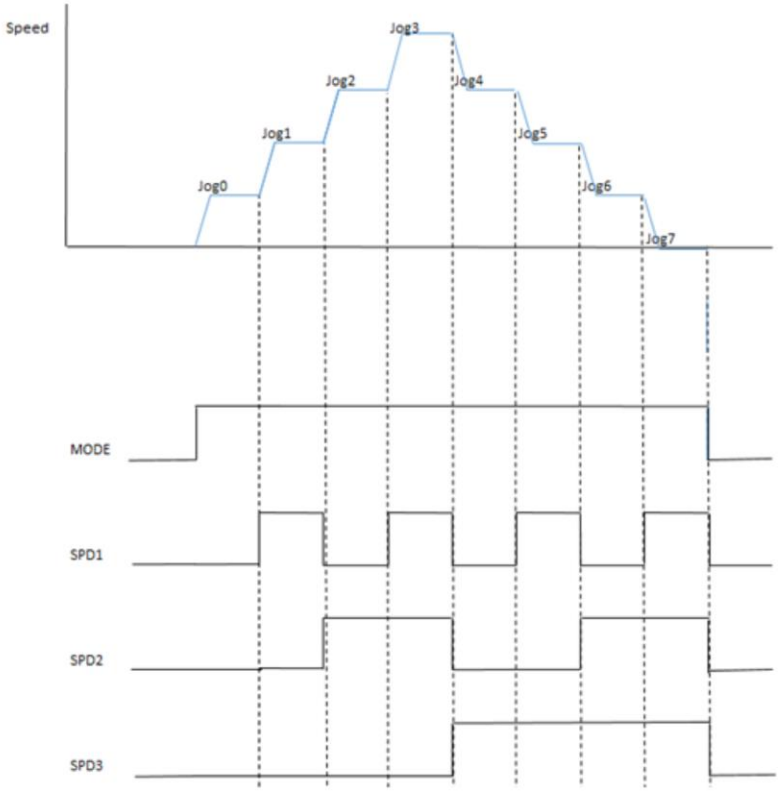


You can jog the indexer by 8 preset velocities over digital inputs using the “Multi-step Jog Speed” feature. To use this feature, you need to change the “Control Mode” to a velocity mode, such as “Index position/Velocity” mode. This can be done from the “Setup Wizard” or in the “Object Dictionary” table. For this “mixed” mode, when the “Mode” input is not active, it is in “Index position” mode. When the “Mode” input signal is active, then the drive switches to velocity mode. The “Velocity Command Switch Select” needs to be set as well. I set this as “3”, which means that the jog speed is based on SPD1, SPD2, and SPD3. To select the “Multi-Step Operation Speed 2”, I’d leave SPD1 off, turn SPD2 on, and leave SPD3 off.

The preset jog speeds may be entered into the “Object Dictionary” under the “Velocity” tab.

Other Features
Multi-step Jog Speed: With digital inputs - Timing





6.4.5 Digital Command Scale

When selected 1, 2, 3 in speed command switch, possible to use speed co
Servo Drive digital speed command.

To use digital speed command, allocate digital input signal SPD1, SPD2, SI
I/O connector or control digital input signal SPD1, SPD2, SPD3 by commun

Input Device			Speed
SPD1	SPD2	SPD3	
X	X	X	Speed command 1 (Parameter 0x2312)
O	X	X	Speed command 2 (Parameter 0x2313)
X	O	X	Speed command 3 (Parameter 0x2314)
O	O	X	Speed command 4 (Parameter 0x2315)
X	X	O	Speed command 5 (Parameter 0x2316)
O	X	O	Speed command 6 (Parameter 0x2317)
X	O	O	Speed command 7 (Parameter 0x2318)
O	O	O	Speed command 8 (Parameter 0x2319)

