AUTOMATIONDIRECT.com

LS ELECTRIC

L7P Series AC Servo Drive
Quick Start Guide

1st Edition Rev. C, February 22nd, 2024

AutomationDirect Foreword

This QuickStart Guide is designed to get an L7P servo system installed and running quickly. This AutomationDirect Guide is a supplement to the LS Electric L7P User Manual. This Guide does not replace the manufacturer's User Manual. For advanced features or options required by your application, you may still need to refer to the User Manual. Download and reference both this QuickStart Guide and the L7P User Manual when commissioning an L7P servo system.

A note on Part Numbers: LS Electric servo parts sold by AutomationDirect have part numbers that end with a "-AD". This suffix signifies special packaging and labeling for AutomationDirect. All the LS servo products with the "-AD" function and behave exactly the same as the standard LS Electric parts. Please note that when reading the LS electric User Manual or using the Drive CM software, the "-AD" will NOT appear in any part numbers.

Example:

AutomationDirect sells a 400W drive with part number L7PA004U-AD. All references to the 400W drive in the LS Electric User Manual and Drive CM software will always show L7PA004U.

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L7P Series Servo System Overview

Warnings and Cautions

WARNING: Install both the servo drive and the servo motor before performing any wiring.

WARNING: Before wiring or inspecting, turn off the power, wait 15 minutes, make sure the charge lamp is off, and check the voltage.

WARNING: Ensure this product is correctly grounded. All grounding and circuit protection methods must comply with all local standards/regulations and the national electrical standard (refer to NFPA 70: National Electrical Code, 202 Ed.)

WARNING: Do not change the motor or drive wiring while power is on.

WARNING: Only qualified and trained technicians may perform wiring on this product.

WARNING: Do not operate the servo system with wet hands.

WARNING: Do not open the servo drive cover during operation.

WARNING: Do not operate the servo system with the servo drive cover removed.

WARNING: Do not touch the heat sink of the servo drive when it is connected to power and operating This component gets very hot and will scald.

CAUTION: The installation location must be free of vapor and corrosive or flammable gas.

CAUTION: When wiring, do not connect the three-phase power supply to the motor UVW connectors. Incorrect wiring may cause damage to the servo drive.

CAUTION: Do not disassemble the servo drive.

CAUTION: Verify the emergency stop can be activated before the servo drive is connected to power and put into operation.

For additional warnings and precautions, please see pages ***ii*** through ***vi*** of the L7CA User Manual and sections 3.1, 3.2, and 3.4 of the L7PA User Manual.

Installation

Ambient Installation Conditions

The L7P Servo and APM/APMC motors should be installed under the environmental conditions detailed below. Exceeding these conditions risks damage to the equipment.

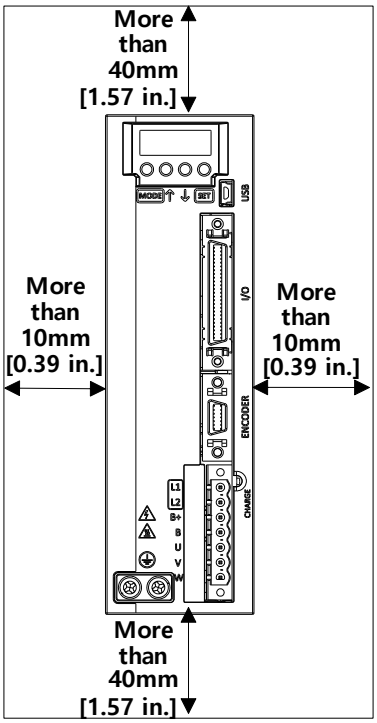
	Condition	Requirement	Notes
Servo Drive	Operating Temperature	0–50°C [32–122 °F]	Install a cooling fan on the control panel for ventilation and to maintain the temperature within the required range.
	Operating Humidity	80% relative humidity or below	Moisture developed inside the drive due to ice formation or condensation during a prolonged period of inactivity may damage the drive. If the drive has been inactive for a prolonged period remove all moisture before operating the drive.
	External Vibration	Vibration acceleration 4.9 m/s^2 (5G) or lower	Excessive vibration can cause malfunctions and reduces the lifespan of the drive.
	Ambient Conditions	• Do not expose the drive to direct sunlight. • Do not expose the drive to corrosive or combustible gases. • Do not expose the drive to oil or dust. • Ensure that the drive receives sufficient ventilation even if installed in a confined place.	

	Condition	Requirement	Notes
Motor	Operating Temperature	0–40°C [32–104 °F]	If motor temperature exceeds 40°C [104 °F], use forced air cooling to keep the motor temperature within spec.
	Operating Humidity	80% relative humidity or below	Do not operate the motors in an environment with steam.
	External Vibration	Vibration acceleration 19.6 m/s^2 (2.5 G) or lower on X and Y axes	Excessive vibrations reduce the lifespan of the motor bearings.

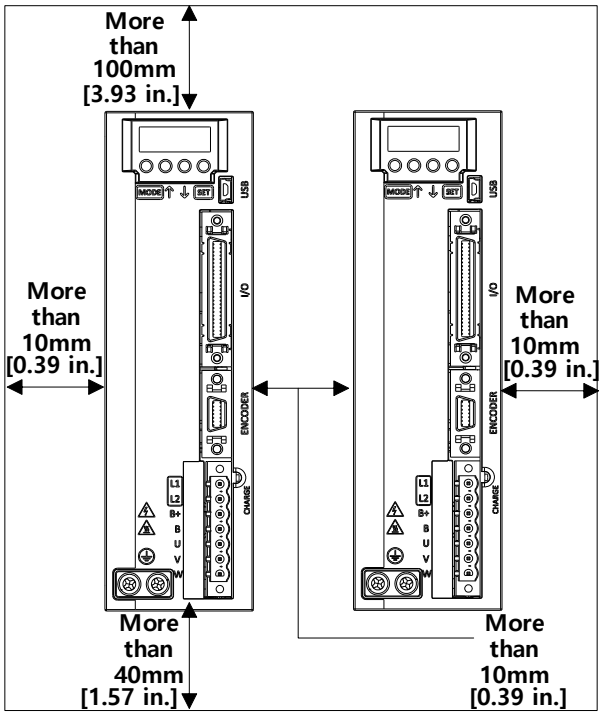
Installation Direction and Space

Comply with the spacing standard below when installing drives with the control panel:

Single Drive



Multiple Drives



Quick Start Instructions

To verify your servo components and motor/drive wiring as quickly as possible, please follow the steps below. These basic instructions will quickly get the motor spinning (verifying that parts and power wiring are correct).

The rest of this quick start guide contains detailed information on how to properly set up your system and configure the drive for your specific application.

What you'll need:

- *Servo Drive*
- *Servo Motor*
- *Motor Power Cable*
- *Encoder Power Cable*
- *Brake Power Cable (for brake-equipped motors)*
- *Drive CM software installed on a Windows PC*
- *A USB A to USB mini-B cable (such as SV2-PGM-USB15)*

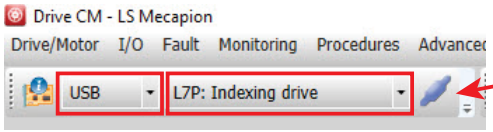
Step 1: Before Powering on the Drive

	Substep	Task
Step 1	A	Ensure Input Power wiring is connected to L1, L2, and Ground. Refer to "Main Power Connection Wiring" on page 16.
	B	Ensure 24VDC power and I/O signals are connected. At the very least, make sure the E-Stop circuit is connected. Refer to "I/O Connection Wiring Diagram with Default Functions" on page 19.
	C	Ensure the Motor Encoder cable is connected. Do not simply plug the connector into the motor. Use the captive screws to ensure the connector is secure. Intermittent encoder connection can wreak havoc with the system.
	D	Ensure the Motor Brake cable is connected (if using a brake motor). If practical, wire the brake directly to 24VDC during initial system testing. This eliminates any question of brake wiring functioning properly. Brake testing can be verified after initial drive testing.
	E	Leave the motor power cable disconnected until initial drive setup and testing are complete to prevent unwanted motion. Later, the motor will be wired and tested. Do not connect a load to the motor shaft until testing is completed.

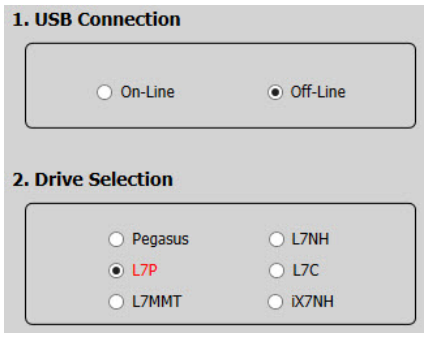
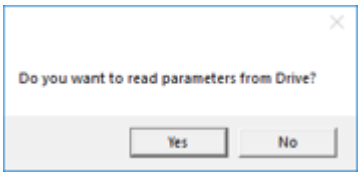
Step 2: Power up the Drive

	Substep	Task
Step 2	A	Turn on 24VDC power to the Drive I/O terminal and brake (if using a brake motor).
	B	Turn on main Input power (230VAC or 460VAC, depending on drive model to the Drive Input Terminal at L1, L2, L3 (motor power), and C1, C2 (control power)..
	C	The drive LED display will show the drive's status and Warning or Alarm codes if present.

Step 3: Connect the PC to the Drive

	Substep	Task
Step 3	A	Using a standard USB A to USB mini-B cable (such as SV2-PGM-USB15, MOSAIC-CSU, etc.), connect the PC to the Drive.
	B	Start Drive CM software.
	C	Select **L7P: Indexing Drive** and press the **Connect** button. The software should begin to communicate with the drive. A green flashing square should appear in the bottom left corner of the screen indicating comms traffic.  Push to connect After connecting, icon will change to this. Push to disconnect.

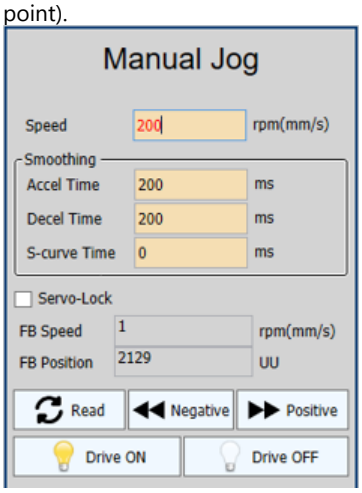
Step 4: Setup Wizard

	Substep	Task
Step 4	A	In the Quick Setup window (left side of screen), click **Setup Wizard**.
	B	In the USB Connection window, choose **On-Line** and click **Yes** to read parameters from the drive.   If the **On-Line** radio button is not available and greyed out, click on **Setup Wizard** again. This should restart the Setup Wizard and enable the button.
	C	Follow the steps in the Setup Wizard to define your application. 1) For initial setup and system testing, allow the Setup Wizard to choose the default selections. After completing this hardware test/verification, you can go through the rest of this guide and refer to the User Manual if you want to customize your configuration. 2) After stepping through the Setup Wizard, select **Write to Drive**. 3) After writing to the drive is complete, make sure to cycle power to the drive. A quick way to power cycle the CPU only is to click the **Software Reset** button in the upper right toolbar. Many settings in the Setup Wizard only take affect after a power cycle.

Step 5: Clear Faults

	Substep	Task
Step 5	A	Restart the drive and establish communications again.
	B	Go to "Fault\Servo Alarm History" and press the **Read** button. Correct any errors that are causing alarms to display on this page. Correction actions and information can be found in the User Manual or by selecting "Fault\Alarm List."
	C	After fixing any issues, click on **Reset Servo Alarm** and verify the alarms have been corrected.

Step 6: Jog the Motor

	Substep	Task
Step 6	A	Remove power from the drive.
	B	Ensure that there is nothing attached to the motor shaft. Initial motion testing should always be done with the motor uncoupled.
	C	Connect the motor power cable and re-apply power to the drive.
	D	Reconnect the software to the drive (see Step 3C).
	E	Click on the **Jog** icon
	F	Enter a nominal speed, acceleration, and deceleration (a value of 200 for each setting is a good starting point).  If a value is red, that means the value in the drive is different than the value in the software. Click in that field and press **Enter** to send the updated value to the drive.
	G	Press **Drive ON** to enable the drive from the software. The drive's LED should read **S-.run** (servo is in run mode).
	H	Press **Negative** or **Positive** to jog the motor. Once the motor jogs, you have verified the power wiring, servo drive, motor, and motor cables are connected properly.

Step 7: Set Operating Mode

	Substep	Task
Step 7	A	Determine whether you want to run the system in Internal Index, Velocity, Torque, or High Speed Pulse Input mode.
	B	For Index Mode, see "Index Position Mode" on page 35. For Pulse Mode, see "Pulse Input Position Mode" on page 45. For Velocity Mode, see "Velocity Mode" on page 53. For Torque Mode, see "Torque Mode" on page 61.
	C	Once operating mode is set, system quick setup is complete.

First Time Inspection

Ensure your servo motor and drive match capacity.

L7P Servo Drive

Part Number Explanation

The three digit number in the middle of the drive part number determines the power of the drive. "A" drives use 230VAC while "B" drives use 460VAC. Note that the "-AD" simply represents special packaging for AutomationDirect. These are standard LS Electric Parts. For example:

- *L7PA**004**U-AD*
- *L7PB**010**U-AD*

The value 004 represents a 400W drive. The value 010 represents a 1000W (or 1kW) drive.

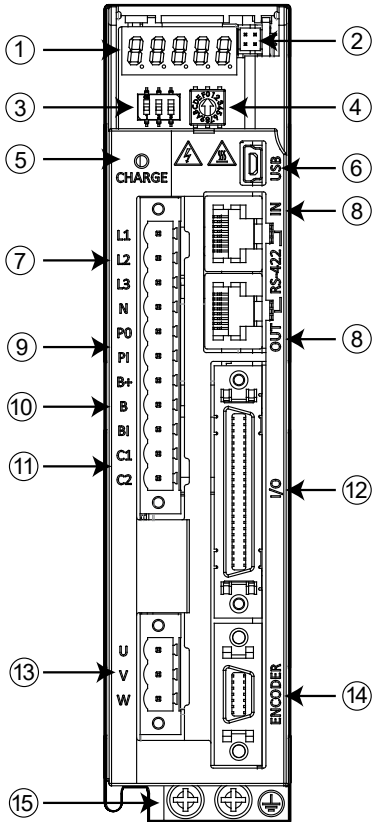
Drive Model Explanation	Drive	Input Voltage	Power Rating	Compatible Motors	
				Non-braking	Braking
	L7PA004U-AD	230VAC	400W	APMC-FBL01AMK-AD APMC-FBL02AMK-AD APMC-FBL04AMK-AD	APMC-FBL01AMK2-AD APMC-FBL02AMK2-AD APMC-FBL04AMK2-AD
	L7PA010U-AD		1kW	APMC-FCL08AMK-AD APMC-FCL10AMK-AD*	APMC-FCL08AMK2-AD APMC-FCL10AMK2-AD*
	L7PA020U-AD		2kW	APM-FE15AMK-AD APM-FE16DMK-AD APM-FE22DMK-AD*	APM-FE15AMK2-AD APM-FE16DMK2-AD APM-FE22DMK2-AD*
	L7PA035U-AD		3.5 kW	APM-FF35DMK-AD	APM-FF35DMK2-AD
	L7PA050U-AD		5kW	APM-FF55DMK-AD	APM-FF55DMK2-AD
	L7PA075U-AD		7.5kW	APM-FF75DMK-AD	APM-FF75DMK2-AD
	L7PB010U-AD	460VAC	1kW	APM-FEP09AMK-AD	APM-FEP09AMK2-AD
	L7PB020U-AD		2kW	APM-FEP15AMK-AD APM-FEP16DMK-AD APM-FEP22DMK-AD	APM-FEP15AMK2-AD APM-FEP16DMK2-AD APM-FEP22DMK2-AD
	L7PB035U-AD		3.5 kW	APM-FFP35DMK-AD	APM-FFP35DMK2-AD
	L7PB050U-AD		5kW	APM-FFP55DMK-AD	APM-FFP55DMK2-AD
	L7PB075U-AD		7.5kW	APM-FFP75DMK-AD	APM-FFP75DMK2-AD

** 100W to 750W 230V motors can use their recommended drives if using a single phase supply. No derating required.*

1kW 230V motors must be derated to 200% max torque if using 1kW drives with single phase input (use the 2kW drive for no derating with single phase supply).

1.5 kW, 1.6 kW, and 2.2 kW 230V motors must use the 3.5 kW drive if using single phase supply. 1.5 kW and 1.6 kW motors must be derated to 200% max torque. The 2.2 kW motor must be derated to 150% max torque.

Servo Drive Components	Location	Description
	1	Display
	2	Analog Monitor Connector
	3	Terminating Resistance Setting
	4	Node Address Switch
	5	Charge Lamp
	6	USB Connector (USB, Mini B Type)
	7	Main Power Connectors (L1, L2, L3)[Do not connect to "N"]
	8	RS-422 Communication Connector (In/Out)
	9	DC Reactor Connection Connector (PO, PI)
	10	Recovery Resistance Connection Connector
	11	Control power Terminal (C1, C2)
	12	Input/Output Signal Connector (I/O)
	13	Servo Motor Connection Terminal (U, V, W)
	14	Servo Motor Encoder Connector (ENCODER)
	15	Ground Terminal



APMC and APM Servo Motor

Part Number Explanation

The motor part number is defined by several of the digits in the middle. Note that the "-AD" simply represents special packaging for AutomationDirect. These are standard LS Electric Parts.

APM-F**xx(P)yy**zMK**(2)**-AD

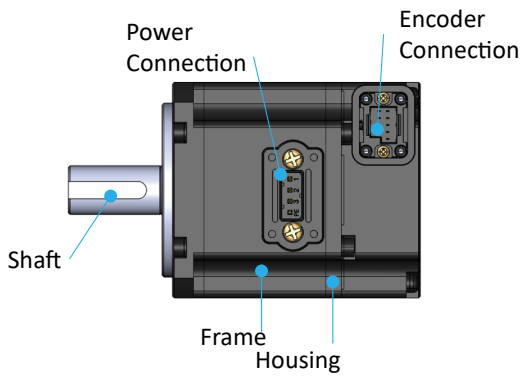
- *XX = the frame size:*
  - *BL = 60mm square (70mm bolt circle)*
  - *CL = 80mm square (105mm bolt circle)*
  - *E = 130mm square (145mm bolt circle)*
  - *F = 180mm square (200mm bolt circle)*
- *(P) = 460VAC if present, 230VAC otherwise*
- *YY = power in hundreds of watts*
- *Z = Rated speed 3000rpm if A, 2000rpm if D*
- *(2) = If present at the end of the part number, represents a motor with built-in brake. No (2) = no brake.*

For example:

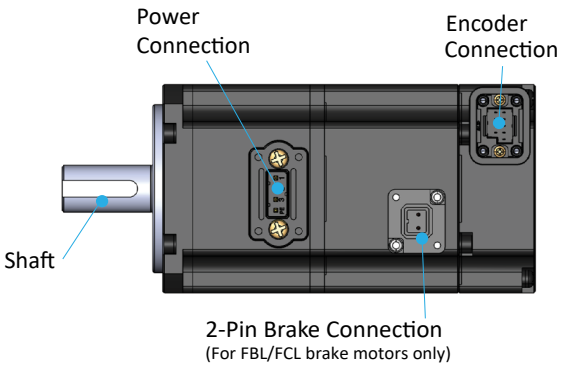
APM-FEP16DMK2-AD

This represents a 460VAC motor, 130mm square, 1.6 kW power, 2000rpm rated speed, with brake, specially packaged for AutomationDirect.

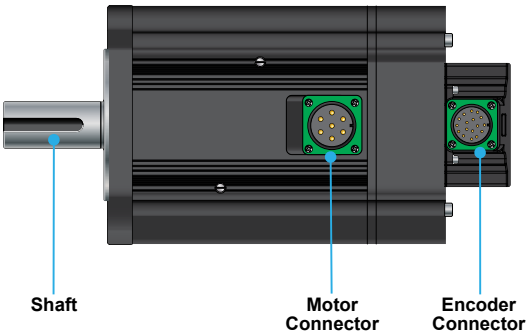
FBL/FCL Motors



FBL/FCL Braking Motors



FE/FF Motors



Note: FE/FF brake motors have brake wiring incorporated into the power cable (no separate brake cable).

Basic Inspection

Perform periodic inspections to maintain your equipment, as well as inspections before operation of the servo and motor.

Inspection	*Task*
General Inspection	Periodically check to confirm the screws are securely tightened. This includes the screws in the servo drive, the connection screws between the motor shaft and the machine, and the connection screws between the terminal block and machine.
	Prevent oil, water, metallic particles, and other foreign matter from entering the control box or ventilation equipment. Protect the servo drive from any drill cuttings.
	If the control box is installed in a location where dust or harmful gas are present, ensure the dust or harmful gas cannot enter the control box.
	Make sure to wire encoders and other devices in the proper sequence to avoid sudden unintended acceleration or damage to the motor.
Inspection before operation (power OFF)	To avoid electric shock, connect the ground terminal of the servo drive to the ground terminal of the control box. If wiring must be added or modified, wait at least 10 minutes after disconnecting the servo drive from the power supply or discharge the electricity with a discharge device.
	Isolate the wires at the wiring terminal.
	Make sure the wiring is correct to avoid damage or any abnormal operation.
	Check for and remove any electrically conductive objects, including metal sheet and screws, or flammable objects inside or near the servo drive.
	Make sure the emergency stop switch is OFF.
	To ensure the electromagnetic brake works, make sure the stop and circuit breaker functions are working properly.
	Reduce the electromagnetic interference if there is electromagnetic interference with the peripheral devices.
	Make sure the external voltage level of the servo drive is correct.
Inspection before operation (power ON)	The encoder cable should be protected from excessive stress – make sure the cable is not worn or stretched.
	Contact AutomationDirect if the servo motor vibrates or makes unusual noise during operation.
	Make sure the parameter settings are correct. Different machines have different characteristics. Adjust the parameters according to the characteristics of each machine.
	Reset the parameters when the servo drive is in the Servo OFF status to avoid possible malfunction.
	If there is no contact noise or other abnormal noise when the relay is operating, contact AutomationDirect.
	Contact AutomationDirect if the power indicator or LED display does not function properly.

System Wiring

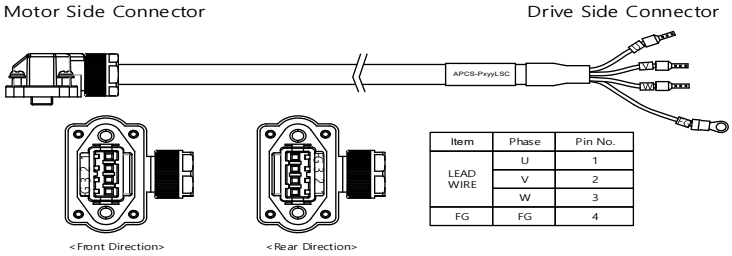
Pre-made Motor Cables

Motor connections utilize premade cables available in normal flex or robotic flex specifications. Cables are available for any L7P drive and motor size 100W–7.5 kW but are model dependent (brake cables are only applicable for brake motors). They are available in lengths of 3m, 5m, 10m, and 20m (9.8 ft, 16.4 ft, 32.8 ft, and 65.6 ft).