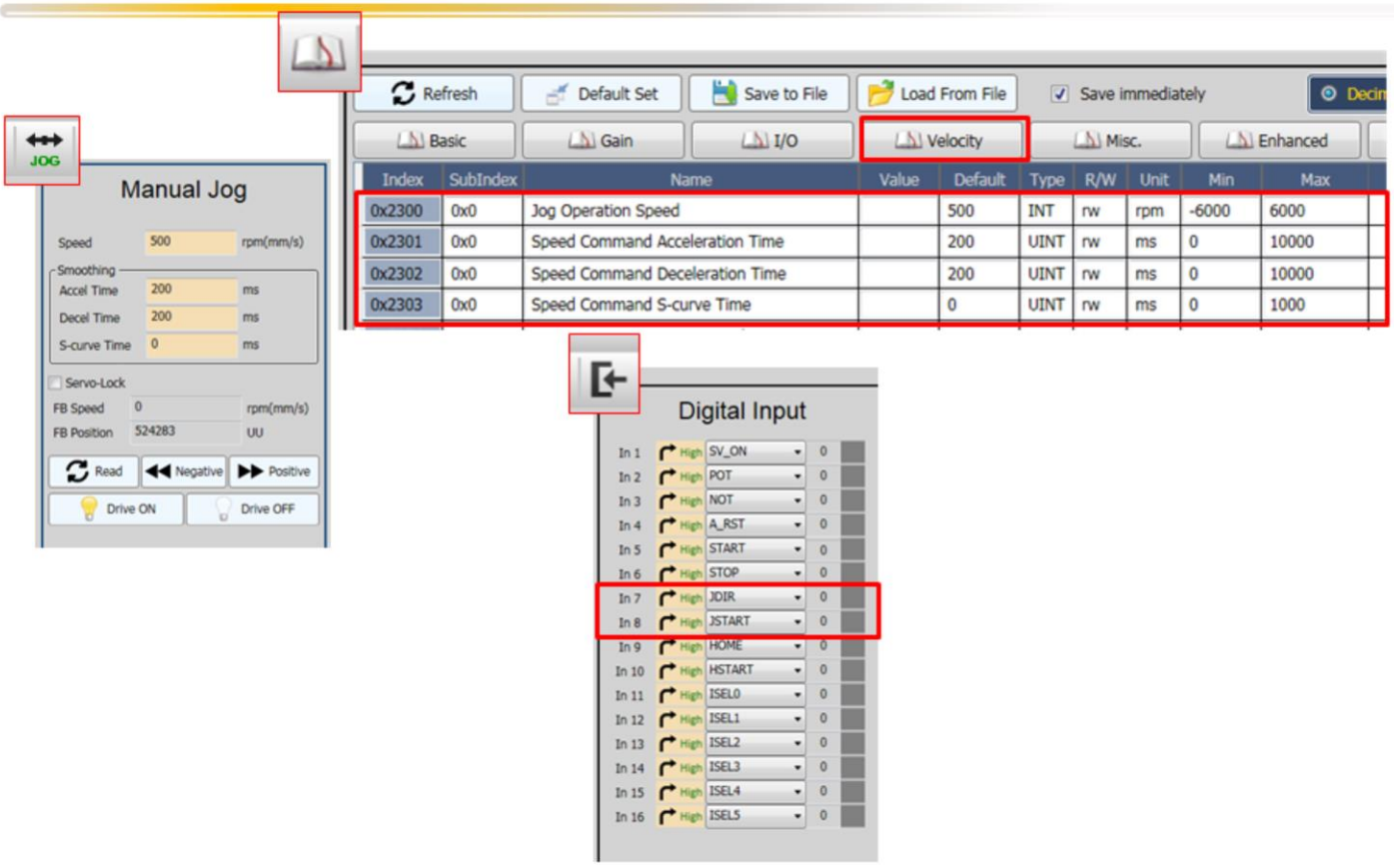
Table 77. Speed setting by Digital Input Signal

Table from user guide: x = OFF
o = ON

When the Digital Input "MODE" signal is asserted, then the indexer is in "Velocity" mode, and the digital input SPD1, SPD2, and SPD3 input signals can be used to select the 8 different preset speeds.