For cable model details and specifications, please see www.automationdirect.com.

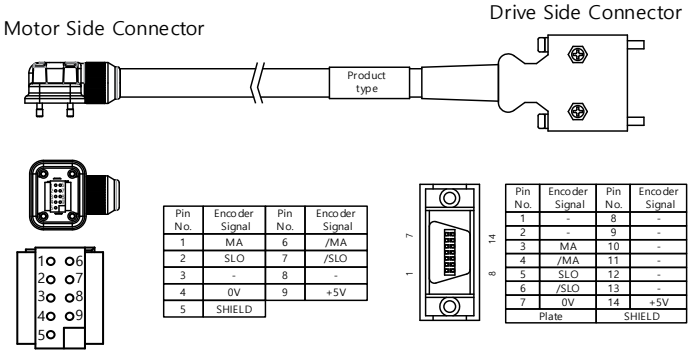
For assistance in specifying a servo system, go to www.automationdirect.com/selectors for utilities that will help pick the correct motor, drive, cables, IO components, and accessories.

Motor Power Cables (FBL, FCL motors)



Item	Phase	Pin No.
LEAD WIRE	U	1
	V	2
	W	3
FG	FG	4

Motor Encoder Cable (FBL, FCL motors)



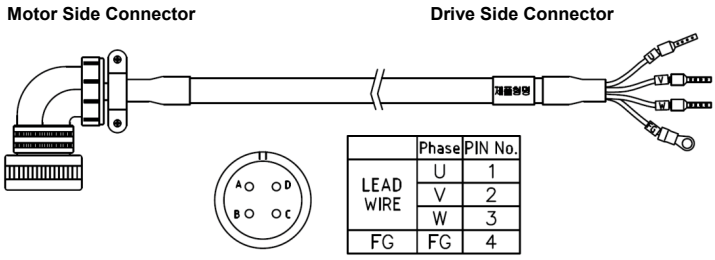
Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	MA	6	/MA
2	SLO	7	/SLO
3	-	8	-
4	0V	9	+5V
5	SHIELD		

Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

Motor Brake Cable (FBL, FCL motors)

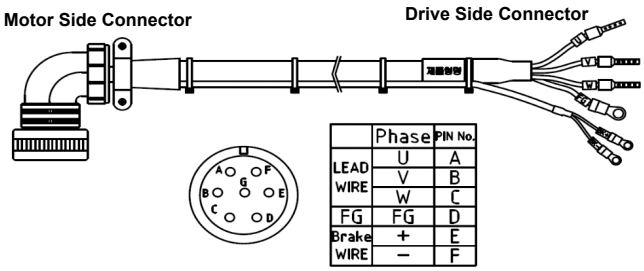
PIN No.	Signal
1	BK +
2	BK -

Motor Power Cable (FE, FF motors)



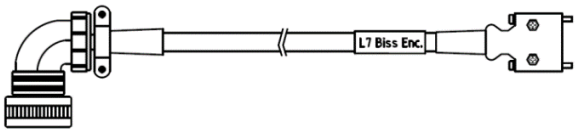
	Phase	PIN No.
LEAD WIRE	U	1
	V	2
	W	3
FG	FG	4

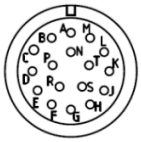
Motor Power and Brake Cable (FE, FF motors)



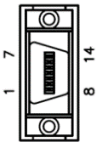
	Phase	PIN No.
LEAD WIRE	U	A
	V	B
	W	C
FG	FG	D
Brake WIRE	+	E
	−	F

Motor Encoder Cable (FE, FF motors)



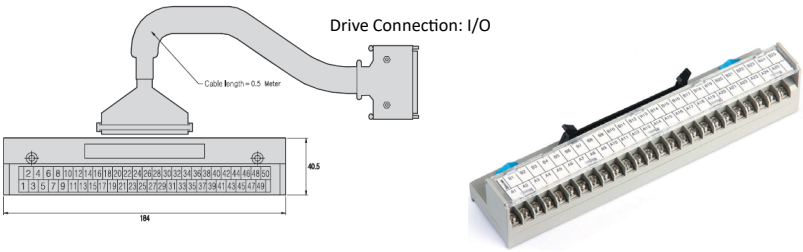


PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
A	MA	F	-	P	-
B	$\overline{MA}$	K	-	R	-
C	SLO	L	-	H	+5V
D	$\overline{SLO}$	M	-	G	0V
E	-	N	-	J	SHIELD



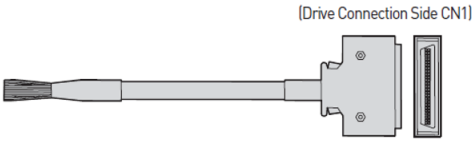
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	-	6	$\overline{SLO}$	11	-
2	-	7	0V	12	-
3	MA	8	-	13	-
4	$\overline{MA}$	9	-	14	+5V
5	SLO	10	-	Plate	SHIELD

Drive I/O Cables



APC-VSCN1T-AD, APC-VSCN1T01-AD, APC-VSCN1T02-AD

You can download a printable terminal label ("I/O Breakout Template") at https://www.automationdirect.com/pn/APC-VSCN1T-AD
See terminal assignments table on the following page.

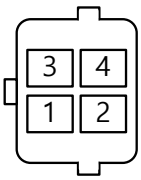


APC-CN101A-AD, APC-CN102A-AD, APC-CN103A-AD

Analog Monitoring Connector

Connect with:

- *L7P-CON-E (for 24-48 AWG pins)*
- *L7P-CON-F*
- *L7P-CON-G (for 26AWG IDC)*



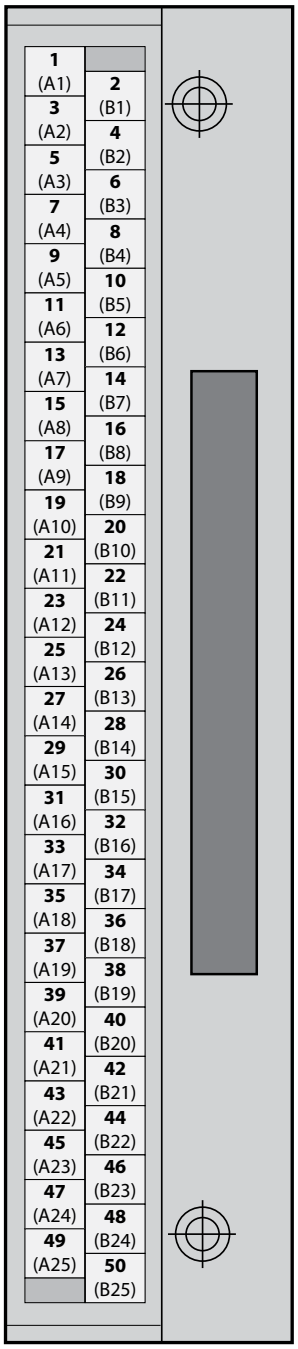
Analog Output Monitor Connector
(viewed from front side of drive)

Terminal Assignments and Wire Colors

CAUTION: Terminal assignments are different for every LS drive series. Use this terminal assignment chart with L7P series drives ONLY. Using terminal charts from other LS series drives will result in incorrect wiring that will damage your equipment.

Terminal	Drive I/O Pin/Wire #	L7P Series Description	APC-CN10xA Flying Lead Cables		
			Wire Color	Stripe Color	Number of Stripes
A1	1	AO	Orange	Black	1
B1	2	/AO	Orange	Red	1
A2	3	BO	Orange	Black	2
B2	4	/BO	Orange	Red	2
A3	5	ZO	Orange	Black	3
B3	6	/ZO	Orange	Red	3
A4	7	A-TLMT	Orange	Black	4
B4	8	AGND	Orange	Red	4
A5	9	A-OVR	Orange	Black	5
B5	10	AGND	Orange	Red	5
A6	11	+24V	Yellow	Black	1
B6	12	DI-1	Yellow	Red	1
A7	13	DI-2	Yellow	Black	2
B7	14	DI-3	Yellow	Red	2
A8	15	DI-4	Yellow	Black	3
B8	16	DI-5	Yellow	Red	3
A9	17	DI-6	Yellow	Black	4
B9	18	DI-7	Yellow	Red	4
A10	19	DI-8	Yellow	Black	5
B10	20	N/C	Yellow	Red	5
A11	21	+24v	Gray	Black	1
B11	22	DI-9	Gray	Red	1
A12	23	DI-10	Gray	Black	2
B12	24	DI-11	Gray	Red	2
A13	25	DI-12	Gray	Black	3
B13	26	DI-13	Gray	Red	3
A14	27	DI-14	Gray	Black	4
B14	28	DI-15	Gray	Red	4
A15	29	DI-16	Gray	Black	5
B15	30	PULCOM 24V pwr input	Gray	Red	5
A16	31	PF+	White	Black	1
B16	32	PF-	White	Red	1
A17	33	PR+	White	Black	2
B17	34	PR-	White	Red	2
A18	35	DO-1+	White	Black	3
B18	36	DO-1-	White	Red	3
A19	37	DO-2+	White	Black	4
B19	38	DO-2-	White	Red	4
A20	39	DO-3+	White	Black	5
B20	40	DO-3-	White	Red	5
A21	41	DO-4+	Pink	Black	1
B21	42	DO-4-	Pink	Red	1
A22	43	DO-5+	Pink	Black	2
B22	44	DO-5-	Pink	Red	2
A23	45	DO-6+	Pink	Black	3
B23	46	DO-6-	Pink	Red	3
A24	47	DO-7+	Pink	Black	4
B24	48	DO-7-	Pink	Red	4
A25	49	DO-8+	Pink	Black	5
B25	50	DO-8-	Pink	Red	5

APC-VSCN1T-AD



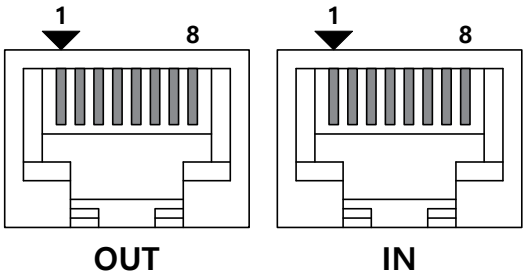
Names and Functions of Analog Inputs and Outputs

Pin #	Name	Location	Description	Function Details
1	AMON1	Output on 4-pin Analog Monitor Connector	Analog monitor 1	Analog monitor output (-10V to +10V)
2	AMON2		Analog monitor 2	Analog monitor output (-10V to +10V)
3	AGND		AGND(0V)	Analog ground
4	AGND		AGND(0V)	Analog ground
7	A-TLMT	Input on I/O Connector	Analog torque input (command/limit)	Index operation mode: -10V to +10V is connected between A-TLMT(AI1) and AGND to limit the motor's output torque. The relationship between input voltage and torque limit varies depending on the set [0x221C] value. Torque operation mode: -10V to +10V is connected between A-TLMT(AI1) and AGND to operate torque command. The relationship between input voltage and torque command varies depending on the set [0x221C] value.
9	A-OVR		Analog speed input (command/override)	Index operation mode : -10V to +10V is connected between A-OVR(AI2)and AGND to override index operation speed. The override value is 0% under -10V input, 100% under 0V input, and 200% under +10V input. You can choose whether to use this function by [0x221E] or AVOR contact input. Speed operation mode : -10V to +10V is connected between A-OVR(AI2)and AGND to operate Analog speed mode. The relationship between input voltage and speed command varies depending on the set [0x2229] value.
8	AGND		AGND(0V)	Analog ground
10	AGND		AGND(0V)	Analog ground

RJ45 Port Pin Out for RS422 Communications

Serial Modbus RS422 (compatible with RS485 PLCs) communication interface for communication between drives and controllers. Modbus RTU/ASCII protocol. Set the Node Address and Terminating resistor on the front of the drive. To connect multiple drives, use an ethernet patch cable (not a crossover cable) between drives. On the last drive, set DIP switch #2 to ON for a 120Ω terminating resistor.

Pin #	Pin Function
1	Not used
2	Not used
3	RXD+
4	TXD-
5	TXD+
6	RXD-
7	Not used[1]
8	Not used[1]
1 - For IN connector, 5V voltage is output to Pin 7 and Pin 8. Do not use Pin 7 and Pin 8 for any purpose.	



Pin arrangement viewed from the front side of the drive

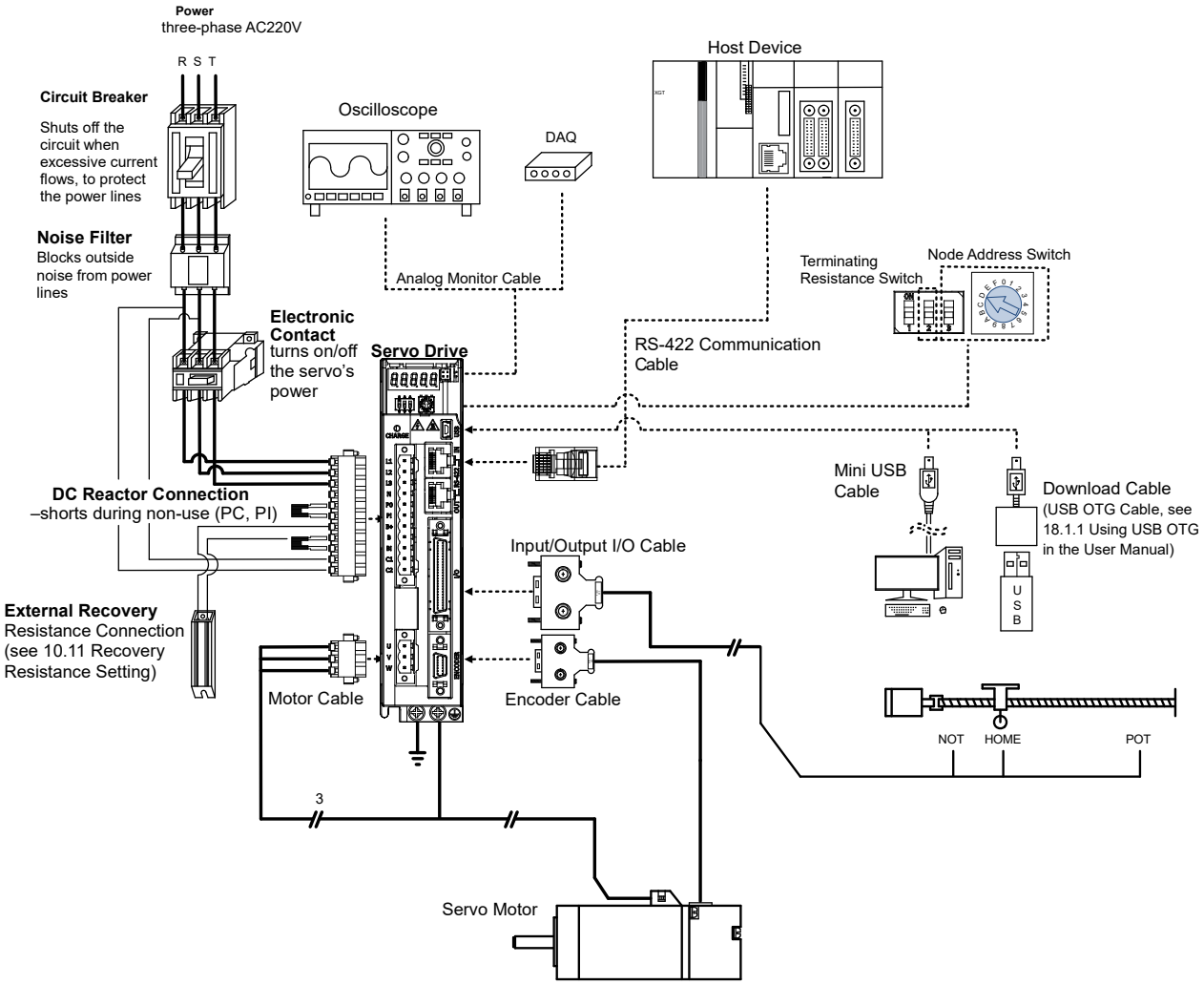
NOTE: Connect TXD+ and TXD-, RXD+ and RXD- using twisted pair. TXD and RXD are defined by the servo drive.

NOTE: For 2-wire RS485 PLCs, connect RXD-/TXD- to RS485-, and RXD+/TXD+ to RS485+.

General Wiring Overview

Example System Configuration

NOTE: 100W to 2kW 230VAC systems can use a single phase supply. Any 2 of R,S,T can be used.

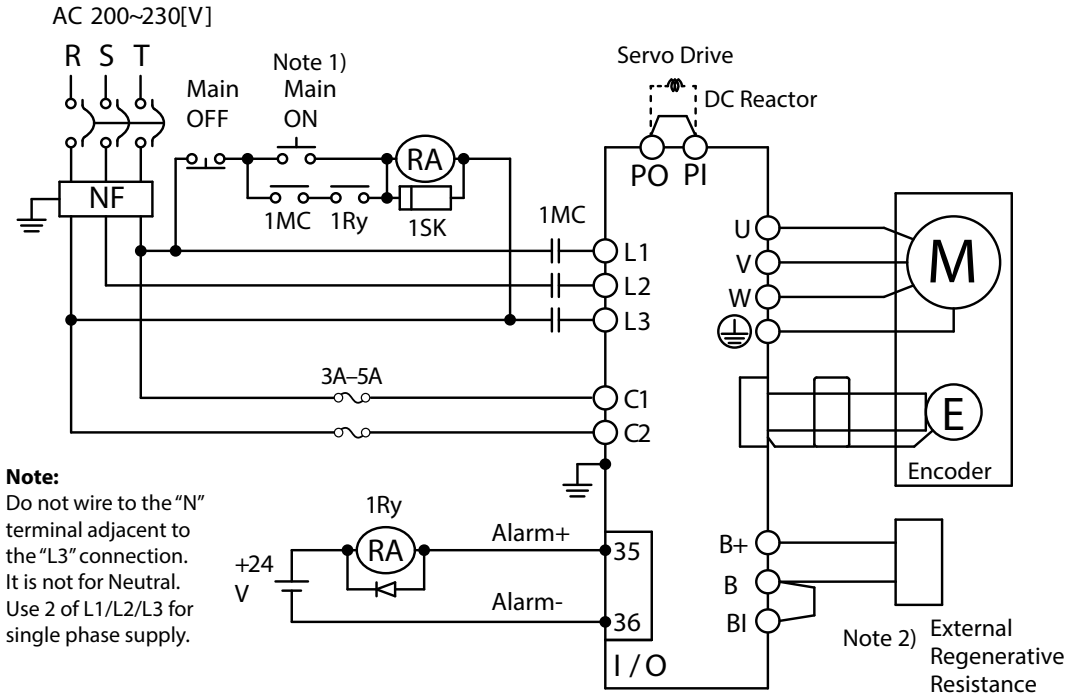


NOTE: PE between the servo motor and the servo and between the servo and the device must be connected.

Main Power Connection Wiring

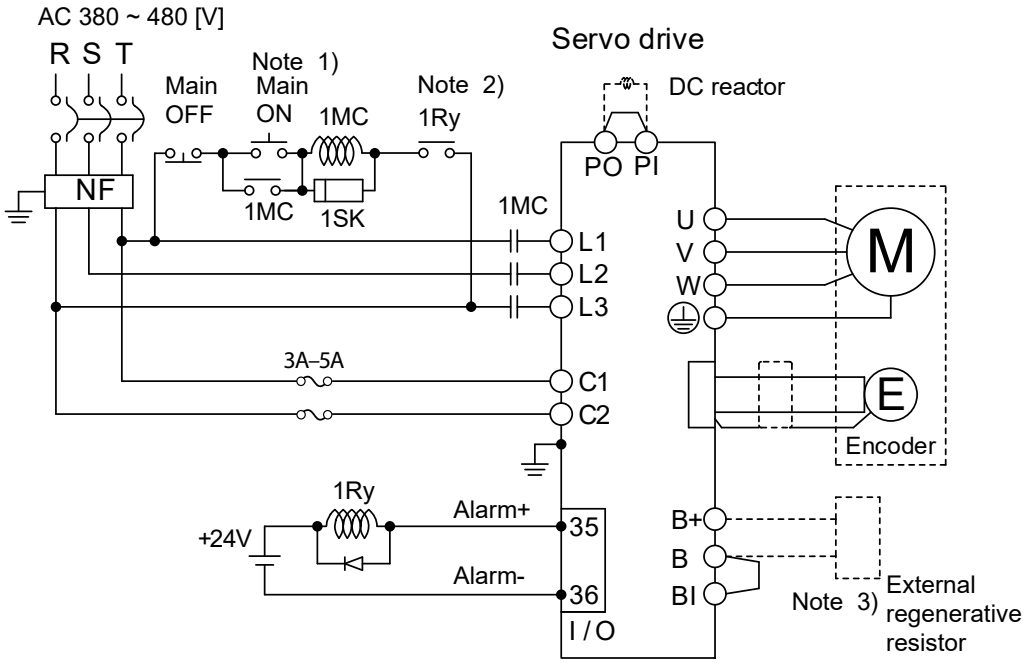
NOTE: Single phase can use any two wires of R, S, or T. Ensure C1 and C2 are powered as well.

230VAC Drives



Note:
Do not wire to the "N" terminal adjacent to the "L3" connection. It is not for Neutral. Use 2 of L1/L2/L3 for single phase supply.

460VAC Drives



NOTE 1: About 1-2 seconds are required from main power supply to alarm signal output. Hold the main power on for 2 seconds until the alarm circuit ("1Ry") will latch main power ON.

NOTES 2 & 3: If an external regen resistor is required, see the available regen resistors under Motion Control category at AutomationDirect.com (APCS-140R50-AD, APCS-300R30-AD, etc.). Remove the jumper from the internal resistor between B and BI, and connect the external resistor to the B+ and B pins.

230VAC Drives

Drive Size	400W	1kW	2kW	3.5 kW	5kW	7.5 kW
MCCB (UL489 NFB)	15A C trip curve		30A C trip curve		40A B trip curve	50A B trip curve
Fuse[2]	15A	20A	40A	70A	125A	150A
Noise Filter (NF)	TB6-B010LBEI (10A)		TB6-B030NBDC (30A)		TB6- B040A (40A)	TB6-B060LA(60A)
DC Reactor	HFN-10 (10A)	HFN-15 (15A)	HFN-30 (30A)		HFN-40 (40A)	HFN-50 (50A)
MC	11A / 240V	18A / 240V	32A / 240V		50A / 240V	50A / 240V
L1, L2, L3, PO, PI, N, B+, B, BI, U, V, W [1]	16AWG (1.5 mm^2)	14AWG (2.5 mm^2)	12AWG (4.0 mm^2)		10AWG (6.0 mm^2)	8AWG (8.0 mm^2)
Screw Terminal	UA-F1510, SEOIL (10mm Strip and Twist)	UA-F2010, SEOIL (10mm Strip and Twist)	UA-F4010, SEOIL (10mm Strip and Twist)		GP110028 KET	GP110732 KET
Recovery Resistance	50W 100Ω	100W 40Ω	150W 13Ω		120W 6.8Ω	240W 6.8Ω
Power Connector	L7P-CON-B (BLF 5.08/03/180F SN BK BX) L7P-CON-A (BLF 5.08/11/180F SN BK BX		L7P-CON-D (BLZ 7.62HP/03/180LR SN BK BX SO) L7P-CON-C (BLZ 7.62HP/11/180LR SN BK BX SO)		n/a	

1 *- Select and use 600V, PVC-insulated wires. To comply with UL (CSA) standards, use UL-certified wires that have a heat resistant temperature of 75°C [167°F] or above. To comply with other standards, use proper wires that meet the applicable standards. For other special specifications, use wires equivalent or superior to those specified in this section.*
2 *- Use Class CC or High Speed J (HL series) current limiting fuses to prevent nuisance tripping and to increase the panel SCCR rating.*

460VAC Drives

Drive Size	1kW	2kW	3.5 kW	5kW	7.5 kW
MCCB (UL489 NFB)	10A B trip curve	20A B trip curve		30A B trip curve	
Fuse[2]	15A	25A	35A	50A	65A
Noise Filter (NF)	TB6-B010LBEI (10A)	TB6-B020NBDC (20A)		TB6-B030NBDC (30A)	TB6-B040A (40A)
DC Reactor	10A	20A		30A	
MC	9A / 550V	18A / 550V		26A / 550V	
L1, L2, L3, PO, PI, N, B+, B, U, V, W [1]	14AWG (2.5 mm^2)			10AWG (5.5 mm^2)	
C1, C2	14AWG (2.5 mm^2)				
Screw Terminal	UA-F4010, SEOIL (10mm Strip and Twist)			GP110028 KET	
Recovery Resistance	100W 100Ω	150W 40Ω		120W 27Ω	240W 27Ω
Power Connector	L7P-CON-D (BLZ 7.62HP/03/180LR SN OR BX SO) L7P-CON-C (BLZ 7.62HP/11/180LR SN OR BX SO)			n/a	

1 *- Select and use 600V, PVC-insulated wires. To comply with UL (CSA) standards, use UL-certified wires that have a heat resistant temperature of 75°C [167°F] or above. To comply with other standards, use proper wires that meet the applicable standards. For other special specifications, use wires equivalent or superior to those specified in this section.*
2 *- Use Class CC or High Speed J (HL series) current limiting fuses to prevent nuisance tripping and to increase the panel SCCR rating.*

Power Connector Signal Names

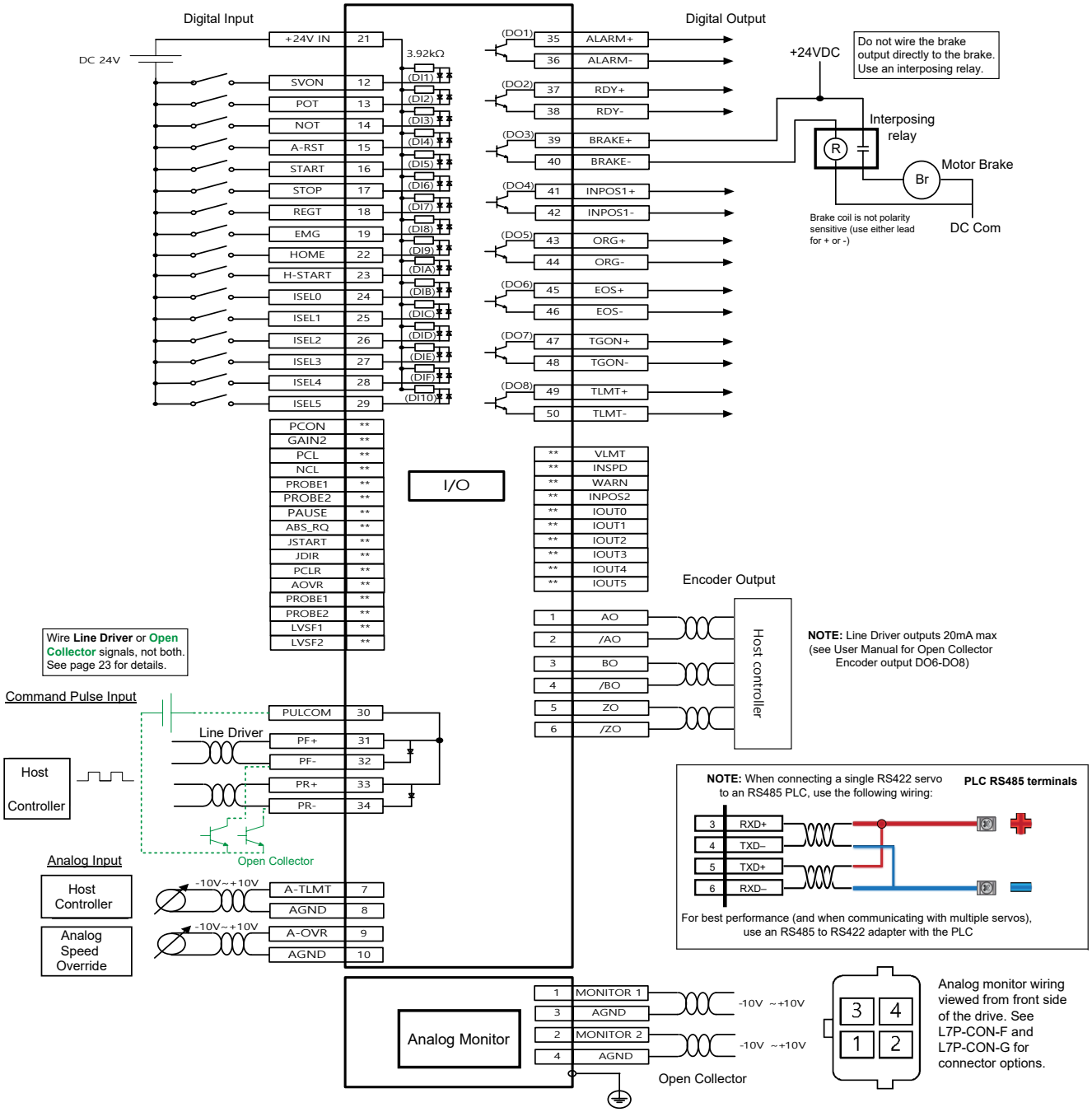
Signal Name	***Description***
L1	Main power connectors
L2	
L3	
N	No connection (Do not connect to Neutral)
P0	DC reactor connection connector
PI	
B+	Recovery resistance connection connector
B	
BI	
C1	Control power terminal
C2	
U	Servo motor connection terminal
V	
W	

NOTE: Strip all Power Connector wiring 7-10mm. Refer to section 3.4.3 of the User Manual.

I/O Connection Wiring Diagram with Default Functions

I/O Connection wiring diagram is shown below. For a printable terminal label, go to: https://www.automationdirect.com/pn/APC-VSCN1T-AD.

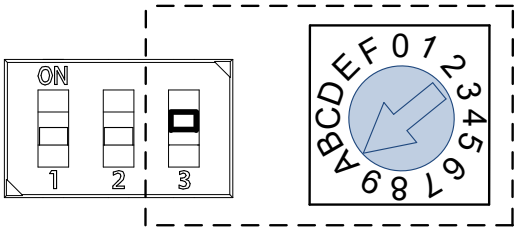
See "Terminal Assignments and Wire Colors" on page 13 for terminal assignments.



NOTE: Input signals DI1-DI6 and output signals DO1-DO8 are factory default signals and can be reconfigured. Note that DO6 and DO7 cannot be used as other functions when they are set in encoder output mode [0x3007] as line drive and open collector.

NOTE: APC-VSCN1Txxx-AD provides shielding between the servo and the terminal blocks. User provided shielding should be installed for high speed and analog signals (ground the shield on the PLC side).

Drive Node Address Setting for RS422/RS485



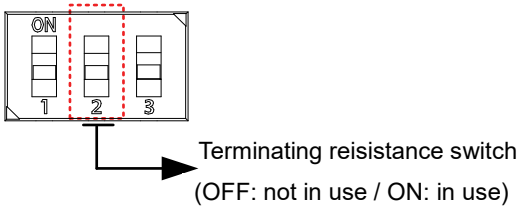
The drive rotary dial and number 3 DIP switch can be used to set drive node addresses. DIP switch 3 adds 16 (hex 0x10) to the node address. Configure the dial and toggle switch per the tables below to set the desired address. Values from 0 to 31 can be set. Note that the drive only reads the node switch value when power is turned on. To change the value, the power has to be turned off and back on again. To connect multiple drives in a serial network, use standard ethernet patch cables (not crossover cables) between drives.

Desired Node Address	*Rotary Dial Position*	*DIP Switch #3 Position*
0	0	OFF
1	1	OFF
2	2	OFF
3	3	OFF
4	4	OFF
5	5	OFF
6	6	OFF
7	7	OFF
8	8	OFF
9	9	OFF
10	A	OFF
11	B	OFF
12	C	OFF
13	D	OFF
14	E	OFF
15	F	OFF
16	0	ON
17	1	ON
18	2	ON
19	3	ON
20	4	ON
21	5	ON
22	6	ON
23	7	ON
24	8	ON
25	9	ON
26	A	ON
27	B	ON
28	C	ON
29	D	ON
30	E	ON
31	F	ON

NOTE: DIP Switch #1 is reserved. Do not change position from factory default.

Terminating Resistance Setting

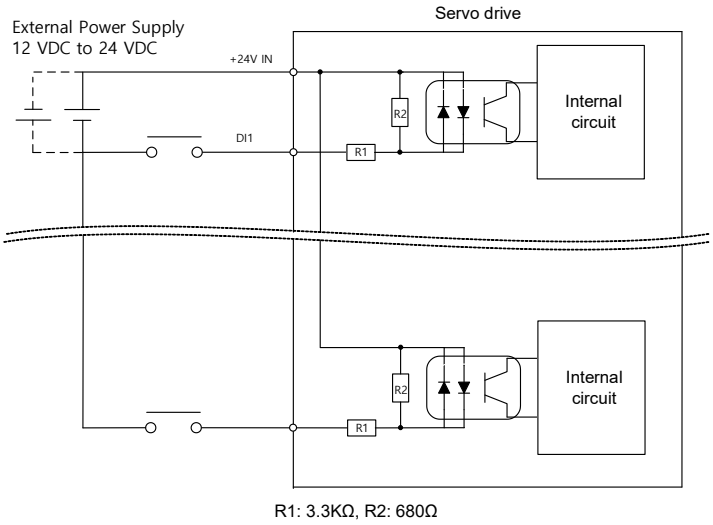
Terminating resistance of 120Ω can be enabled for RS-422 communications. To enable the resistance, set DIP switch #2 to ON for the last physical drive on the RS422/485 network.



I/O Wiring Details Digital Inputs/Outputs

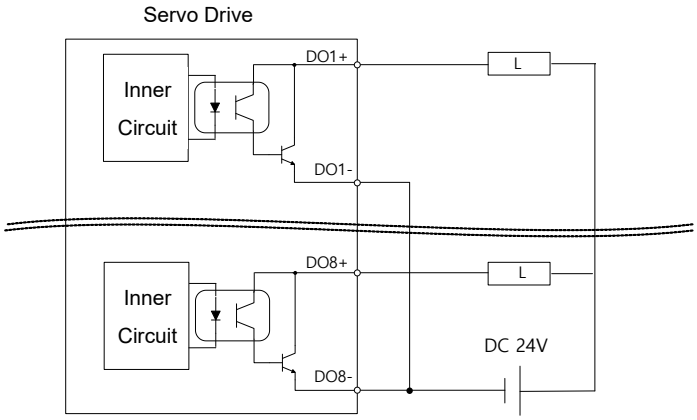
Digital Inputs

1) You can set the input contact to contact A (normally open) or contact B (normally closed).
2) You can assign each input contact to one of 28 functions.
3) For more information on signal assignment and change of the input contact, refer to the User Manual, section 11.2 "Input/Output Signals Setting." The Drive CM software makes setting the I/O signals very quick and easy.
4) The rated voltage is 12VDC to 24VDC.



Digital Outputs

1) You can set the output to contact A (normally open) or Contact B (normally closed).
2) You can assign each output contact to one of 19 output functions.
3) For more information on signal assignment and change of the output contact, refer to the User Manual, section 11.2 "Input/Output Signals Setting." The Drive CM software makes setting the I/O signals very quick and easy.
4) Excessive voltage or overcurrent may damage the device because it uses an internal transistor switch. Be cautious. Do not directly power large inductive loads, use an interposing relay.
5) The rated voltage and current are 24VDC ± 10% and 120mA.

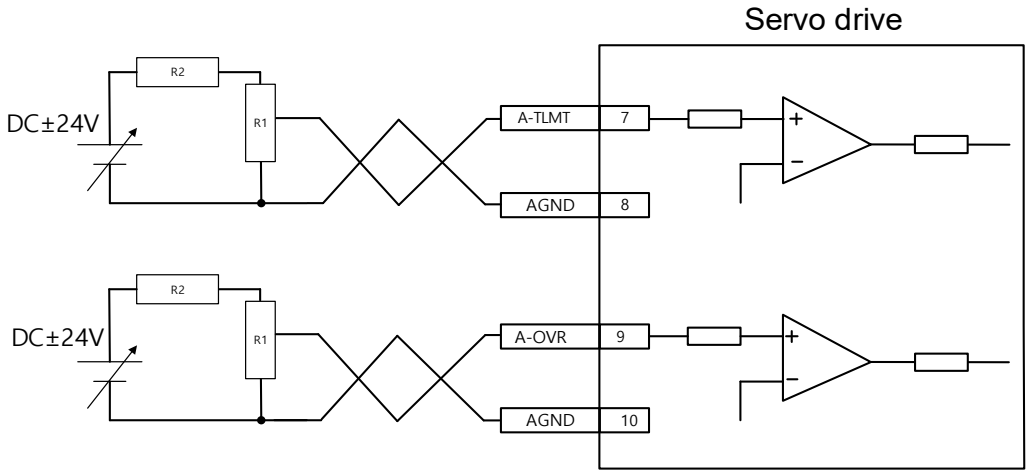


NOTE: DO6 and DO7 cannot be used as other functions when they are set in encoder output mode [0x3007] as line drive or open collector.

I/O Wiring and Option Details

Analog

1) For information on how to operate analog input signals, refer to the User Manual, section 4.5 "Analog Speed Override," section 6.2 "Analog Velocity Command," section 8.1 "Analog Torque Command Scale," and section 11.8 "Torque Limit Function."
2) The range of analog input signals is -10V to 10V.
3) The impedance for input signals is approximately 10KΩ.



NOTE: APC-VSCN1Txxx-AD provides shielding between the servo and the terminal blocks. User provided shielding should be installed for high speed and analog signals (ground the shield on the PLC side).

4) Example of resistance selection for use of 24V for input voltage:

No.	R1	R2
1	5KΩ	6KΩ
2	10KΩ	12KΩ

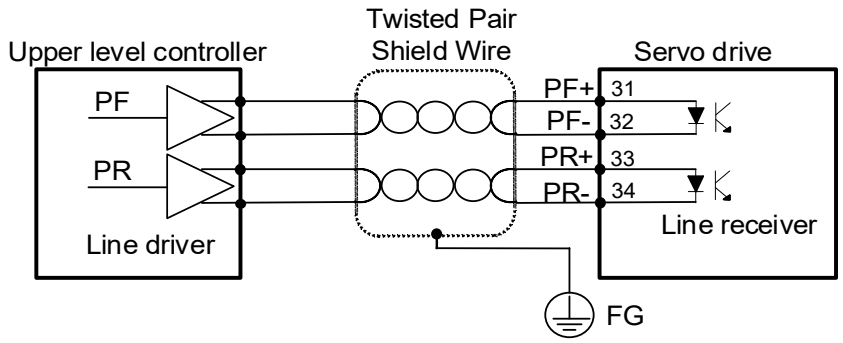
5) Example R1 potentiometers:
   - *GSDA-5K: 5K potentiometer with 0-100% dial*
   - *ECX2300-5K: 5k potentiometer*
   - *ECX2300-10K: 10k potentiometer*

Pulse

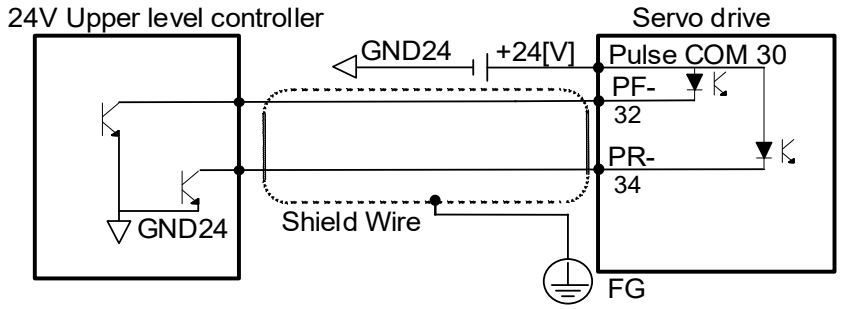
0x3003 = Pulse Input Logic Select.
Determines CW+CCW, Pulse+DIR, A+B, etc.

NOTE: APC-VSCN1Txxx-AD provides shielding between the servo and the terminal blocks. User provided shielding should be installed for high speed and analog signals (ground the shield on the PLC side).

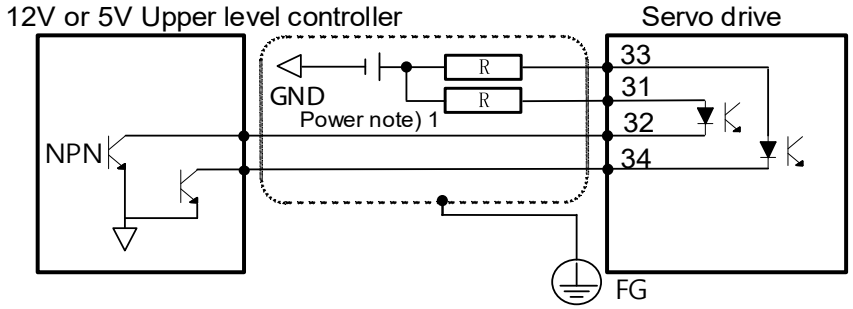
Line Driver (5V) Pulse Input



24V NPN Open Collector Pulse Input (internal dropping resistor on pulse COM (30))



12V or 5V NPN Open Collector Pulse Input (external dropping resistors required)



NOTE: When using 5V power, Resistance R = 100-150 Ω, 1/2 W.
When using 12V power, R = 560-680 Ω, 1/2 W.

Pulse Format

Signal		Pulse/ Direction	CW/ CCW	Quad	L7P Label and Pin #	Productivity PLC HSO Terminals	Productivity PLC AMC Motion
Line Driver	A or A+	Pulse	CCW	B	PF+ 31	1A	STEP+
	/A or A-				PF- 32	/1A	STEP-
	B or B+	Direction	CW	A	PR+ 33	1B	DIR+
	/B or B-				PR- 34	/1B	DIR-
Open Collector	A Voltage Supply	Pulse	CCW	B	**	N/A	N/A
	A Pulse Out				PF- 32	1A SNK*	N/A
	B Voltage Supply	Direction	CW	A	**	N/A	N/A
	B Pulse Out				PR- 34	1B SNK*	N/A

** Must also connect the HSO "COM" logic terminal to power supply common (0V or 24V). See middle diagram on the previous page.*

*** For 24V pulse systems, connect power to Pulse COM (pin 30). See middle diagram on the previous page. For 12V or 5V pulse systems, connect power/resistors to PR+ and PF+ (pins 33, 31). See bottom diagram on the previous page.*

LED Display

The LED status display can contain a variety of information, including the status of the drive's operating state, digital inputs, digital outputs, alarms, and warnings. Please refer to Chapter 11 of the User Manual to see details of using the display on the front of the drive to monitor drive status.

Any configuration must be done using Drive CM software as the L7P series drives do not have a keypad for direct user input.

Alarms

See section 15.5 of the User Manual for more information on Alarms.

Code	*Alarm*
AL-10	IPM fault (Overcurrent H/W)
AL-14	IPM fault (Overcurrent S/W)
AL-16	Current Limit exceeded (Overcurrent (H/W))
AL-11	IPM Temperature (IPM Overheat)
AL-15	Current Offset Abnormality
AL-21	Continuous Overload Abnormality
AL-22	Drive Temperature Overheat 1
AL-23	Regeneration Overload
AL-24	Motor Cable Open
AL-25	Drive Temperature Overheat 2
AL-26	Encoder Temperature (Reserved)
AL-30	Encoder Communication Error
AL-31	Encoder Cable Open
AL-32	Encoder Data Error
AL-38	Encoder Setting Error
AL-33	Motor ID Setting
AL-34	Encoder Z Phase Open
AL-35	Encoder Battery Low Voltage
AL-40	Main Power Input Undervoltage
AL-41	Main Power Input Overvoltage
AL-42	Main Power Input Failure
AL-43	Control Power Failure (reserved)
AL-50	Over Speed Limit
AL-51	POS Excessive Position Error
AL-52	Emergency Stop
AL-53	Excessive Speed Deviation
AL-63	Parameter Checksum Error
AL-71	Factory Setting Error

Warnings

Code	*Warning*
W01	Main Power Phase Loss
W02	Encoder Battery Low Voltage
W04	Software Position Limit
W08	Dynamic Braking Overcurrent
W10	Operation Overload
W20	Drive-Motor Setup Abnormality
W40	Main Power Undervoltage
W80	Emergency Signal Input Abnormality

Drive CM Software

AutomationDirect Foreword

The LS Electric Drive CM software does not include “Are you sure?” types of warnings. When you make a change in the SW it takes place immediately in the drive, even settings that initiate motion.

Example 1:

When you go to the JOG screen and press “Enable”, the drive Enables immediately.

Example 2:

When you change a Digital Input from active low to active high, the definition changes immediately by pushing the “Edge” button. In the picture to the right, Input #1 is configured for Servo On. If the input is physically low and you press the Edge button, the input’s definition is changed to active low and the servo will immediately be enabled.

There is nothing wrong with this approach, but it may be more direct than most software packages that are in use today.

Getting Started

Drive CM software provides the fastest and easiest way to set up the LS Electric L7P drive. The following steps show how to get started with the software and a few key features.

Before starting, you will need:

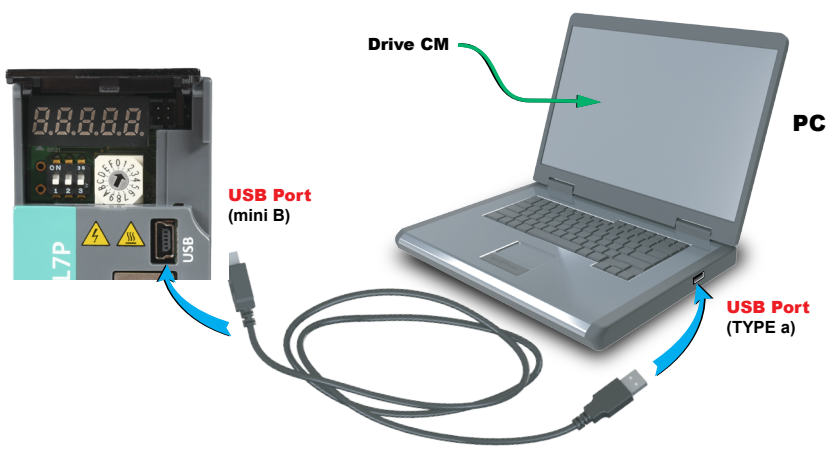
- *PC with Windows 8 or later*
- *PC USB port*
- *USB Type A to USB mini B cable (SV2-PGM-USB15 is a good choice due to the dual ferrite filters and opto-isolator included with the cable. This USB cable is helpful when dealing with PC to Drive connectivity issues due to EMI)*

Step 1

Download and install Drive CM Software from the AutomationDirect L7P servo drives support page at https://support.automationdirect.com/products/lselectric.html.