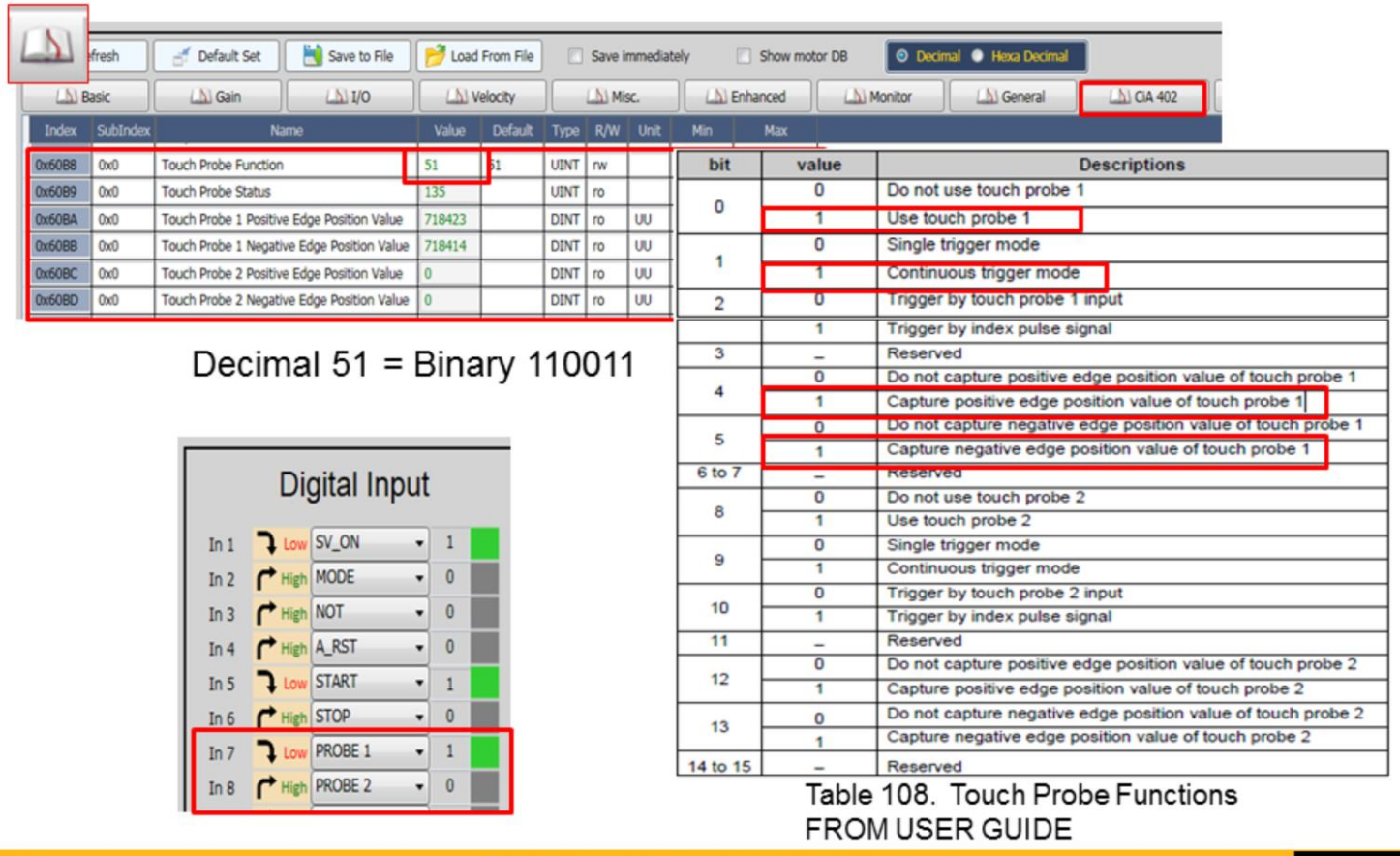
Other Features

Manual Jog: With software and digital inputs



You can make a simple jog move by selecting the icon at the top that says “JOG”. From the software, you can make a “Manual Jog” move. You can also have the PLC jog the motor by sending a signal to the digital inputs that you have mapped to the JSTART and JDIR signals. The jog velocity may also be set in the “Object Dictionary” by selecting the “Velocity” tab.

Other Features
Touch Probe: High speed input position capture



bit	value	Descriptions
0	0	Do not use touch probe 1
	1	Use touch probe 1
1	0	Single trigger mode
	1	Continuous trigger mode
2	0	Trigger by touch probe 1 input
	1	Trigger by index pulse signal
3	–	Reserved
4	0	Do not capture positive edge position value of touch probe 1
	1	Capture positive edge position value of touch probe 1
5	0	Do not capture negative edge position value of touch probe 1
	1	Capture negative edge position value of touch probe 1
6 to 7	–	Reserved
8	0	Do not use touch probe 2
	1	Use touch probe 2
9	0	Single trigger mode
	1	Continuous trigger mode
10	0	Trigger by touch probe 2 input
	1	Trigger by index pulse signal
11	–	Reserved
12	0	Do not capture positive edge position value of touch probe 2
	1	Capture positive edge position value of touch probe 2
13	0	Do not capture negative edge position value of touch probe 2
	1	Capture negative edge position value of touch probe 2
14 to 15	–	Reserved

Table 108. Touch Probe Functions
FROM USER GUIDE

The last feature I will discuss is the touch probe feature. This enables you to capture the encoder's position value using external digital inputs (PROBE 1 and PROBE 2) signals or the Index(Z) pulse of the encoder.

You can access the "Touch Probe" functions from the "Object Dictionary" under the "CIA 402" tab.