Step 2

Connect the servo drive USB port to the PC USB port using a standard USB-A to USB-mini-B cable. Some cables available from AutomationDirect include:

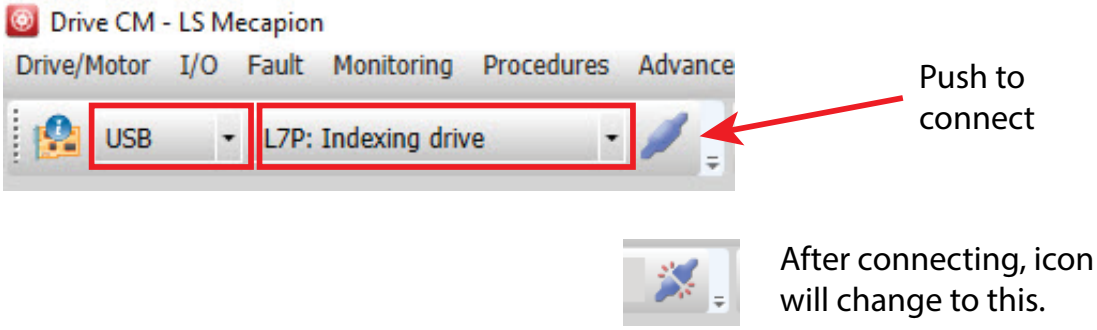


USB-A to USB-mini-B Cables
SV2-PGM-USB15
SV2-PGM-USB30
MOSAIC-CSU

Step 3

Open Drive CM Software and Connect to the drive.

1) Select the USB connection type and L7P drive.
2) Then press the Cable icon to connect and establish communications with the drive.



NOTE: The icon does not show the current comms state, it shows what will happen if you push the button.

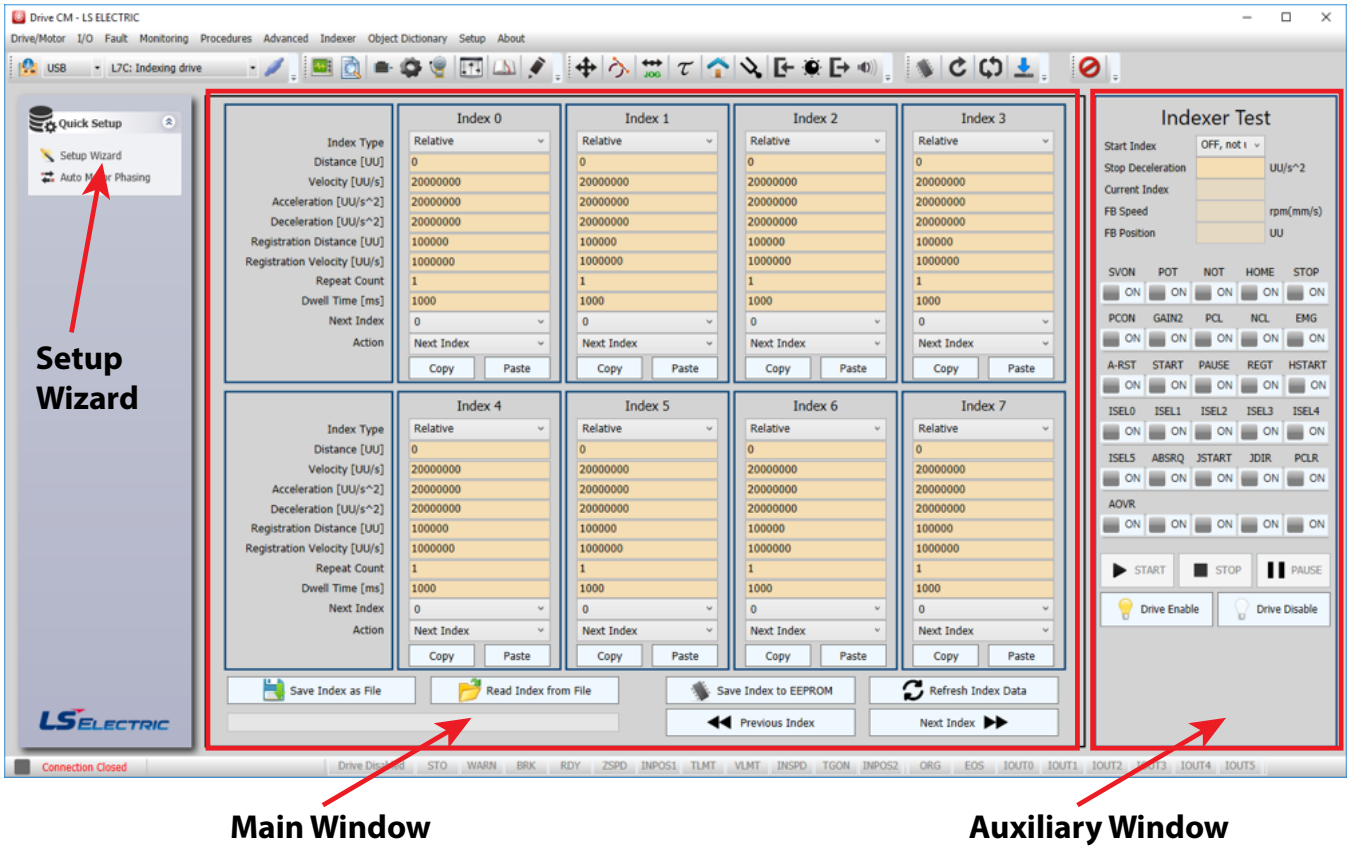
The comms status is displayed at the bottom left corner of the software screen. A green blinking square indicates active communication.

Using the Drive CM Software

There are two main working areas in Drive CM. The Main Window (larger, left) is mostly used for setup and configuration. The Auxiliary Window (smaller, right) has more dynamic operations available. Both areas can be viewed simultaneously for maximum usefulness (ex: select both Index Edit and Indexer Test to define and test Indexes at the same time). The left area is also used to run the Setup Wizard. The Setup Wizard will walk you step-by-step through setting up the basic parameters of the system.

NOTE: If you exit the "Setup Wizard" before completing the process, you will have to restart the wizard from the beginning. The "Setup Wizard" will not update the drive's parameters or the parameters in the object dictionary until they are written to the drive.

NOTE: In the "About" drop down menu you can find the Drive CM software user manual for specifics on each function in the software.



Toolbars

The two main toolbars at the top of the screen control what is displayed in the Main and Auxiliary windows.

Toolbar	*Controls*
	Main Window
	Auxiliary Window

Toolbar Functions

Icon	*Function*	*Displays In*
	Trace/Trigger Monitor (Scope)	Main Window
	Cyclic Monitor (System Data View)	
	Motor Encoder Setup (no configuration needed for auto-identifiable FBL/FCL motors)	
	General Configuration Setup	
	Fault Configuration	
	Controls Loop (Manual Tuning)	
	Object Dictionary (Parameters)	
	Index Edit (configure point-to-point moves/indexes)	
	Indexer Test	Auxiliary Window
	PTP Move	
	Jog Manual	
	Torque Control	
	Homing	
	Tuning	
	Digital Input	
	Analog Input	
	Digital Output	
	Analog Monitor	
	Save to Drive Memory	n/a (Command only)
	Reset Servo Alarm	
	Software Reset for Drive CPU power cycle	
	Firmware Update	
	Emergency STOP	

I/O Configuration

Digital Inputs

Use the following parameters to configure Digital Input functionality or use the Digital Input window in Drive CM directly to make changes.

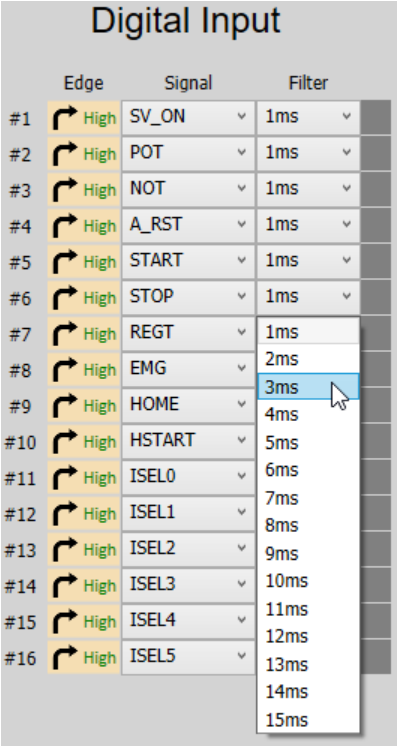
The software provides a very easy way to change the DI functions using the digital input icon (quickest and easiest method for configuration). Alternatively, you can open the parameter object dictionary using the Object Dictionary menu button or the Object Dictionary icon.

NOTE: When making these changes while the software is connected to the drive the change will take affect immediately, there is no "Are you sure?" warning. Example: Changing an SVON digital input from NO to NC by pressing the "Edge" button will cause the drive to change state immediately.
This feature of immediate changes from NO <-> NC can be used for "forcing" a digital input for testing and troubleshooting your application.

Digital Input Default Functions

These functions are located under the **I/O** tab.

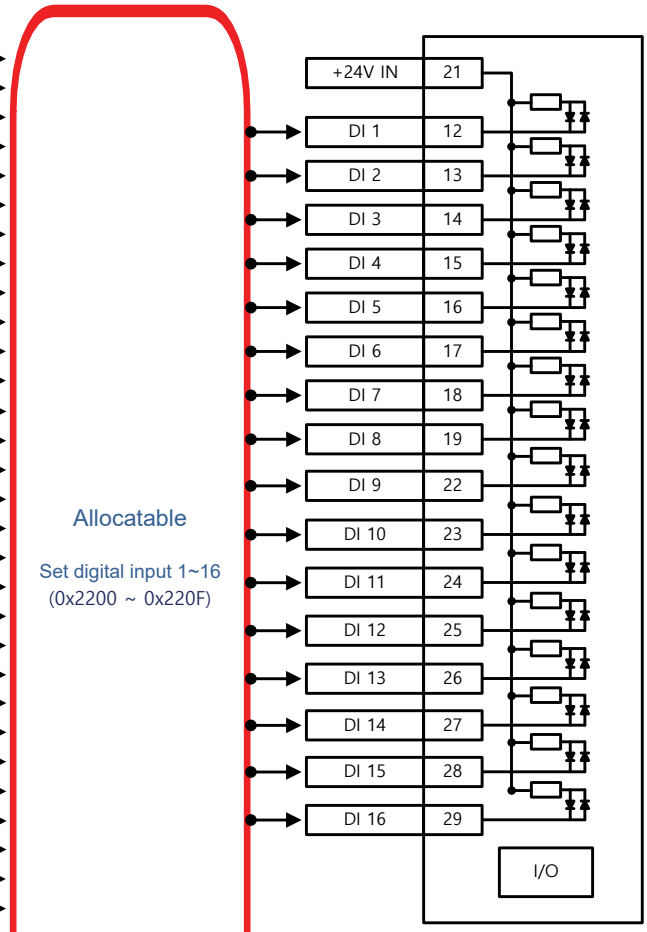
Input	Parameter Object	Default Function
DI1	0x2200	SVON
DI2	0x2201	POT
DI3	0x2202	NOT
DI4	0x2203	A_RST
DI5	0x2204	START
DI6	0x2205	STOP
DI7	0x2206	REGT
DI8	0x2207	EMG
DI9	0x2208	HOME
DI10	0x2209	HSTART
DI11	0x220A	ISEL0
DI12	0x220B	ISEL1
DI13	0x220C	ISEL2
DI14	0x220D	ISEL3
DI15	0x220E	ISEL4
DI16	0x220F	ISEL5



Digital Input Codes

See section 3.5.1 and 11.2 in the User Manual for more information about DI codes. Drive CM is the easiest way to edit the DI codes - including changing the NO and NC settings. Either enter values directly into Parameters 0x2200–0x220F (Object Dictionary's I/O tab) or use the pulldown lists after selecting the Digital Input icon.

Parameter Setting		Code	Function
NC	NO		
0x8000	0x0000	Not assigned	Input not used
0x8001	0x0001	POT	Prohibit forward rotation (CCW limit)
0x8002	0x0002	NOT	Prohibit reverse rotation (CW limit)
0x8003	0x0003	HOME	Origin sensor
0x8004	0x0004	STOP	Stop servo
0x8005	0x0005	PCON	Operate P control
0x8006	0x0006	GAIN2	Switch between Gain1 and Gain2
0x8007	0x0007	P_CL	Forward torque limit
0x8008	0x0008	N_CL	Reverse torque limit
0x8009	0x8009	PROBE1	Probe signal stores position value (1)
0x800A	0x000A	PROBE2	Probe signal stores position value (2)
0x800b	0x000b	EMG	Emergency stop
0x800C	0x000C	A_RST	Reset alarm
0x800F	0x000F	SV_ON	Servo on
0x8010	0x0010	START	Start operation
0x8011	0x0011	PAUSE	Pause index
0x8012	0x0012	REGT	Registration input
0x8013	0x0013	HSTART	Start homing
0x8014	0x0014	ISEL0	Selection position 0
0x8015	0x0015	ISEL1	Selection position 1
0x8016	0x0016	ISEL2	Selection position 2
0x8017	0x0017	ISEL3	Selection position 3
0x8018	0x0018	ISEL4	Selection position 4
0x8019	0x0019	ISEL5	Selection position 5
0x801A	0x001A	ABSRQ	Request absolute position data
0x801b	0x001b	JSTART	Operate jog
0x801C	0x001C	JDIR	Select jog rotation direction
0x801d	0x001d	PCLR	Clear input pulse
0x801E	0x001E	AOVR	Select velocity override
0x8020	0x0020	SPD1/LVSF1	Multi-step speed 1 / Vibration control filter 1
0x8021	0x0021	SPD2/LVSF2	Multi-step speed 2 / Vibration control filter 2
0x8022	0x0022	SPD3	Multi-step speed 3
0x8023	0x0023	MODE	Switch operation mode

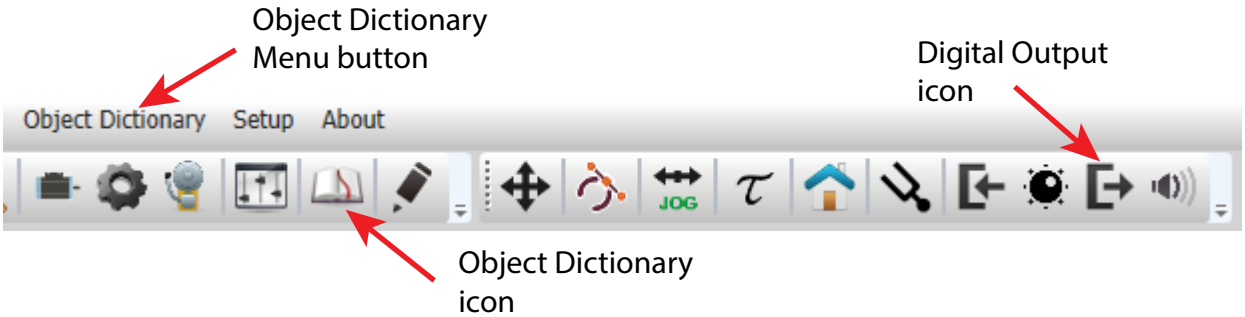


Digital Outputs

Use the following parameters to configure Digital Output functionality or use the Digital Output window in Drive CM directly to make changes. Digital Outputs 1-8 are configurable but DO6, DO7, and DO8 cannot be used as other functions when the encoder output mode is set for Open Collector (0x3007=1). When using Open Collector encoder output, DO6=AO, DO7=BO, and DO8=ZO.

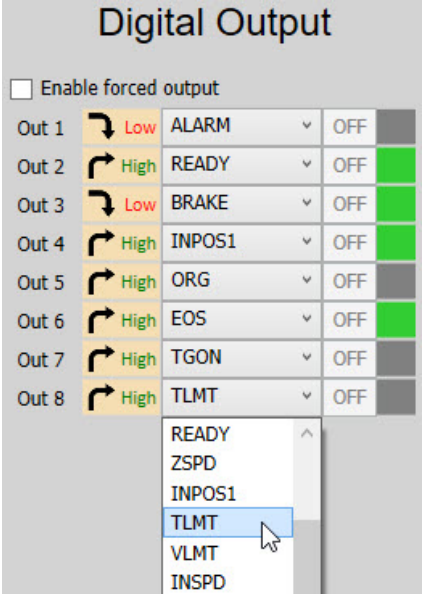
The software provides a very easy way to change the DO functions using the digital output icon (the quickest and easiest method of configuration). Here you can also force the outputs individually by checking the "Enable forced output" check box. Alternatively, you can open the parameter object dictionary using the Object Dictionary menu button or the Object Dictionary icon.

NOTE: When making these changes while the software is connected to the drive the change will take affect immediately, there is no "Are you sure?" warning. Example: Changing the BRAKE output from active low to active high (see the red "Low" and green "High" text in the in the Digital Output image below) will immediately change the physical state of the output.



Digital Output Functions

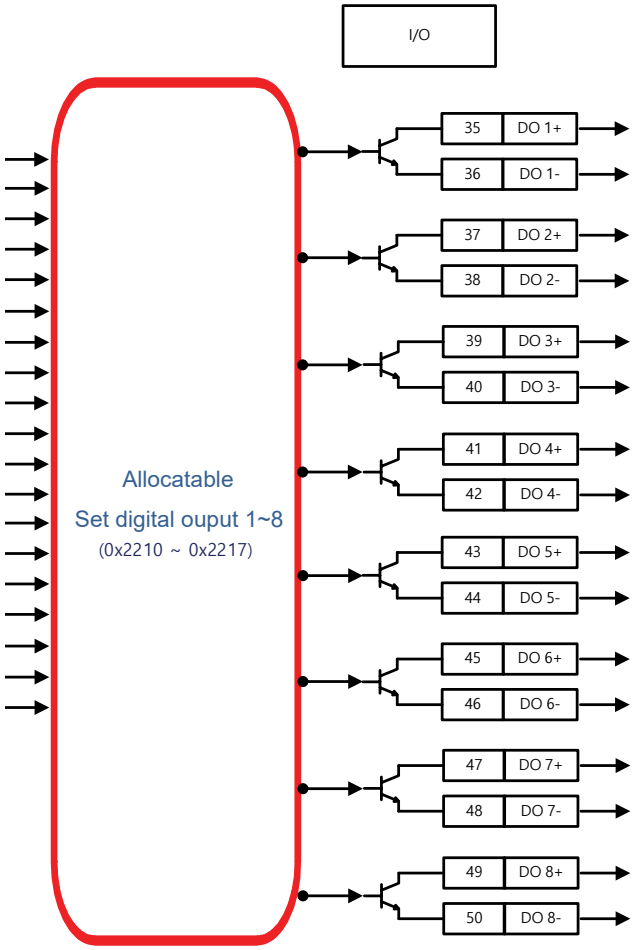
Input	*Parameter Object*	*Default Function*
DO1	0x2210	ALARM
DO2	0x2211	READY
DO3	0x2212	BRAKE
DO4	0x2213	INPOS1
DO5	0x2214	org
DO6	0x2215	EOS
DO7	0x2216	TGON
DO8	0x2217	TLMT



Digital Output Codes

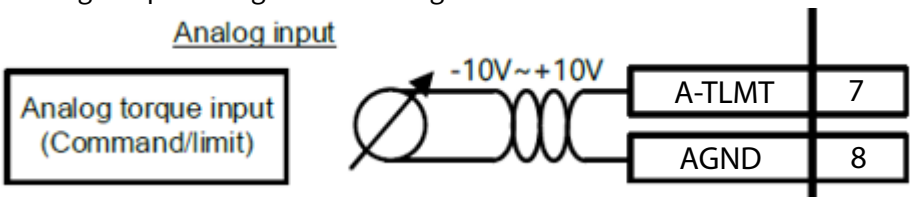
See section 3.5.1 and 11.2 in the user manual for more information about DO codes. Drive CM is the easiest way to edit the DO Codes, including changing the NO and NC settings. Either enter values directly into Parameters 0x2210–0x2217 (Object Dictionary's I/O tab) or use the pulldown lists after selecting the Digital Output icon.

Parameter Setting		Code	Function
NC	NO		
0x8000	0x00	Not assigned	Input not used
0x8001	0x01	BRAKE	Brake- (ON when SVON is off)
0x8002	0x02	ALARM	Servo alarm
0x8003	0x03	RDY	Servo ready
0x8004	0x04	ZSPD	Zero speed reached
0x8005	0x05	INPOS1	Complete position reach 1
0x8006	0x06	TLMT	Limit Torque is enabled
0x8007	0x07	VLMT	Speed Limit is enabled
0x8008	0x08	INSPD	Velocity is reached
0x800b	0x09	WARN	Servo warning
0x800C	0x0A	TGON	Output rotation detection
0x800F	0x0B	INPOS2	Complete position reach 2
0x8010	0x10	ORG	Complete homing
0x8011	0x11	EOS	Complete drive coordinate
0x8012	0x12	IOUT0	Complete drive coordinates 0
0x8013	0x13	IOUT1	Complete drive coordinates 1
0x8014	0x14	IOUT2	Complete drive coordinates 2
0x8015	0x15	IOUT3	Complete drive coordinates 3
0x8016	0x16	IOUT4	Complete drive coordinates 5
0x8017	0x17	IOUT5	Complete drive coordinates 6



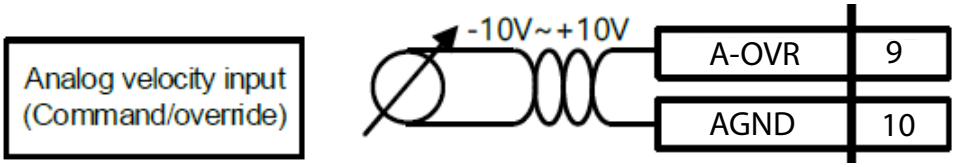
I/O Connection - Analog Torque Input

The L7P drive has an analog -10V -> +10V analog torque signal. This signal can be used as an analog torque command (in Analog Torque Command Mode) or can be used as an analog torque limit in other control modes. Using a FA-DCDC-1 DC-to-DC converter and the ECX2300-10K potentiometer from AutomationDirect is a good option for providing a +10 to -10 volt supply and control signal. See page 61 for Analog Torque configuration settings.



I/O Connection - Analog Velocity Input

The L7P drive has an analog -10V -> +10V analog velocity signal. This signal can be used as an analog velocity command (in Analog Velocity Command Mode) or can be used as an analog velocity override in Index Position mode. Using a FA-DCDC-1 DC-to-DC converter and the ECX2300-10K potentiometer from AutomationDirect is a good option for providing a +10 to -10 volt supply and control signal. See page 53 for Analog Velocity configuration settings.

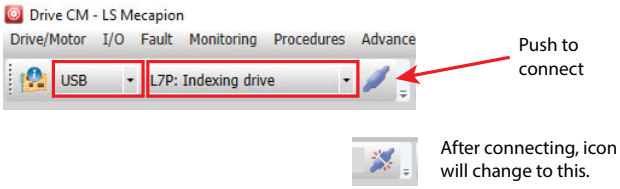
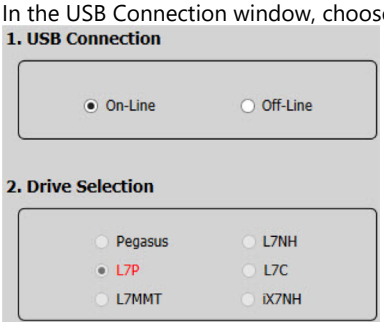
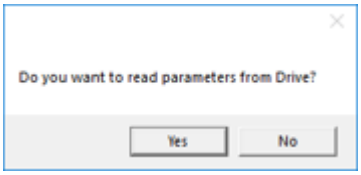


Index Position Mode

Indexing Position Mode using the Setup Wizard for Simple Motion Commissioning

Below is a simple walk through of minimal settings to establish an index application. Other object configuration settings may be required for your specific needs. See the User Manual for details

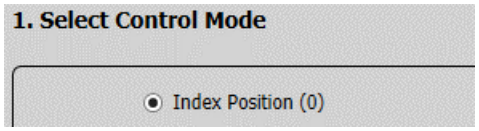
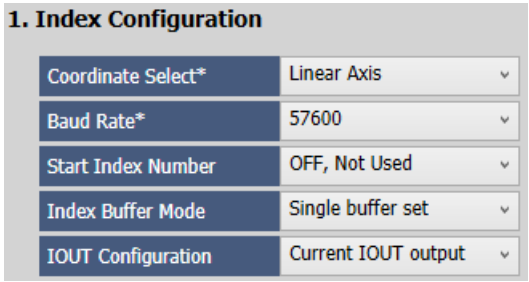
Step 1: Drive Selection

	Substep	Task
Index Mode Step 1	A	Using a standard USB A to USB mini-B cable (such as SV2-PGM-USB15, MOSAIC-CSU, etc.), connect the PC to the Drive.
	B	Start Drive CM software.
	C	Select **L7P: Indexing Drive** and press the **Connect** button. The software should begin to communicate with the drive. A green flashing square should appear in the bottom right corner of the screen indicating comms traffic. 
	D	Click on **Setup Wizard**.
	E	In the USB Connection window, choose **On-Line** and click **Yes** to read parameters from the drive.   If the **On-Line** radio button is not available and greyed out, click on **Setup Wizard** again. This should restart the Setup Wizard and enable the button. Click **On-Line** and **Yes** to read drive parameters.
	F	Click **Next**.

Step 2: Motor/Encoder Selection

	Substep	Task
Index Mode Step 2	A	Select **Auto Setting** for motor selection.
	B	Click **Next**.

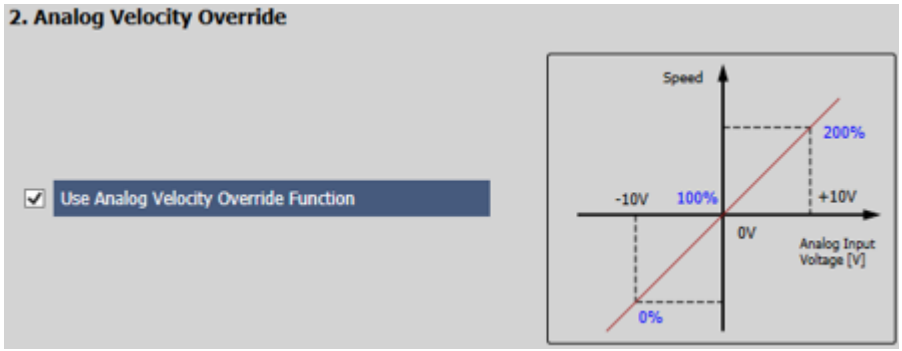
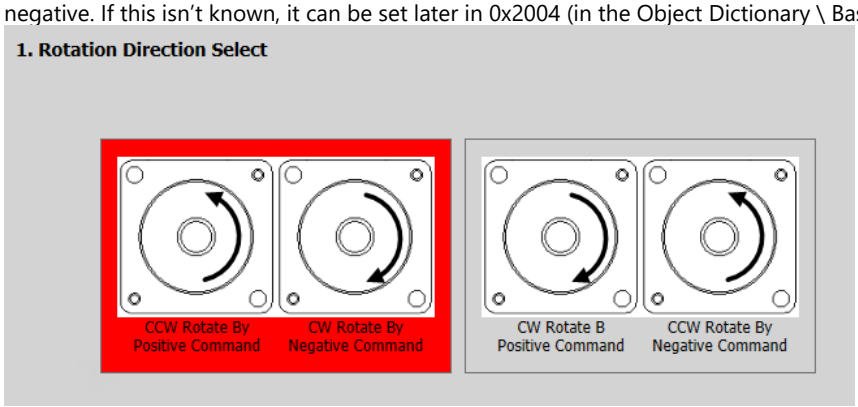
Step 3: Control Mode Selection

	Substep	Task
Index Mode Step 3	A	On the **Select Control Mode** screen, select **Index Position** for Control Mode (Object 0x3000).  Click **Next**.
	B	Select Linear or Rotary axis. **Linear Axis** is selected for this example. (Object 0x3001). 
	C	Set **Baud Rate** (Object 0x3002) as appropriate. This setting does not matter unless you will be communicating RS422/RS485 to the drive from a PLC. Be sure to set the drive's serial address with DIP switch #3 and the rotary switch located beside the LED display. At powerup, these settings overwrite **Node ID** parameter 0x2003 (Object Dictionary \ Basic tab).
	D	Set **Start Index Number** (Object 0x3008). This allows you to select index numbers 0-63 for which index number will be called when the START signal is applied. Setting this parameter to a value of 64 allows you to use the digital inputs for index selection using a binary pattern (ISEL0~ISEL5). Option 64 is selected for this example. *NOTE: The Start Index Number (0x3008) MUST be set to 64 if you want to test different indexes using DriveCM.*
	E	Set **Index Buffer Mode** (Object 0x3009) allows you to trigger the START signal once or twice. In this example, **Single buffer set** is selected. [AutomationDirect advises using **Single buffer set**]
	F	Set **IOUT Configuration** (Object 0x300A). This determines which binary pattern via digital outputs are represented. If **Current IOUT output** is selected and index 3 is executing, IOUT0 and IOUT1 will be active (binary 3). If **Previous IOUT output** is selected and index 3 is being executed, IOUT0 will be inactive and IOUT1 will be active (binary 2).
	G	Click **Next**.

NOTE: This example shows a Linear Axis setup. If you have a Rotary Application, the following settings are critical:

1. *Coordinate Select in step 3B above (0x3001) = Rotary Axis*
2. *E-Gear Numerator (0x6091:1) = 131072 (2^{17} bit encoders); 524,288 (2^{19} bit encoders)*
3. *E-Gear Denominator (0x6091:2) = desired User Units per motor rotation*
4. *Modulo Factor (0x240C) = "Rollover" for the machine. Use Units equal to one machine revolution (i.e. if using a 10:1 gearbox, the Module would be 10x the E-Gear Denominator)*

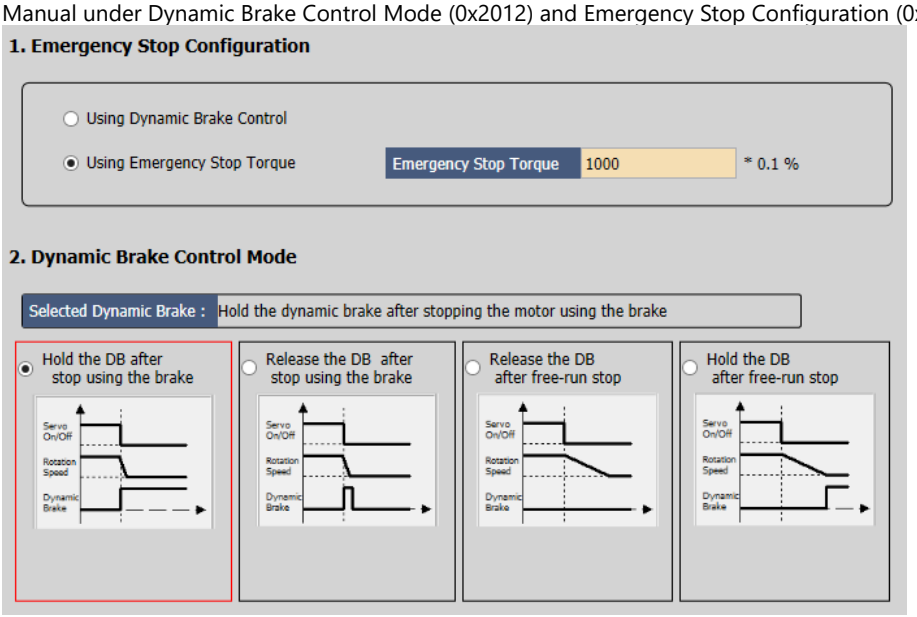
Step 4: Set Analog Velocity Override

	Substep	Task
Index Mode Step 4	A	To slightly adjust or override command speed, select the **Analog Velocity Override Function** (only available in **Index Mode**). This will allow the -10V to +10V analog velocity input scale to override the commanded velocity 0% to 200%. See Section 5.4 in the User Manual for more details about 0x221E and 0x221F. 
	B	Click **Next** to set the **Rotation Direction**. This sets which motor direction is considered positive or negative. If this isn't known, it can be set later in 0x2004 (in the Object Dictionary \ Basic tab). 
	C	Click **Next**.

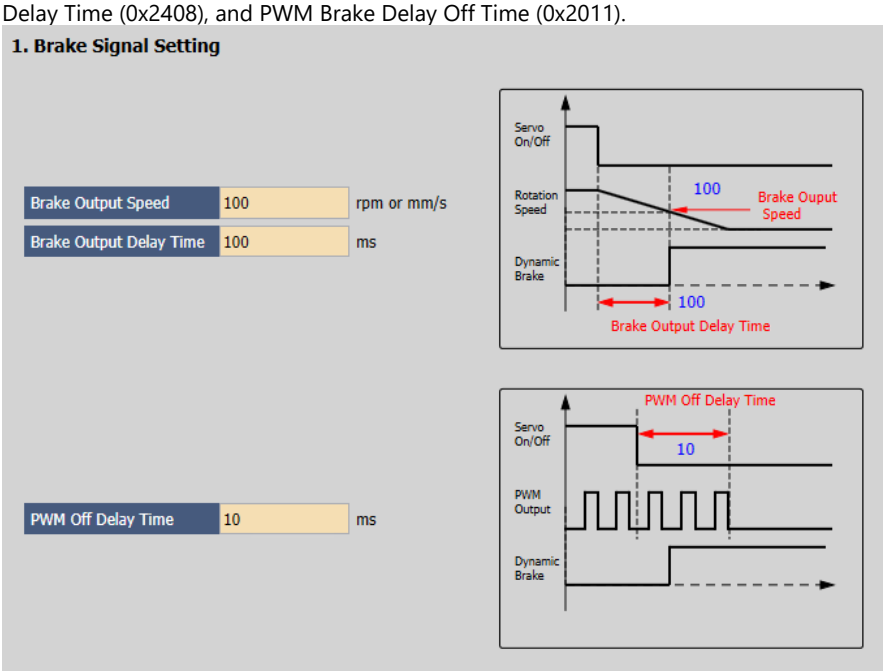
Step 5: Set Electronic Gear Ratio

	Substep	Task
Index Mode Step 5	A	On the Electronic Gear Ratio screen, enter the resolution of the motor's encoder (19-bit=524288 ppr) (Object 6091:1). Also enter the number of pulses (User Units) you want to equal one shaft rotation (Object 6091:2). **1. Electronic Gear Ratio** Electronic Gear Ratio = Motor Resolution 524288 / Shaft Resolution 360
	B	If no gear ratios are changed (all numerators and denominators have default values=1), then a position command of 524288 user units (UU) will result in one motor shaft revolution. This is because the LS APM and APMC motors that are compatible with the L7P drive and sold by Automation Direct have 19 bit serial encoders (19 bits=524288 pulses/rev). To convert this into an easier number to use for positioning adjust the Electronic Gear ratios in step C.
	C	If desired, set the Electronic Gear ratio so that one motor revolution = 360 user units (360 user units/rev will be used later in the Index example). To do this, set the Electronic Gear numerator to the 19-bit encoder value (encoder pulses per motor rev) and set the denominator to your desired User Units/rev. • Set Motor Resolution 0x6091:01 = 524288 (encoder pulses per motor rev) • Set Shaft Revolution 0x6091:01 = 360 (user units per motor rev) Now all Index positions, speeds, accelerations, and decelerations will be referenced in degrees. $\text{Actual Move Distance} = 720 \text{ user units} \times \frac{524288 \text{ encoder pulses}}{\text{motor rev}} \times \frac{1 \text{ motor rev}}{360 \text{ user units}} = 2 \times 524288 \text{ encoder pulses}$ (which is 2 motor revs) **NOTE:** You will probably want more resolution than 360 user units per motor rev. The basic rule of thumb is: • Set Motor Resolution = 524288 • Set Shaft Revolution = your desired pulses per motor rev.
	D	[This step is performed on the same screen with Electronic Gear Ratio] Configure the Encoder Output signal if desired. If the definition isn't known, the Encoder Output can be configured later with Encoder Output Pulse (0x3006) and Encoder Output Mode (0x3007) on the Object Dictionary \ Index tab if Encoder Ouput Mode is set to "Line Drive+Open Collector". These outputs are fixed: DO6=AO, DO7=BO, DO8=ZO (open collector encoder output). **2. Encoder Output Setup** Encoder Output Pulse 10000 Pulse / Resolution Encoder Output Mode Line Drive only
	E	Click **Next**.

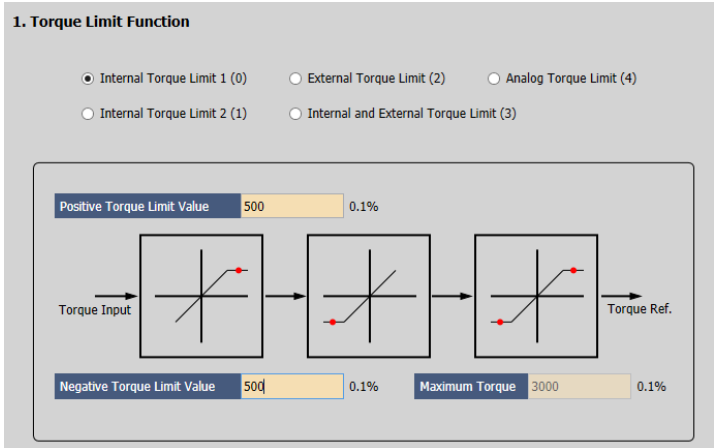
Step 6: Set Emergency Stop and Dynamic Brake Control

	Substep	Task
Index Mode Step 6	A	For initial setup and testing, choose the defaults for these settings on the **Emergency Stop Configuration** and **Dynamic Brake Control Mode** screen. More information can be found in the User Manual under Dynamic Brake Control Mode (0x2012) and Emergency Stop Configuration (0x2013). 
	B	Click **Next**.

Step 7: Set Brake Signal Setting

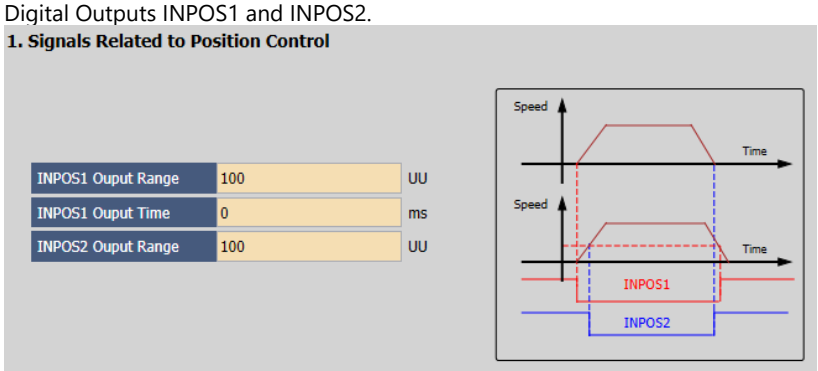
	Substep	Task
Index Mode Step 7	A	For initial setup and testing, choose the defaults for these settings on the **Brake Signal Setting** screen. More information can be found in the User Manual under Brake Output Speed (0x2407), Brake Output Delay Time (0x2408), and PWM Brake Delay Off Time (0x2011). 
	B	Click **Next**.

Step 8: Set the Torque Limit Function

	Substep	Task
Index Mode Step 8	A	Set the **Torque Limit Function**.  Select a method for limiting the torque (0x2110) applied to the load while the motor is trying to attain commanded speed and final position. For initial testing and setup, a value less than max torque is recommended. The above example sets the torque limits to 50% of system **rated** torque. Rated torque is the motor's nameplate torque. These values can be increased after initial commissioning by adjusting 0x60E0 and 0x60E1 in the **Object Dictionary \ CIA 402** tab. Default values are 3000 (300%).
	B	Click **Next**.

Option	Description
Internal Torque Limit 1 (0)	• Uses the value of 0x60E0 as the Fwd direction torque limit • Uses the value of 0x60E1 as the Rev direction torque limit
Internal Torque Limit 2 (1)	Uses a constant 300% of rated motor torque as the Fwd and Rev torque limits
External Torque Limit (2)	• Uses the value of 0x2111 as the Fwd direction torque limit • Uses the value of 0x2112 as the Rev direction torque limit
Internal and External Torque Limit (3)	• Uses the value of 0x60E0 when Digital Input P_CL is on and the value of 0x2111 when Digital Input P_CL is off for the Fwd direction torque limit • Uses the value of 0x60E1 when Digital Input N_CL is on and the value of 0x2112 when Digital Input N_CL is off for the Rev direction torque limit
Analog Torque Limit (4)	Uses the analog value that is supplied to pin 7 of CN1 (A-TLMT)

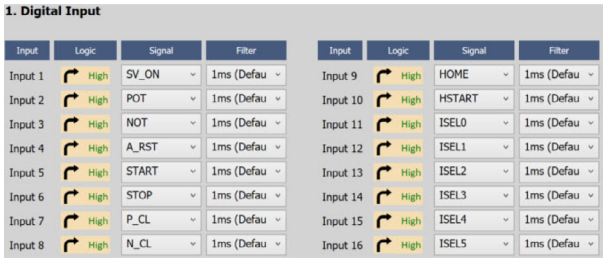
Step 9: Set Signals Related to Position Control

	Substep	Task
Index Mode Step 9	A	Configure the "In Position" signals on the **Signals Related to Position Control** screen if you will use Digital Outputs INPOS1 and INPOS2. 
	B	Click **Next**.

Step 10: Set the I/O Signal Setting

Index Mode Step 10

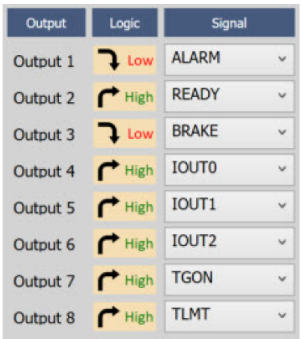
Substep	Task
A	Configure Inputs 1 through 7 as shown below on the **Digital Input** screen. Configure additional inputs as needed for your application. The filter column allows for filtering out EMI and false triggering. 1 millisecond is the default and multiple processor cycles can be added to the filter time. 1 cyle = 125 microseconds.



Below is a binary map of how the Index Select digital inputs can select any of 0–63 indexes using ISEL0 through ISEL5.

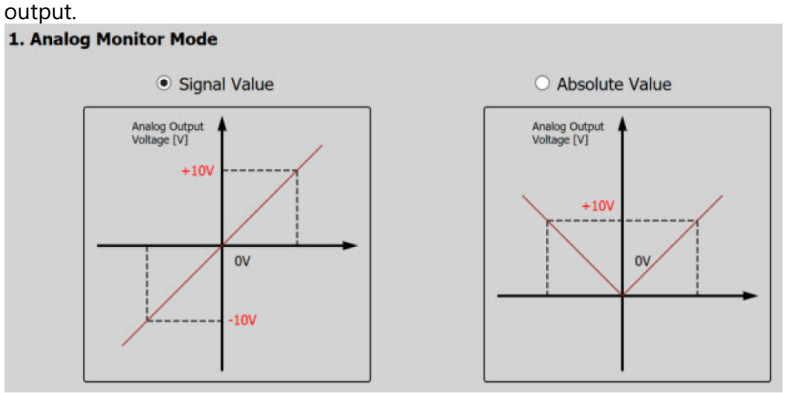
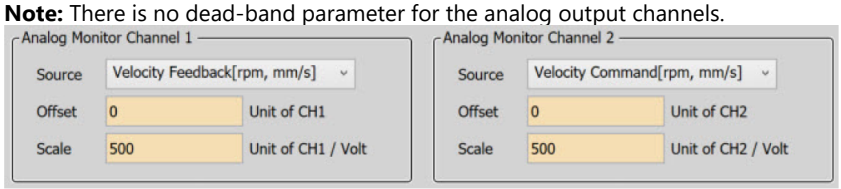
Index No	ISEL Input Signal					
	ISEL5	ISEL4	ISEL3	ISEL2	ISEL1	ISEL0
0	X	X	X	X	X	X
1	X	X	X	X	X	O
2	X	X	X	X	O	X
3	X	X	X	X	O	O
4	X	X	X	O	X	X
...						
60	O	O	O	O	X	X
61	O	O	O	O	X	O
62	O	O	O	O	O	X
63	O	O	O	O	O	O

B	Click **Next** to Go to **Digital Output** in the Setup Wizard.
C	Configure Outputs 1 through 3 as shown below. Configure additional outputs as needed for your application. The IOUT outputs will signal the Index that is currently in operation (in binary code).

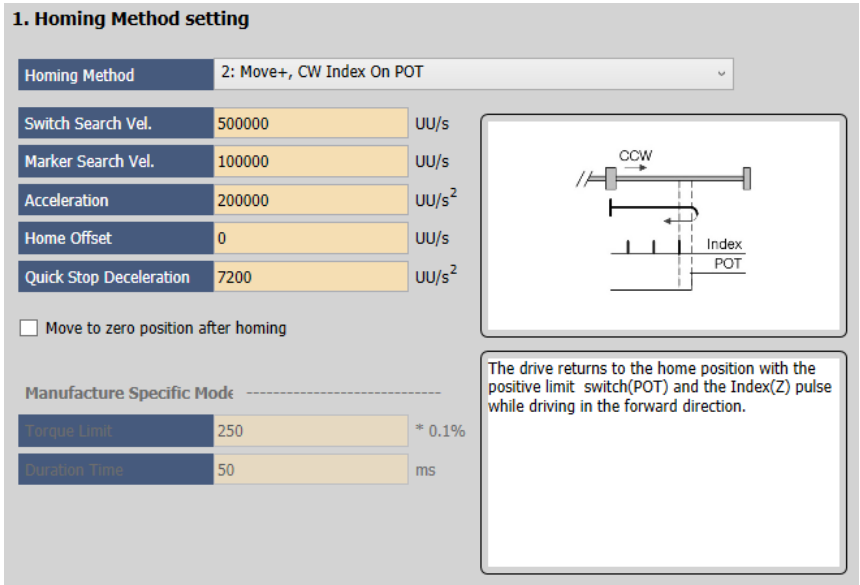


D	Click **Next**.