The "Touch Probe" function is able to capture accurate registration position at high speeds with built-in hardware.

The P-Series drive immediately captures an event occurrence position and stores it in memory (objects 0x60BA and 060BB). This is useful if you have an external trigger and would like to know the position at which it occurs in your system.

In the above example, I left the "Touch Probe Function" at the default setting of 51 decimal, which equates to 110011 binary. You can see from the "Touch Probe Function" table from the user guide, this turns on touch probe 1, sets it to continuous trigger mode, captures on the positive edge value of the touch probe 1 and the negative edge position value of touch probe 1.

Agenda

- Product Overview
  - P-Series Servo Drives
  - Front Panel
  - System Configuration
  - "Drive Support Software" Brief Summary
- Applications
  - Example Application Feed-to-Length
    - Calculating scaling parameters, Setup Wizard, Test with I/O
    - Using with an XPR2 HMI running Interact Xpress
- Other Features
  - Other Index Types
  - Homing
  - End-of-Travel Limits
  - Point-to-Point Motion and Jogging
  - Touch-probe (high speed input position capture)
- Conclusion and Where to get More Information

Now I will briefly summarize the material and show you where you can get more information.

Conclusion
Summary

- Product Overview
  - Indexer functionality
  - System configuration with a PLC or another host controller
  - "Drive Support Tool" software" Summary
- Applications
  - Example Application Feed-to-Length using the software
  - Using with an XPR2 HMI running Interact Xpress
- Other Features
  - Other Index Types: Relative, Absolute, Registration, Rotary
  - Homing
  - End-of-Travel Limits
  - Jogging and Point-to-Point Motion
  - Touch-probe (high speed input position capture)

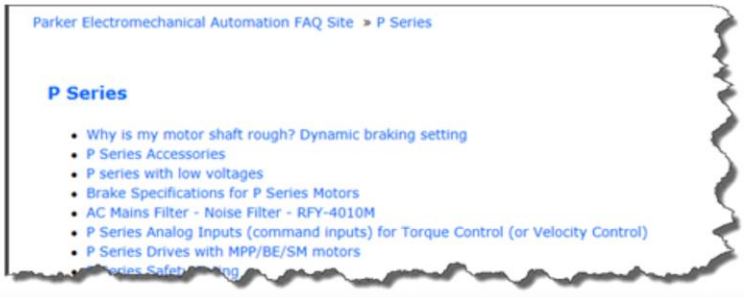
We went through a product overview discussing in general the P-Series family, which consist two different drives and some direct drive motors and rotary motors. The drive we focused on was the P-Series Pulse drive, which has traditional control mode capability and can be operated as an indexer. As previously mentioned, an indexer can't do any logic, thus it is typically used with a host controller or a PLC. The host controls it via digital inputs/outputs or through the serial Modbus-RTU interface. Then we also discussed the P-Series "Drive Support Tool" software, which was used to configure the drive and create the index table. Next, we went through a linear feed-to-length example application. For the example, we calculated the scaling values, used the "Setup Wizard" software to configure the drive, and "programmed" the index table with our move and timing signals. We also discussed how a Parker HMI with a Modbus-RTU drive can be used to interface to the drive. Finally, we discussed other features such as the various index Types, homing, end-of-travel limits, jogging and point-to-point motion, and the touch-probe feature. Next, will I will show you where you can get more information.

Conclusion
Where to Find More Information

- parkermotion.com/pseries
  - P Series Brochure
    - Specifications:
      - Drive and Motors
  - User Guides
  - P-Series "Drive Support Tool" software (free download)
  - Drawings and CAD files
  - Firmware

FAQ: Link below has common frequently asked questions

http://www.parkermotion.com/dmxreadyv2/faqsmanager/faqsmanager.asp?knowledgebase=faqmanager&category=123



Contact us:
Technical Support e-mail North America:
EMN_Support@parker.com

You can find more information from the product web page, whose short-cut website address is: parkermotion.com/pseries

From the product page, you can get a copy of the brochure that contains the specifications for the motors and the drives. Additionally, there are links to the user guides which goes over the details of all the product features of the drives. You can also download the free P-Series "Drive Support Tool" software that was discussed in this presentation. Another useful site to visit is the frequently asked questions section. This site contains additional information that may be discussed more in depth than in the user guide, or explained in a different manner, as well as some frequently asked questions, and we are continually adding to it.

If you have any other technical questions about the P-Series Product family, or any other Parker products, you may contact us at the email address listed on the slide.

Thank you for your interest in the P-Series Pulse Drive with indexing capabilities.