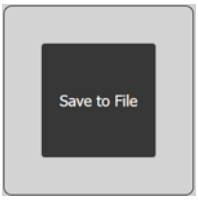
Step 11: Set the Analog Monitor Mode

	Substep	Task
Index Mode Step 11	A	Objects 0x2220–0x2226 are used to configure Ch1 and Ch2 of the analog output monitoring terminals. There are 22 different drive status variables you can monitor using the analog output pins. See section 12.5 in the User Manual for more details. Decide below whether to have the voltage output -10V to +10V or have both positive and negative variable information represented in an absolute (positive only) voltage output. 
	B	Choose what variable (source) you want to monitor. The offset is just the shift, positive (up) or negative (down), from 0 units desired. Next set the scale. This is how many units of the selected variable is represented per 1 volt out of Ch1 or Ch2. Example below would represent 500rpms of the motor for every 1 volt. **Note:** There is no dead-band parameter for the analog output channels. 
	C	Click **Next**.

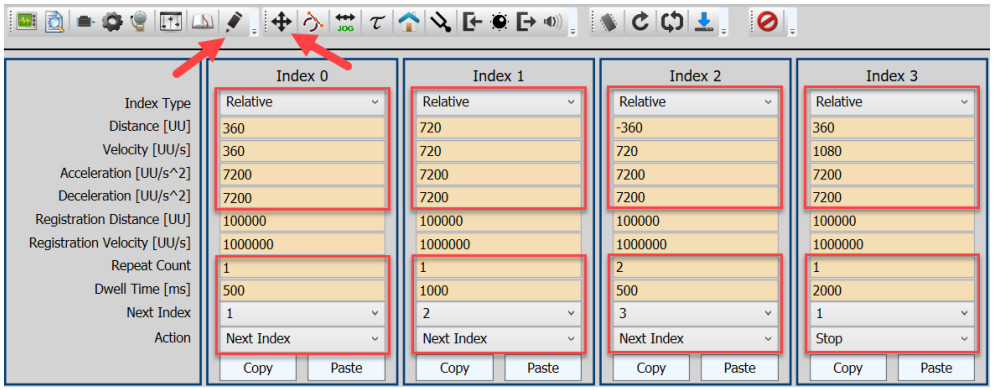
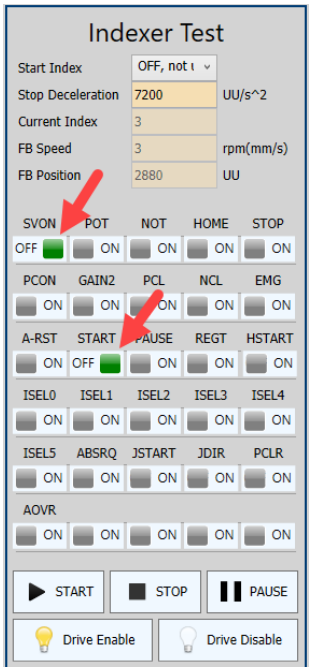
Step 12: Set Homing Method Setting

	Substep	Task
Index Mode Step 12	A	On the **Homing Method Setting** screen, select the Homing method appropriate for your application. For initial setup and testing, choose the defaults for these settings. Refer to Chapter 10 Homing in the User Manual for more details. 
	B	Click **Next**.

Step 13: Save Your Configuration

	Substep	Task
Index Mode Step 13	A	Select **Save to File** to save the configuration file to your PC. 
	B	Select **Write to Drive** to download the configuration to the drive. The drive **MUST NOT** be enabled during download. The software will not acknowledge that certain parameters were not changed, so ensure that the drive is not enabled before pressing **Write to Drive**. This **Write to Drive** button also saves the settings to memory.
	C	After download is complete either power cycle the drive (ensuring the LED display turns off) or click on the **Software Reset** icon in the upper toolbar.

Step 14: Open Index Edit and Index Test Windows

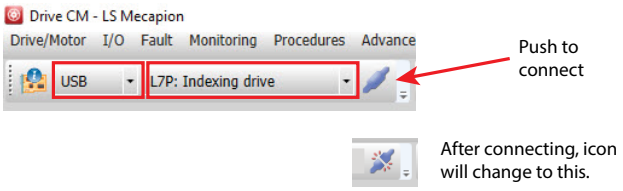
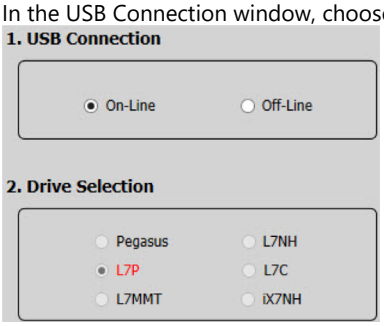
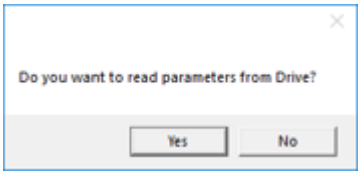
	Substep	Task
Index Mode Step 14	A	Click the **Index Edit** button on the Drive CM toolbar.
	B	Configure Index 0, Index 1, Index 2, and Index 3 per the image below:  After each entry the text will turn red indicating it has not been downloaded to the drive. Press the **Enter** key after typing a new value to write this value to the drive. The value will turn black indicating it has been downloaded. This will only push the value to the drive's RAM (volatile memory). You must still press the **Save Index to EEPROM** button for the settings to survive a power cycle.
	C	Click the **Indexer Test** button on the toolbar. The Indexer Test window will open. 
	D	Switch **SVON** [DI1] to **ON**.
	E	Switch **START** [DI3] to **ON**. Sometimes the START button must be pressed twice to initiate an index.
	F	Index 0 will begin executing (if not, select Start Index = "0" at the top of Indexer Test). As the drive cycles through the index moves you can monitor the current index number in the **Index Tester** window (Current Index) or by viewing the status of IOUT0 through IOUT2.
	G	Index 2 will execute twice (because Repeat Count = 2) and after Index 3 is complete the Index sequence will stop (because Action = Stop). Index Position Mode Commissioning is now complete.

Pulse Input Position Mode

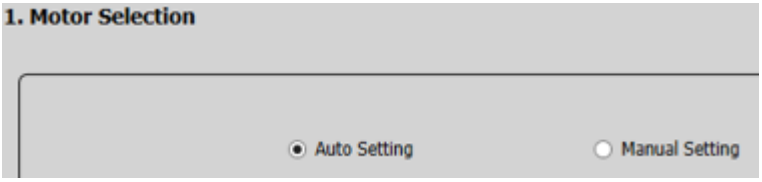
Pulse Input Position Mode Using the Setup Wizard for Simple Motion Commissioning

Below is a simple walkthrough of minimal settings to establish a pulse input controlled application. Other object configuration settings may be required for your specific needs. See the User Manual for details

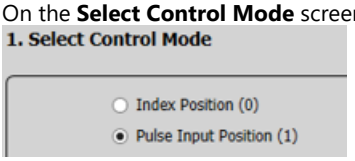
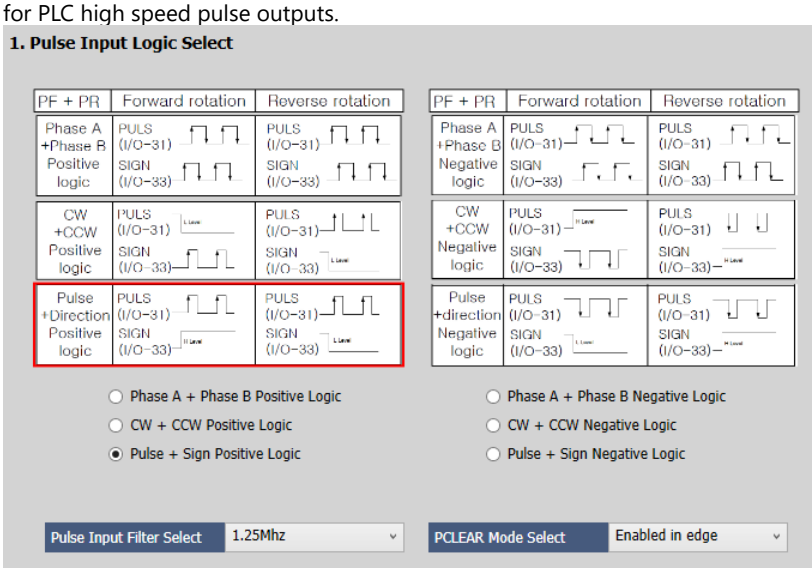
Step 1: Drive Selection

	Substep	Task
Pulse Mode Step 1	A	Using a standard USB A to USB mini-B cable (such as SV2-PGM-USB15, MOSAIC-CSU, etc.), connect the PC to the Drive.
	B	Start Drive CM software.
	C	Select **L7P: Indexing Drive** and press the **Connect** button. The software should begin to communicate with the drive. A green flashing square should appear in the bottom left corner of the screen indicating comms traffic. 
	D	Click on **Setup Wizard**.
	E	In the USB Connection window, choose **On-Line** and click **Yes** to read parameters from the drive.   If the **On-Line** radio button is not available and greyed out, click on **Setup Wizard** again. This should restart the Setup Wizard and enable the button. Click **On-Line** and **Yes** to read drive parameters.
	F	Click **Next**.

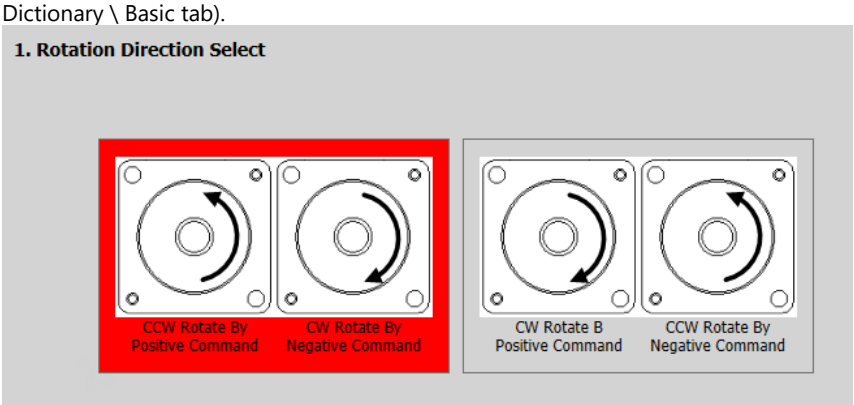
Step 2: Motor/Encoder Selection

	Substep	Task
Pulse Mode Step 2	A	Select **Auto Setting** for motor selection. 
	B	Click **Next**.

Step 3: Control Mode Selection

	Substep	Task
Pulse Mode Step 3	A	On the **Select Control Mode** screen, select **Pulse Input Position (1)** for Control Mode (Object 0x3000).  Click **Next**.
	B	On the **Pulse Input Logic Select** screen, select the type of pulse train you want to use from the host controller or PLC. **Pulse + Sign Positive Logic** is selected in the image below. This is the typical setting for PLC high speed pulse outputs.  For the L7P drive CN1 connector, the pulse inputs terminate as follows: • Pulse (or CW) signal will terminate to pin 31 PF+ and pin 32 PF- • Sign (or CCW) signal will terminate to pin 33 PR+ and pin 34 PR- See section 3.5.6 of the User Manual for more details (and how to connect Open Collector high speed pulses).
	C	For Pulse Input Filter Select and PCLEAR Mode Select, use the default settings for initial setup/testing.
	D	Click **Next**.

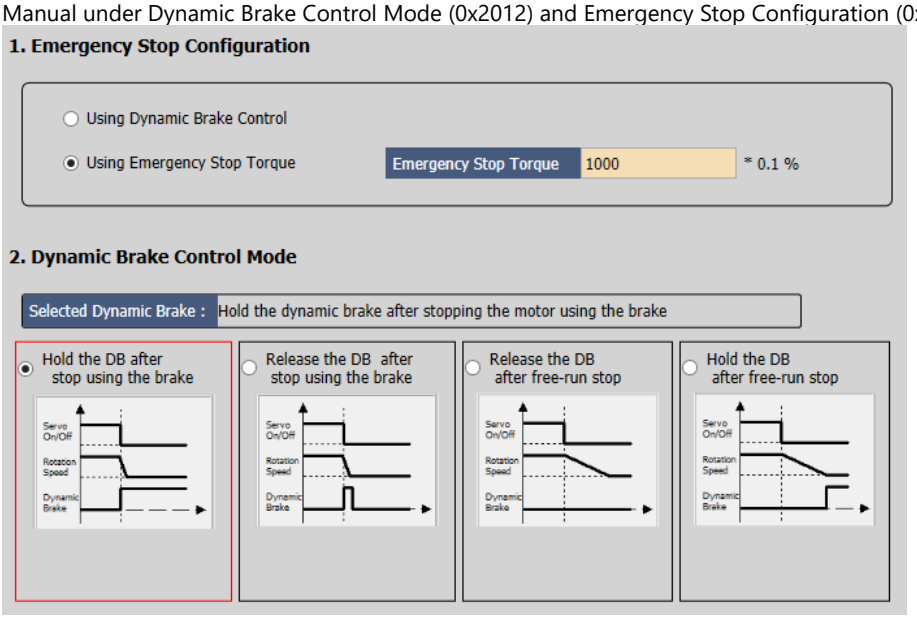
Step 4: Set Rotation Direction

	Substep	Task
Pulse Mode Step 4	A	Set rotation direction on the **Rotation Direction Select** screen. This sets which motor direction is considered positive or negative. If this isn't known, it can be set later in 0x2004 (in the Object Dictionary \ Basic tab). 
	B	Click **Next**.

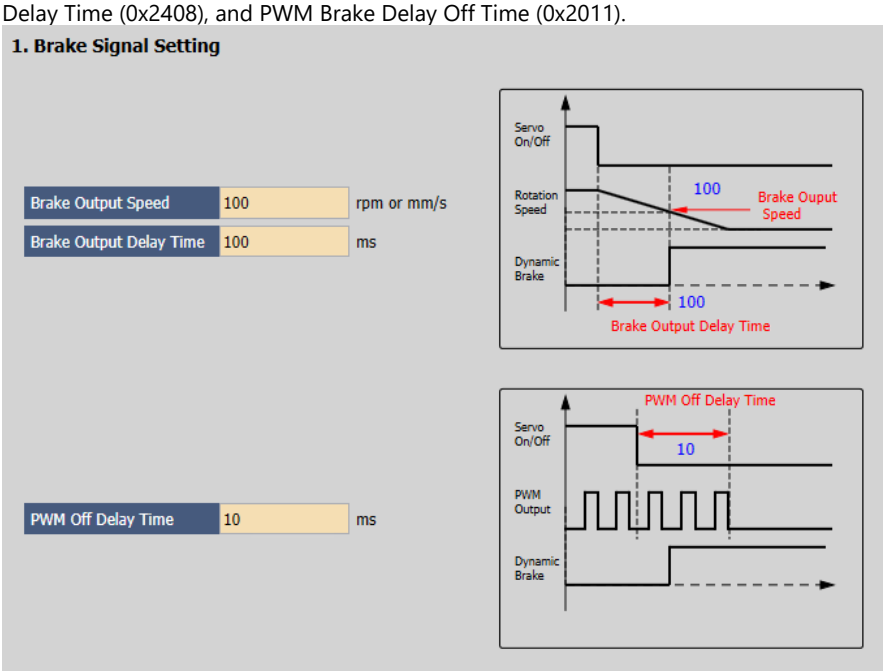
Step 5: Set Electronic Gear Ratio

	Substep	Task
Pulse Mode Step 5	A	On the Electronic Gear Ratio screen, enter the resolution of the motor's encoder (19-bit=524288 ppr) (Object 6091:1). Also enter the number of pulses (User Units) you want to equal one shaft rotation (Object 6091:2). **1. Electronic Gear Ratio** Electronic Gear Ratio = Motor Resolution 524288 / Shaft Resolution 360
	B	If no gear ratios are changed (all numerators and denominators have default values=1), then a position command of 524288 user units (UU) will result in one motor shaft revolution. This is because the LS APM and APMC motors that are compatible with the L7P drive and sold by Automation Direct have 19 bit serial encoders (19 bits=524288 pulses/rev). To convert this into an easier number to use for positioning adjust the Electronic Gear ratios in step C.
	C	If desired, set the Electronic Gear ratio so that one motor revolution = 360 user units (360 user units/rev will be used later in the Index example). To do this, set the Electronic Gear numerator to the 19-bit encoder value (encoder pulses per motor rev) and set the denominator to your desired User Units/rev. • Set Motor Resolution 0x6091:01 = 524288 (encoder pulses per motor rev) • Set Shaft Revolution 0x6091:01 = 360 (user units per motor rev) Now all Index positions, speeds, accelerations, and decelerations will be referenced in degrees. $\text{Actual Move Distance} = 720 \text{ user units} \times \frac{524288 \text{ encoder pulses}}{\text{motor rev}} \times \frac{1 \text{ motor rev}}{360 \text{ user units}} = 2 \times 524288 \text{ encoder pulses}$ (which is 2 motor revs) **NOTE:** You will probably want more resolution than 360 user units per motor rev. The basic rule of thumb is: • Set Motor Resolution = 524288 • Set Shaft Revolution = your desired pulses per motor rev.
	D	[This is located on the same screen with Electronic Gear Ratio] Configure the Encoder Output signal if desired. If the definition isn't known, the Encoder Output can be configured later with Encoder Output Pulse (0x3006) and Encoder Output Mode (0x3007) on the Object Dictionary \ Index tab if Encoder Ouput Mode is set to "Line Drive+Open Collector". These outputs are fixed: DO6=AO, DO7=BO, DO8=ZO (open collector encoder output). **2. Encoder Output Setup** Encoder Output Pulse 10000 Pulse / Resolution Encoder Output Mode Line Drive only
	E	Click **Next**.

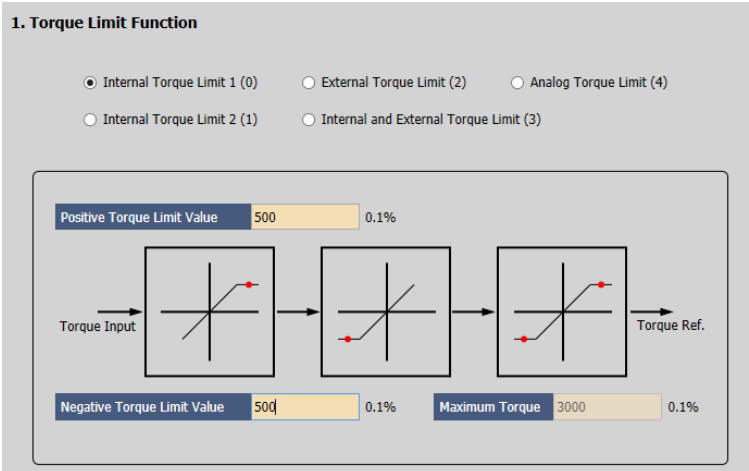
Step 6: Set Emergency Stop and Dynamic Brake Control

	Substep	Task
Pulse Mode Step 6	A	For initial setup and testing, choose the defaults for these settings on the **Emergency Stop Configuration** and **Dynamic Brake Control Mode** screen. More information can be found in the User Manual under Dynamic Brake Control Mode (0x2012) and Emergency Stop Configuration (0x2013). 
	B	Click **Next**.

Step 7: Set Brake Signal Setting

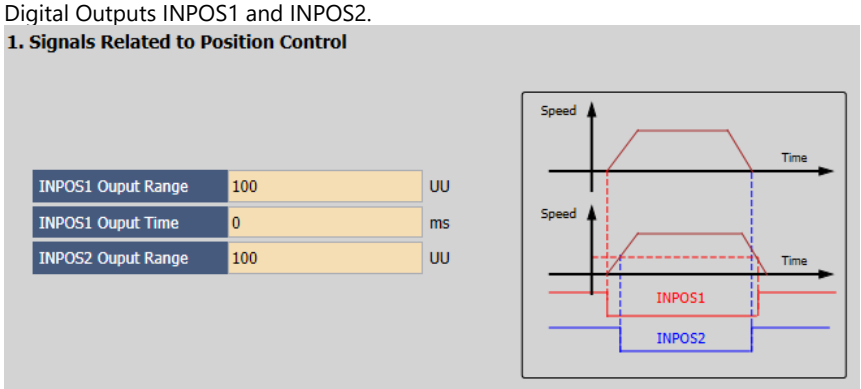
	Substep	Task
Pulse Mode Step 7	A	For initial setup and testing, choose the defaults for these settings on the **Brake Signal Setting** screen. More information can be found in the User Manual under Brake Output Speed (0x2407), Brake Output Delay Time (0x2408), and PWM Brake Delay Off Time (0x2011). 
	B	Click **Next**.

Step 8: Set Torque Limit Function

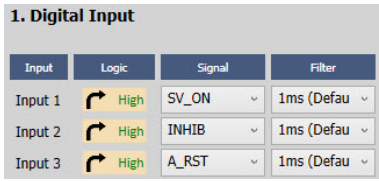
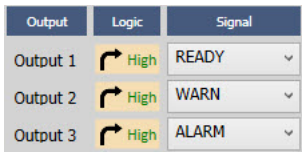
	Substep	Task
Pulse Mode Step 8	A	Set the **Torque Limit Function**.  Select a method for limiting the torque (0x2110) applied to the load while the motor is trying to attain commanded speed and final position. For initial testing and setup, a value less than max torque is recommended. The above example sets the torque limits to 50% of system **rated** torque. These values can be increased after initial commissioning by adjusting 0x60E0 and 0x60E1 in the **Object Dictionary \ Index** tab. Default values are 3000 (300%).
	B	Click **Next**.

Option	Description
Internal Torque Limit 1 (0)	• Uses the value of 0x60E0 as the Fwd direction torque limit • Uses the value of 0x60E1 as the Rev direction torque limit
Internal Torque Limit 2 (1)	Uses a constant 300% of rated motor torque as the Fwd and Rev torque limits
External Torque Limit (2)	• Uses the value of 0x2111 as the Fwd direction torque limit • Uses the value of 0x2112 as the Rev direction torque limit
Internal and External Torque Limit (3)	• Uses the value of 0x60E0 when Digital Input P_CL is on and the value of 0x2111 when Digital Input P_CL is off for the Fwd direction torque limit • Uses the value of 0x60E1 when Digital Input N_CL is on and the value of 0x2112 when Digital Input N_CL is off for the Rev direction torque limit
Analog Torque Limit (4)	Uses the analog value that is supplied to pin 7 of CN1 (A-TLMT)

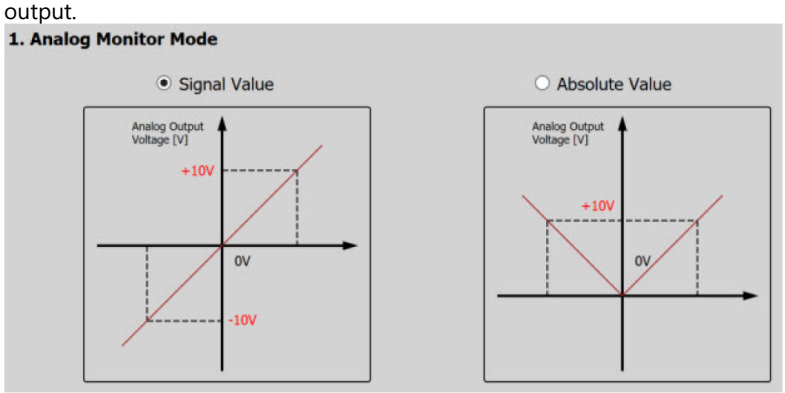
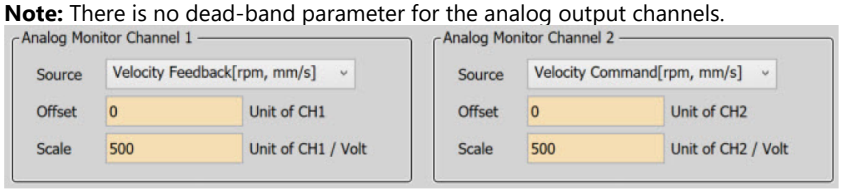
Step 9: Set Signals Related to Position Control

	Substep	Task
Pulse Mode Step 9	A	On the **Signals Related to Position Control** screen, configure the "In Position" signals if you will use Digital Outputs INPOS1 and INPOS2. 
	B	Click **Next**.

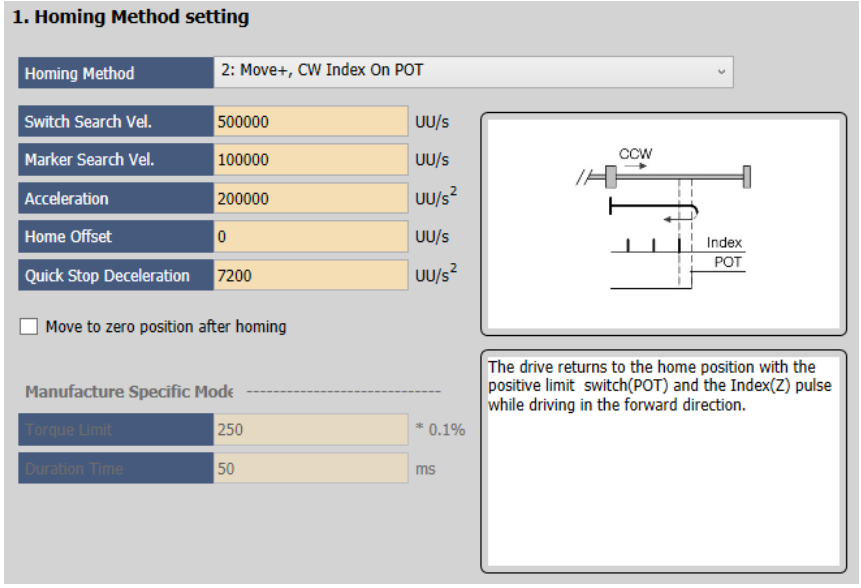
Step 10: Set the I/O Signal Setting

	Substep	Task
Pulse Mode Step 10	A	On the **Digital Input** screen, configure Inputs 1 through 5 as shown below. Configure additional inputs as needed for your application. The filter column allows for filtering out EM and false triggering. 1 millisecond is the default and multiple processor cycles can be added to the filter time. 1 cyle = 125 microseconds. 
	B	Click **Next** to go to **Digital Output** in the Setup Wizard.
	C	Configure Outputs 1 through 3 as shown below. Configure additional outputs as needed for your application. 
	D	Click **Next**.

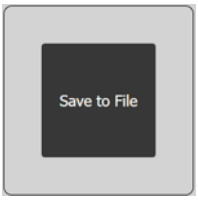
Step 11: Set the Analog Monitor Mode

	Substep	Task
Pulse Mode Step 11	A	Objects 0x2220–0x2226 are used to configure Ch1 and Ch2 of the analog output monitoring terminals. There are 22 different drive status variables you can monitor using the analog output pins. See section 12.5 in the User Manual for more details. Decide below whether to have the voltage output -10V to +10V or have both positive and negative variable information represented in an absolute (positive only) voltage output. 
	B	Choose what variable (source) you want to monitor. The offset is just the shift, positive (up) or negative (down), from 0 units desired. Next set the scale. This is how many units of the selected variable is represented per 1 volt out of Ch1 or Ch2. Example below would represent 500rpms of the motor for every 1 volt. **Note:** There is no dead-band parameter for the analog output channels. 
	C	Click **Next**.

Step 12: Set Homing Method Setting

	Substep	Task
Pulse Mode Step 12	A	On the **Homing Method Setting** screen, select the Homing method appropriate for your application. For initial setup and testing, choose the defaults for these settings. Refer to Chapter 10 Homing in the User Manual for more details. 
	B	Click **Next**.

Step 13: Save Your Configuration

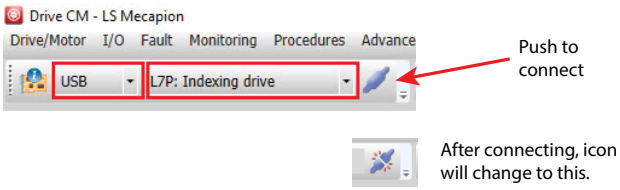
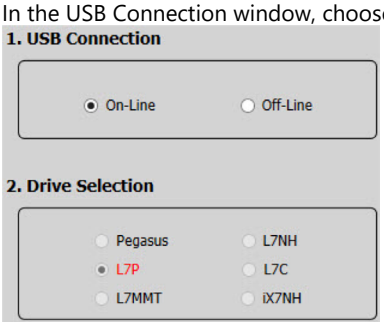
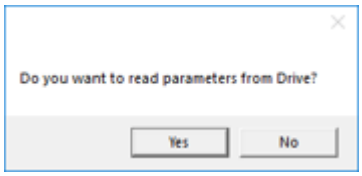
	Substep	Task
Pulse Mode Step 13	A	Select **Save to File** to save the configuration file to your PC. 
	B	Select **Write to Drive** to download the configuration to the drive. The drive **MUST NOT** be enabled during download. The software will not acknowledge that certain parameters were not changed, so ensure that the drive is not enabled before pressing **Write to Drive**. This **Write to Drive** button also saves the settings to memory.
	C	After download is complete either power cycle the drive (ensuring the LED display turns off) or click on the **Software Reset** icon in the upper toolbar.
	D	Pulse Input Position Mode Commissioning is now complete.

Velocity Mode

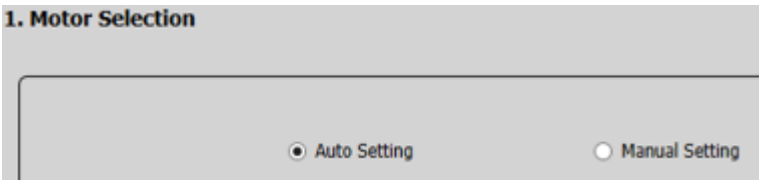
Velocity Mode (Speed Command) using the Setup Wizard for Simple Motion Commissioning

Below is a simple walk through of minimal settings to establish a speed application with a variable torque limit. Other object configuration settings may be required for your specific needs. See the user manual for details. The example below will allow the application to select between 8 preset speeds (saved in the drive) and/or the analog speed input. The changes are made by toggling 3 digital inputs: SPD1, SPD2, SPD3.

Step 1: Drive Selection

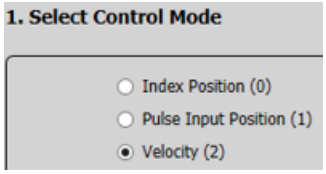
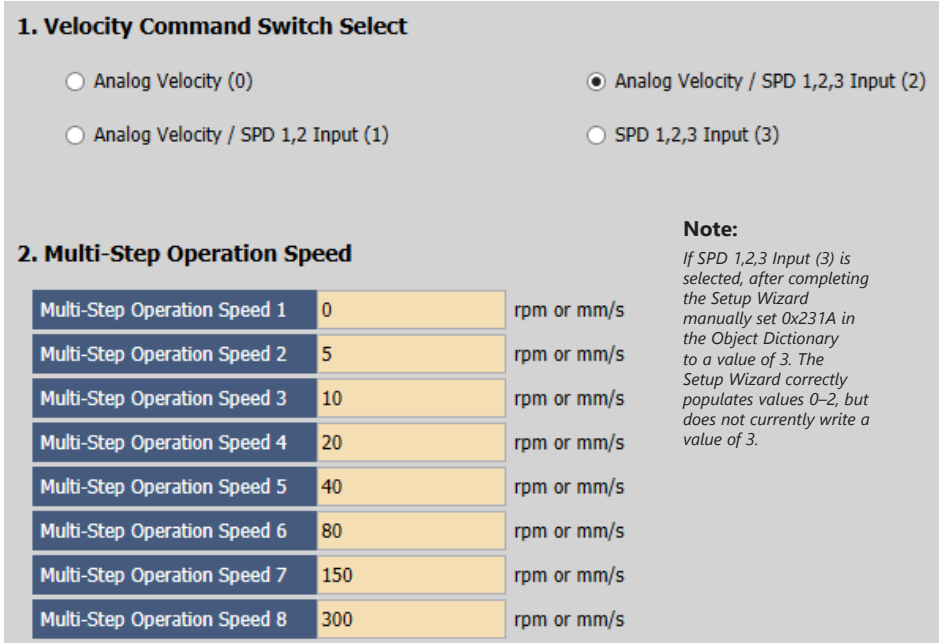
	Substep	Task
Velocity Mode Step 1	A	Using a standard USB A to USB mini-B cable (such as SV2-PGM-USB15, MOSAIC-CSU, etc.), connect the PC to the Drive.
	B	Start Drive CM software.
	C	Select **L7P: Indexing Drive** and press the **Connect** button. The software should begin to communicate with the drive. A green flashing square should appear in the bottom right corner of the screen indicating comms traffic. 
	D	Click on **Setup Wizard**.
	E	In the USB Connection window, choose **On-Line** and click **Yes** to read parameters from the drive.   If the **On-Line** radio button is not available and greyed out, click on **Setup Wizard** again. This should restart the Setup Wizard and enable the button. Click **On-Line** and **Yes** to read drive parameters.
	F	Click **Next**.

Step 2: Motor/Encoder Selection

	Substep	Task
Velocity Mode Step 2	A	Select **Auto Setting** for motor selection. 
	B	Click **Next**.

Step 3: Control Mode Selection

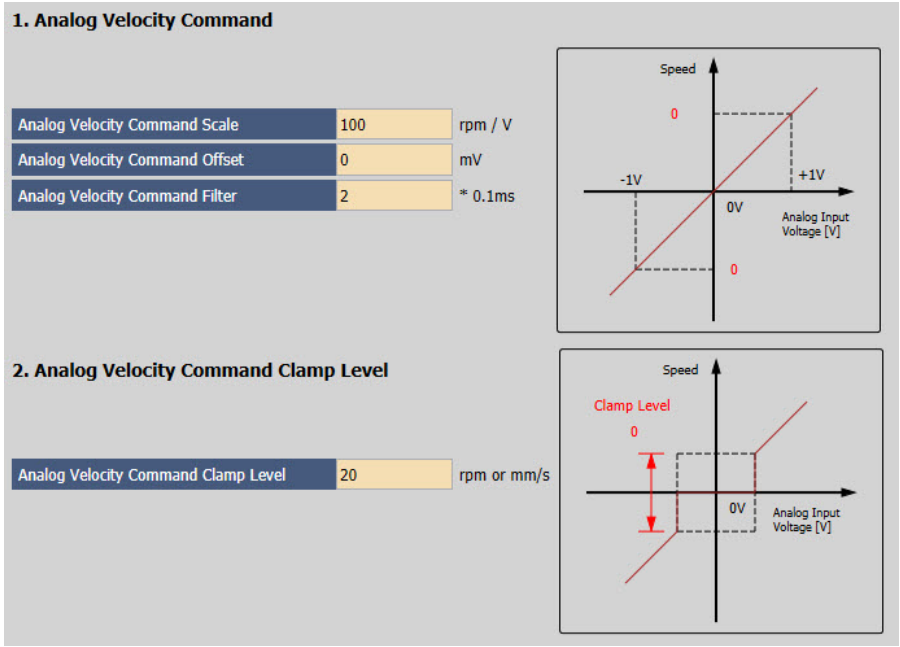
Velocity Mode Step 3

Substep	Task
A	On the **Select Control Mode** screen, select **Velocity (2)** for Control Mode (Object 0x3000).  Click **Next**.
B	On the **Velocity Command Switch Select** screen, select the desired velocity command. In the example below, **Analog Velocity/SPD1, SPD2, SPD3 Input (2)** (Object 0x231A) is selected. This will allow you to have seven predefined speeds selectable via DI and one analog input for variable speed control. 
C	Enter the desired values for the speed registers. Speed register 1 is recommended to be 0 so there is at least one consistent 0 speed command with holding torque. See the table below for the relationship between SPD1, SPD2, SPD3, Analog Input SPDCOM, and the command velocity.

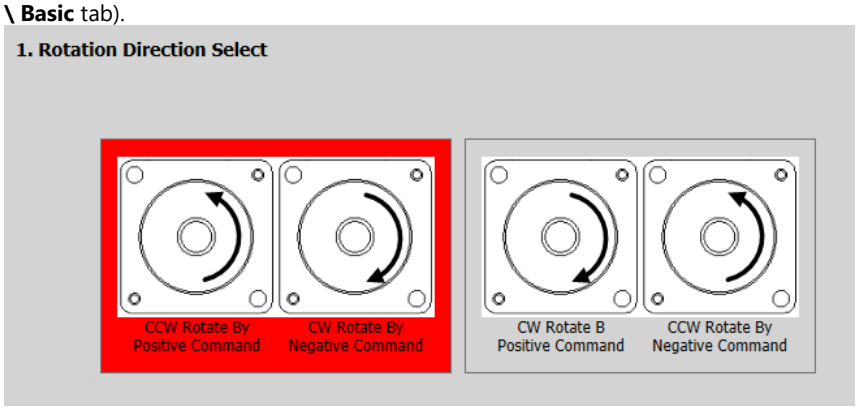
Setting Values	Setting Details	SPD1	SPD2	SPD3	Speed Command
0	Use analog velocity commands.	n/a	n/a	n/a	Analog Input
1	Use SPD1, SPD2 contact and analog velocity commands.	OFF	OFF	n/a	Speed 1 - 0x2312
		ON	OFF	n/a	Speed 2 - 0x2313
		OFF	ON	n/a	Speed 3 - 0x2314
		ON	ON	n/a	Analog input
2	Use SPD1, SPD2, and SPD3 contact and analog velocity commands.	OFF	OFF	OFF	0x2312
		ON	OFF	OFF	0x2313
		OFF	ON	OFF	0x2314
		ON	ON	OFF	0x2315
		OFF	OFF	ON	0x2316
		ON	OFF	ON	0x2317
		OFF	ON	ON	0x2318
		ON	ON	ON	Analog input
3	Use velocity commands for SPD1, SPD2, and SPD3 contact.	OFF	OFF	OFF	0x2312
		ON	OFF	OFF	0x2313
		OFF	ON	OFF	0x2314
		ON	ON	OFF	0x2315
		OFF	OFF	ON	0x2316
		ON	OFF	ON	0x2317
		OFF	ON	ON	0x2318
		ON	ON	ON	0x2319

D	Click **Next**.

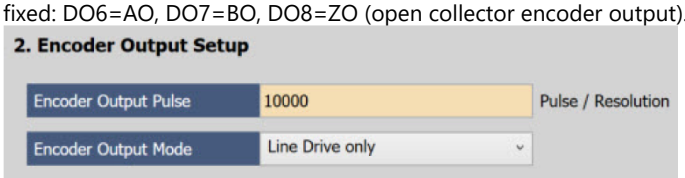
Step 4: Set Analog Velocity Command and Clamp Level

	Substep	Task
Velocity Mode Step 4	A	Set the **Analog Velocity Command Scale** (Object 0x2229). The analog signal is set for +/-10V = +/-1000rpm (100rpm/V x 10V). For initial testing and setup, leave these settings at default values. If your application needs different scaling, adjust these settings. For more information, see 0x2227–0x222A in the User Manual. 
	C	Set the **Analog Velocity Command Clamp Level** (Object 0x222A). This is the same as a deadband. The value entered here will cause the shaft speed to remain at 0 RPMs until the analog speed command is above 20 RPMs.
	D	Click **Next**.

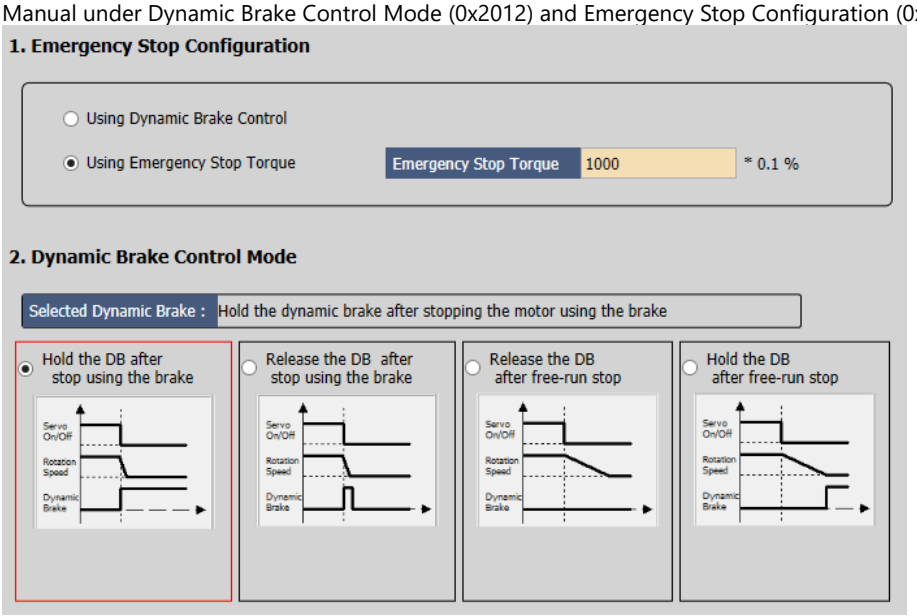
Step 5: Set Rotation Direction

	Substep	Task
Velocity Mode Step 5	A	Set rotation direction on the **Rotation Direction Select** screen. This sets which motor direction is considered positive or negative. If this isn't known, it can be set later in 0x2004 (in the **Object Dictionary \ Basic** tab). 
	B	Click **Next**.

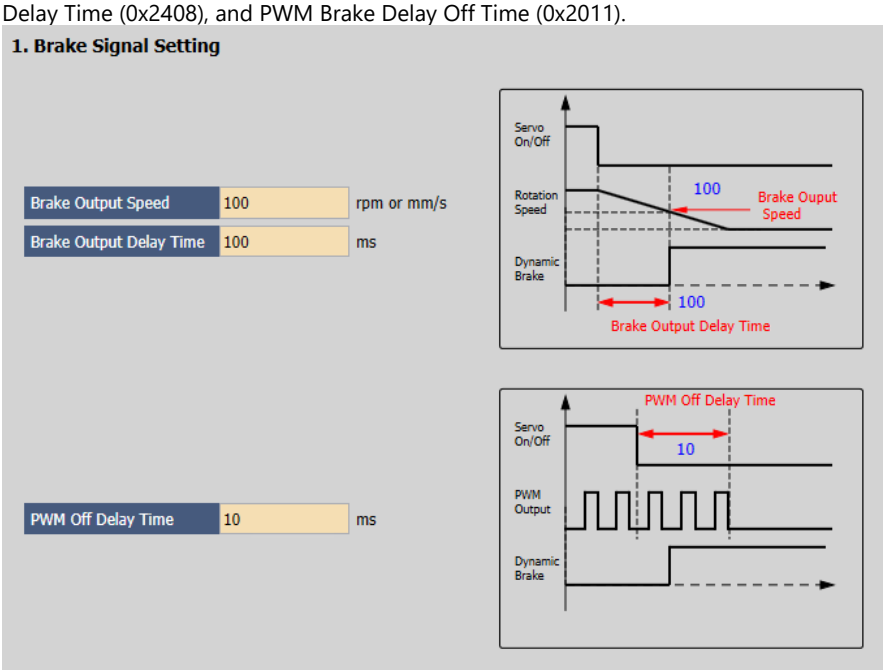
Step 6: Set Electronic Gear Ratio

	Substep	Task
Velocity Mode Step 6	A	Leave the Electronic Gear Ratio settings at default values. They have no affect on Velocity Mode.
	B	[This step is performed on the same screen as Electronic Gear Ratio]. Configure the Encoder Output signal if desired. If the definition isn't known, the Encoder Output can be configured later with Encoder Output Pulse (0x3006) and Encoder Output Mode (0x3007) on the Object Dictionary \ Index tab if Encoder Ouput Mode is set to "Line Drive+Open Collector". These outputs are fixed: DO6=AO, DO7=BO, DO8=ZO (open collector encoder output). 
	C	Click **Next**.

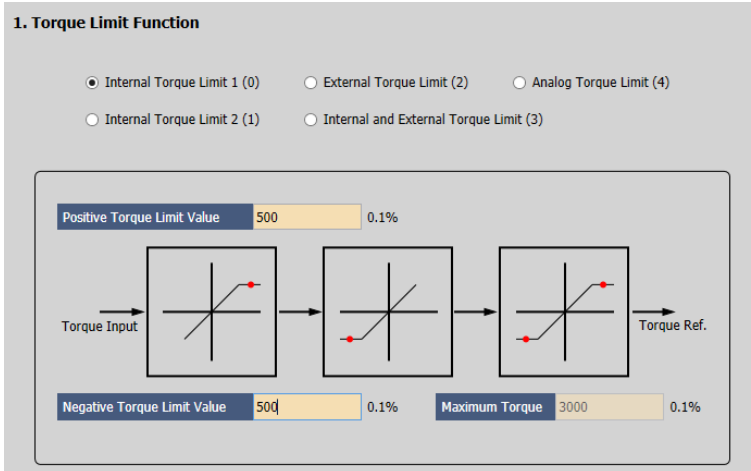
Step 7: Set Emergency Stop and Dynamic Brake Control

	Substep	Task
Velocity Mode Step 7	A	For initial setup and testing, choose the defaults for these settings on the **Emergency Stop Configuration** and **Dynamic Brake Control Mode** screen. More information can be found in the User Manual under Dynamic Brake Control Mode (0x2012) and Emergency Stop Configuration (0x2013). 
	B	Click **Next**.

Step 8: Set Brake Signal Setting

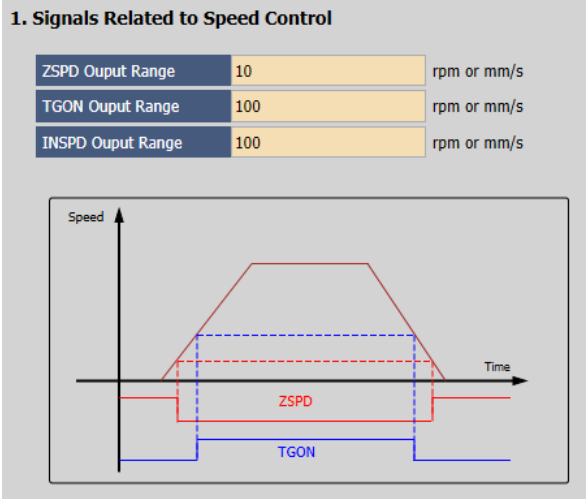
	Substep	Task
Velocity Mode Step 8	A	For initial setup and testing, choose the defaults for these settings on the **Brake Signal Setting** screen. More information can be found in the User Manual under Brake Output Speed (0x2407), Brake Output Delay Time (0x2408), and PWM Brake Delay Off Time (0x2011). 
	B	Click **Next**.

Step 9: Set Torque Limit Function

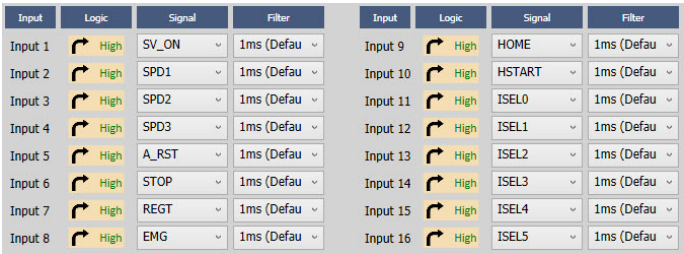
	Substep	Task
Velocity Mode Step 9	A	Set the **Torque Limit Function**.  Select a method for limiting the torque (0x2110) applied to the load while the motor is trying to attain commanded speed. For initial testing and setup, a value less than max torque is recommended. The above example sets the torque limits to 50% of system rated torque. These values can be increased after initial commissioning by adjusting 0x60E0 and 0x60E1 in the **Object Dictionary \ Index** tab. Default values are 3000 (300%).
	B	Click **Next**.

Option	Description
Internal Torque Limit 1 (0)	• Uses the value of 0x60E0 as the Fwd direction torque limit • Uses the value of 0x60E1 as the Rev direction torque limit
Internal Torque Limit 2 (1)	Uses a constant 300% of rated motor torque as the Fwd and Rev torque limits
External Torque Limit (2)	• Uses the value of 0x2111 as the Fwd direction torque limit • Uses the value of 0x2112 as the Rev direction torque limit
Internal and External Torque Limit (3)	• Uses the value of 0x60E0 when Digital Input P_CL is on and the value of 0x2111 when Digital Input P_CL is off for the Fwd direction torque limit • Uses the value of 0x60E1 when Digital Input N_CL is on and the value of 0x2112 when Digital Input N_CL is off for the Rev direction torque limit
Analog Torque Limit (4)	Uses the analog value that is supplied to pin 7 of CN1 (A-TLMT)

Step 10: Set Signals Related to Speed Control

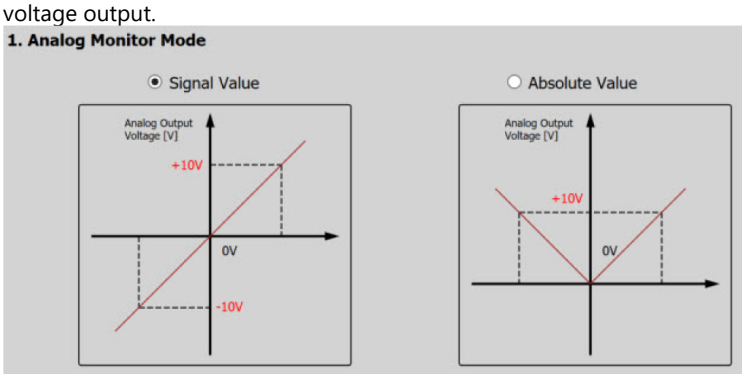
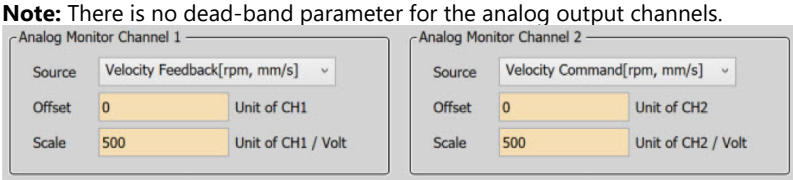
	Substep	Task
Velocity Mode Step 10	A	On the **Signals Related to Speed Control** screen, configure the speed output ranges that will trigger the digital outputs ZSPD, TGON, and INSPD. For initial testing and setup, these can be left as default. For more information, see section 11.4.3 Signals Related with Speed Control in the User Manual. To adjust these values later, see ZSPD (0x2404), TGON (0x2405), and INSPD (0x2406) in the **Object Dictionary \ Misc.** tab. 
	B	Click **Next**.

Step 11: Set the I/O Signal Setting

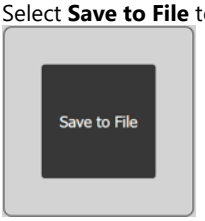
	Substep	Task
Velocity Mode Step 11	A	On the **Digital Input** screen, configure Inputs 1 through 4 as shown below. Configure additional inputs and outputs as needed for your application. The filter column allows for filtering out EMI and false triggering. 1 millisecond is the default and multiple processor cycles can be added to the filter time. 1 cycle =125 microseconds. 
	B	Click **Next** to configure Digital Outputs. For initial setup and testing, these values can be left at defaults. For more information, see Section 3.5.1 Names and Functions of Digital Input/Output Signals in the User Manual.
	C	Click **Next**.

Input	Logic	Signal	Filter	Input	Logic	Signal	Filter
Input 1	High	SV_ON	1ms (Defau	Input 9	High	HOME	1ms (Defau
Input 2	High	SPD1	1ms (Defau	Input 10	High	HSTART	1ms (Defau
Input 3	High	SPD2	1ms (Defau	Input 11	High	ISEL0	1ms (Defau
Input 4	High	SPD3	1ms (Defau	Input 12	High	ISEL1	1ms (Defau
Input 5	High	A_RST	1ms (Defau	Input 13	High	ISEL2	1ms (Defau
Input 6	High	STOP	1ms (Defau	Input 14	High	ISEL3	1ms (Defau
Input 7	High	REGT	1ms (Defau	Input 15	High	ISEL4	1ms (Defau
Input 8	High	EMG	1ms (Defau	Input 16	High	ISEL5	1ms (Defau

Step 12: Set the Analog Monitor Mode

	Substep	Task
Velocity Mode Step 12	A	Objects 0x2220–0x2226 are used to configure Ch1 and Ch2 of the analog output monitoring terminals. There are 22 different drive status variables you can monitor using the analog output pins. See section 12.5 in the User Manual for more details. Decide below whether to have the voltage output -10V to +10V or have both positive and negative variable information represented in an absolute (positive only) voltage output. 
	B	Choose what variable (source) you want to monitor. The offset is just the shift, positive (up) or negative (down), from 0 units desired. Next set the scale. This is how many units of the selected variable is represented per 1 volt out of Ch1 or Ch2. Example below would represent 500rpms of the motor for every 1 volt. **Note:** There is no dead-band parameter for the analog output channels. 
	C	Click **Next**.

Step 13: Save Your Configuration

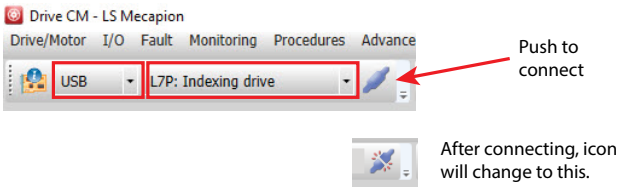
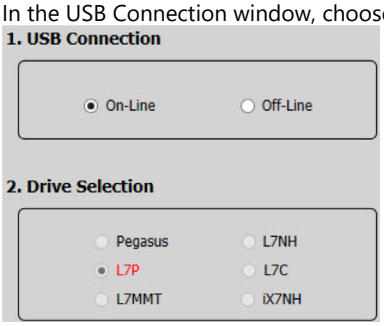
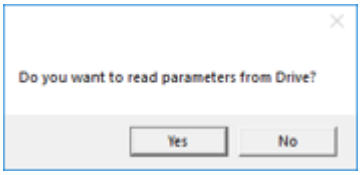
	Substep	Task
Velocity Mode Step 13	A	Select **Save to File** to save the configuration file to your PC. 
	B	Select **Write to Drive** to download the configuration to the drive. The drive **MUST NOT** be enabled during download. The software will not acknowledge that certain parameters were not changed, so ensure that the drive is not enabled before pressing **Write to Drive**. This **Write to Drive** button also saves the settings to memory.
	C	After download is complete either power cycle the drive (ensuring the LED display turns off) or click on the **Software Reset** icon in the upper toolbar.
	D	Velocity Mode Commissioning is now complete.

Torque Mode

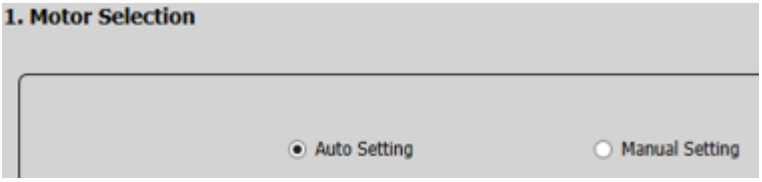
Torque Mode Using the Setup Wizard for Simple Motion Commissioning

Below is a simple walk through of minimal settings to establish a variable torque application with a variable speed limit. Other object configuration settings may be required for your specific needs. See the User Manual for details.

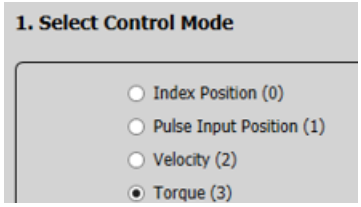
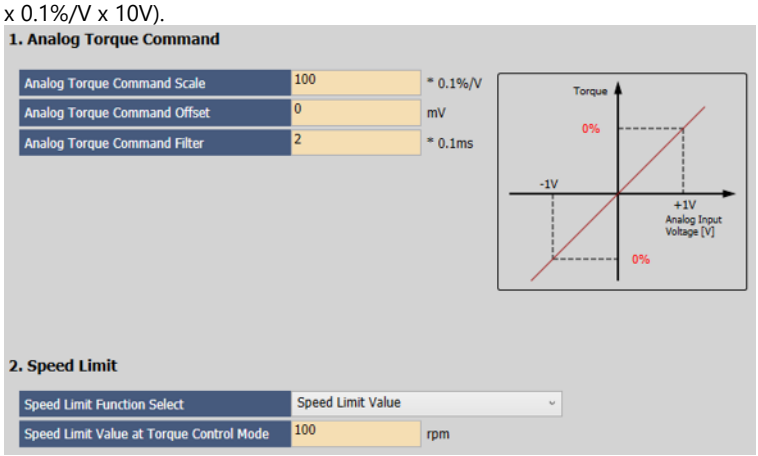
Step 1: Drive Selection

	Substep	Task
Torque Mode Step 1	A	Using a standard USB A to USB mini-B cable (such as SV2-PGM-USB15, MOSAIC-CSU, etc.), connect the PC to the Drive.
	B	Start Drive CM software.
	C	Select **L7P: Indexing Drive** and press the **Connect** button. The software should begin to communicate with the drive. A green flashing square should appear in the bottom right corner of the screen indicating comms traffic. 
	D	Click on **Setup Wizard**.
	E	In the USB Connection window, choose **On-Line** and click **Yes** to read parameters from the drive.   If the **On-Line** radio button is not available and greyed out, click on **Setup Wizard** again. This should restart the Setup Wizard and enable the button. Click **On-Line** and **Yes** to read drive parameters.
	F	Click **Next**.

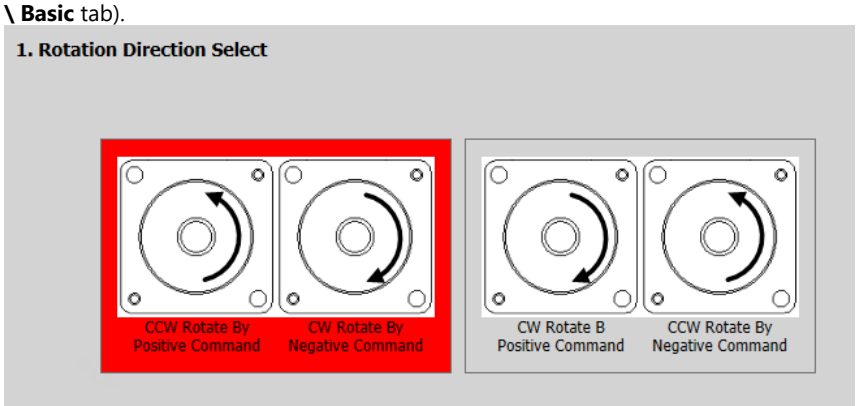
Step 2: Motor/Encoder Selection

	Substep	Task
Torque Mode Step 2	A	Select **Auto Setting** for motor selection. 
	B	Click **Next**.

Step 3: Control Mode Selection

	Substep	Task
Torque Mode Step 3	A	On the **Select Control Mode** screen, select **Torque (3)** for Control Mode (Object 0x3000).  Click **Next**.
	B	Set the **Analog Torque Command Scale** (Object 0x221C). This is how much rated torque you want the motor to output at every volt increment when using the analog input. The analog input has a rated voltage swing of -10VDC to +10VDC. The example below will output 100% torque at +10VDC input (100 x 0.1%/V x 10V). 
	C	Set the **Speed Limit Function Select** dropdown to **Speed Limit Value**.
	D	Enter a **Speed Limit Value at Torque Control Mode** (Object 0x230E). In torque mode the motor will continue to spin faster and faster until the commanded torque is reached. Without a proper speed limit, the motor may reach dangerous speeds depending on your application. The default value is 1000RPM. For initial testing and setup, a smaller value is recommended (100RPM). The 0x230E value can be changed later in the **Object Dictionary**. For more information, see Section 3.5 "Torque Operation" and Chapter 8 "Torque Control" in the User Manual.
	E	Click **Next**.

Step 4: Set Rotation Direction

	Substep	Task
Torque Mode Step 5	A	Set rotation direction on the **Rotation Direction Select** screen. This sets which motor direction is considered positive or negative. If this isn't known, it can be set later in 0x2004 (in the **Object Dictionary \ Basic** tab). 
	B	Click **Next**.

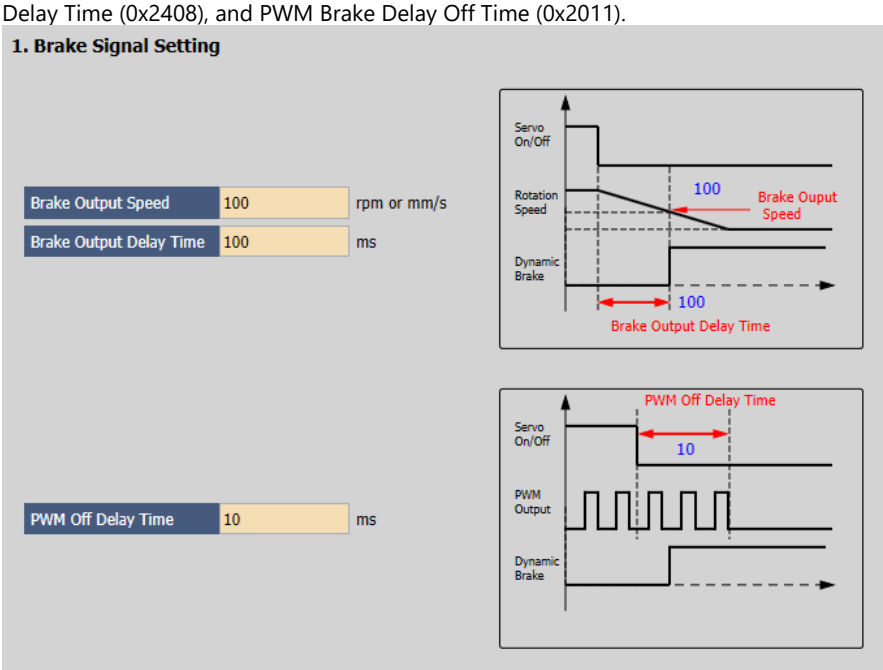
Step 5: Set Electronic Gear Ratio

	Substep	Task
Torque Mode Step 5	A	Leave the Electronic Gear Ratio settings at default values. They have no affect on Velocity Mode.
	B	If your application will use the Encoder Output, enter the desired pulses per revolution and Output Mode/Logic. For initial test and setup, leave these settings at default. For more information, see section 11.14 Encoder Output Signal in the User Manual. Configure the Encoder Output signal if desired. If the definition isn't known, the Encoder Output can be configured later with Encoder Output Pulse (0x3006) and Encoder Output Mode (0x3007) on the Object Dictionary \ Index tab if Encoder Ouput Mode is set to "Line Drive+Open Collector". These outputs are fixed: DO6=AO, DO7=BO, DO8=ZO (open collector encoder output). **2. Encoder Output Setup** Encoder Output Pulse: 10000 — Pulse / Resolution Encoder Output Mode: Line Drive only Encoder Output Logic: Phase A lead
	C	Click **Next**.

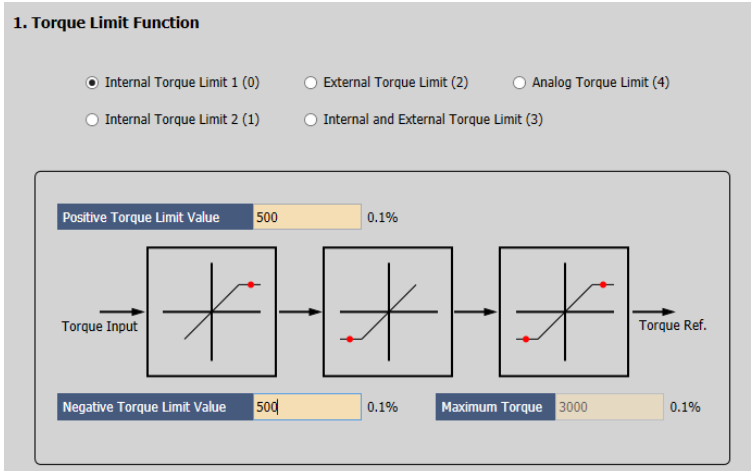
Step 6: Set Emergency Stop and Dynamic Brake Control

	Substep	Task
Torque Mode Step 6	A	For initial setup and testing, choose the defaults for these settings on the **Emergency Stop Configuration** and **Dynamic Brake Control Mode** screen. More information can be found in the User Manual under Dynamic Brake Control Mode (0x2012) and Emergency Stop Configuration (0x2013). **1. Emergency Stop Configuration** Using Dynamic Brake Control Using Emergency Stop Torque — Emergency Stop Torque: 1000 * 0.1 % **2. Dynamic Brake Control Mode** Selected Dynamic Brake : Hold the dynamic brake after stopping the motor using the brake Hold the DB after stop using the brake Release the DB after stop using the brake Release the DB after free-run stop Hold the DB after free-run stop
	B	Click **Next**.

Step 7: Set Brake Signal Setting

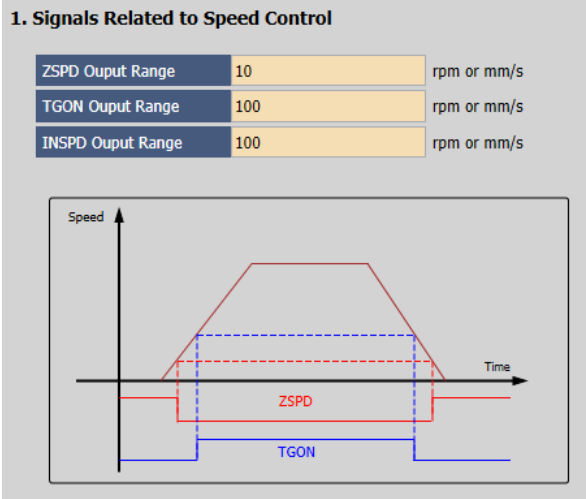
	Substep	Task
Torque Mode Step 7	A	For initial setup and testing, choose the defaults for these settings on the **Brake Signal Setting** screen. More information can be found in the User Manual under Brake Output Speed (0x2407), Brake Output Delay Time (0x2408), and PWM Brake Delay Off Time (0x2011). 
	B	Click **Next**.

Step 8: Set Torque Limit Function

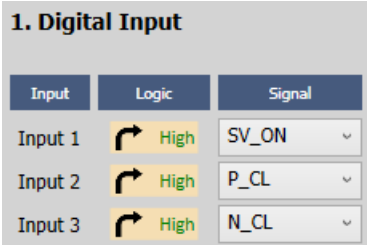
	Substep	Task
Torque Mode Step 8	A	Set the **Torque Limit Function**.  Select a method for limiting the torque applied to the load (0x2110). Here the Analog Torque Limit does not apply since the A-TLMT input is being used as a command and not a limit. Setting the desired torque limit registers will ensure Analog Torque command does not issue dangerous force on the load in either the FWD or REV direction. For initial testing and setup, a value less than max torque is recommended. The above example sets the torque limits to 50% of system rated torque. These values can be increased after initial commissioning by adjusting 0x60E0 and 0x60E1 in the **Object Dictionary \ Index** tab. Default values are 3000 (300%).
	B	Click **Next**.

Option	*Description*
Internal Torque Limit 1 (0)	• Uses the value of 0x60E0 as the Fwd direction torque limit • Uses the value of 0x60E1 as the Rev direction torque limit
Internal Torque Limit 2 (1)	Uses a constant 300% of rated motor torque as the Fwd and Rev torque limits
External Torque Limit (2)	• Uses the value of 0x2111 as the Fwd direction torque limit • Uses the value of 0x2112 as the Rev direction torque limit
Internal and External Torque Limit (3)	• Uses the value of 0x60E0 when Digital Input P_CL is on and the value of 0x2111 when Digital Input P_CL is off for the Fwd direction torque limit • Uses the value of 0x60E1 when Digital Input N_CL is on and the value of 0x2112 when Digital Input N_CL is off for the Rev direction torque limit
Analog Torque Limit (4)	Not applicable in Torque Mode

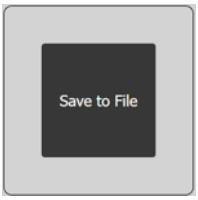
Step 9: Set Signals Related to Speed Control

	Substep	Task
Torque Mode Step 9	A	On the **Signals Related to Speed Control** screen, configure the speed output ranges that will trigger the digital outputs ZSPD, TGON, and INSPD. For initial testing and setup, these can be left as default. For more information, see section 11.4.3 Signals Related with Speed Control in the User Manual. To adjust these values later, see ZSPD (0x2404), TGON (0x2405), and INSPD (0x2406) in the **Object Dictionary \ Misc.** tab. 
	B	Click **Next**.

Step 10: Set the I/O Signal Setting

	Substep	Task
Torque Mode Step 10	A	On the **Digital Input** screen, configure Inputs 1 through 3 as shown below. Configure additional inputs and outputs as needed for your application. P_CL and N_CL are only needed if Internal and External Torque Limit (0x2110=3) was selected. 
	B	Click **Next**.

Step 11: Save Your Configuration

	Substep	Task
Torque Mode Step 11	A	Select **Save to File** to save the configuration file to your PC. 
	B	Select **Write to Drive** to download the configuration to the drive. The drive **MUST NOT** be enabled during download. The software will not acknowledge that certain parameters were not changed, so ensure that the drive is not enabled before pressing **Write to Drive**. This **Write to Drive** button also saves the settings to memory.
	C	After download is complete either power cycle the drive (ensuring the LED display turns off) or click on the **Software Reset** icon in the upper toolbar.
	D	Torque Mode Commissioning is now complete.

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