

## Introduction

The purpose of this app note is to explain how to set up a Copley servo drive to work as an Interpolator with a ServoTube linear motor.

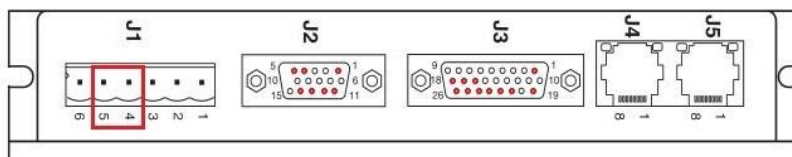
An Interpolator converts the output analog signals from the ServoTube (Sin/Cos 1Vp-p differential signal for position interpolation and analog Hall) into emulated digital incremental quadrature counts A, /A, B, /B, X, /X, and digital Halls outputs U, V, W with respect to ground. These signals can be used with controllers that do not support Sin/Cos 1Vp-p analog Halls. Such as the Rockwell AB (Allen Bradley) Ultra 3000 or Kinetix 300 with EtherNet/IP. By default, the Copley interpolator outputs 4096 interpolations of the magnetic pair length and Hall states independent of motor used, so no configuration is required.

Additionally, Dunkermotoren has discontinued the SI-10 Interpolator, so therefore the objective of this app note is to explain how Copley drives can be utilized to achieve the same 10um of resolution and same Hall states as the obsolete interpolator. This app note provides guidance for the required wiring connections and CME software configurations.

## Hardware

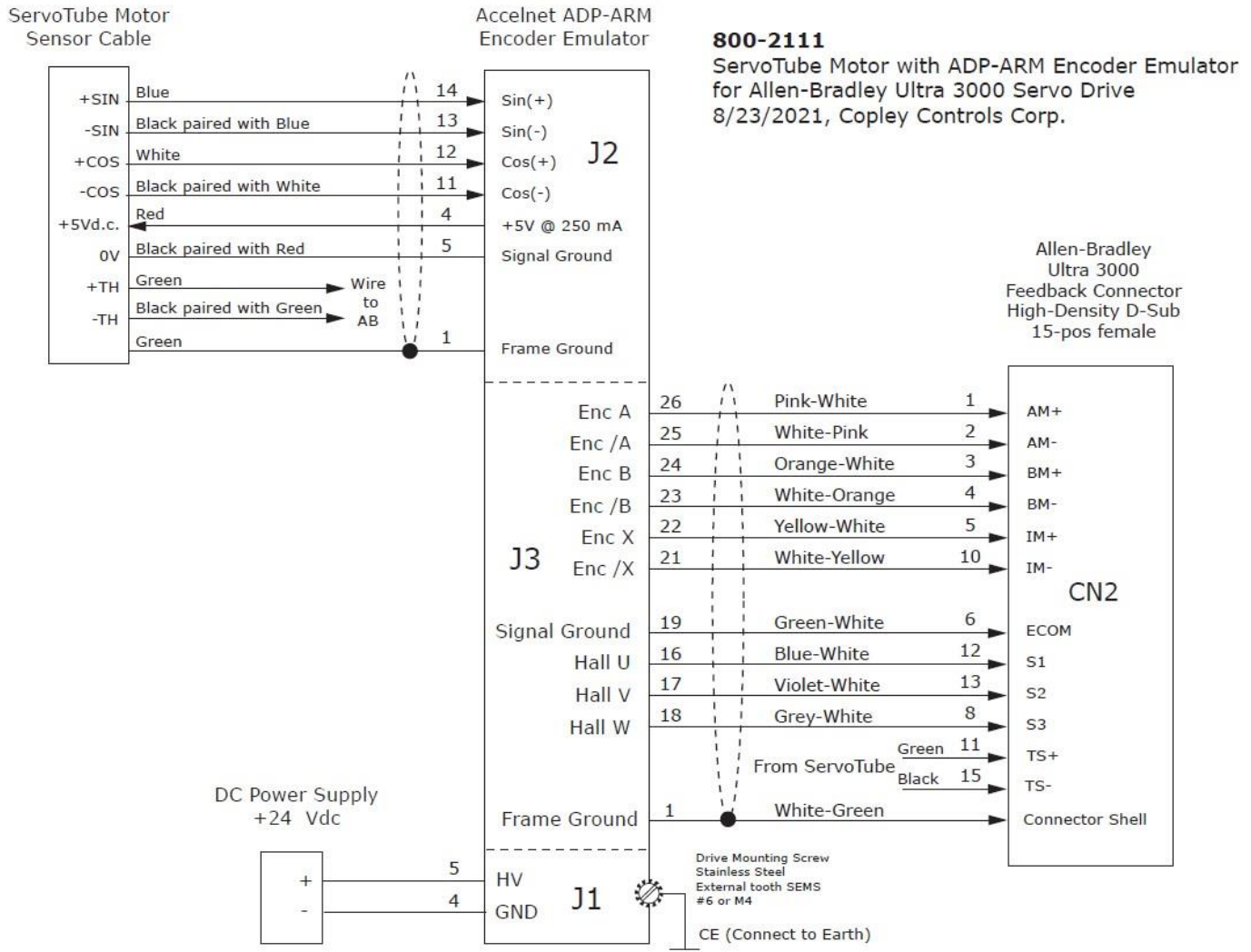
Necessary hardware for connection example:

Copley Drive	Drive Hardware	Communication
800-2111 (ADP-090-09) Emulator	ADP-CK connector kit	SER-USB-RJ11 serial adapter



First connect 24 volts to Copley (J1) power input, and then connect the ServoTube motor feedback output to Copley (J2) feedback.

The example below shows a connected Copley (J3) interpolated and emulated digital Hall output signals to an Allen Bradley Ultra 3000 or Kinetix 300(Rockwell does not take Sin/Cos 1Vp-p analog Hall):



Reference	Copley Controls Colors	Older Servotube Colors	New Servotube Colors	Pin# Copley Drive
+SIN	Blue	Blue	Blue	14
-SIN	Black + Blue	White + Blue	Red	13
+COS	White	Green	White	12
-COS	Black + White	White + Green	Brown	11
+5V	Red	Orange	Yellow	4
0V	Black + Red	White +Orange	Green	5
Frame Ground	Green	Green	N/A	1

**Note:** The motor temperature connections (+TH & -TH) should be connected directly to an Allen-Bradley. Make sure the drive case and all shields find a good path to earth; without good grounding, noise can be injected into the signals.

## Software

CME software configuration is optional as the emulator by default uses 12 bit or 4096 interpolations emulating A /A B /B, and output digital Halls on OUT1,2,3 on any magnetic pair length from the SIN/COS analog signal received by the 1Vp-p analog differential input.

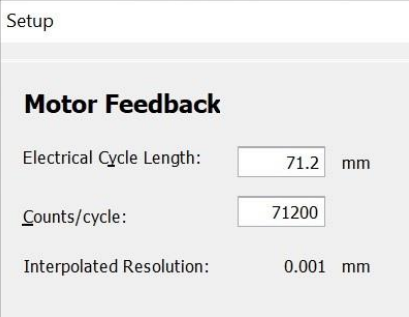
11mm diameter rod pitch 25.6mm/ 4096 = 6.25um resolution.

25mm diameter rod pitch 51.2mm / 4096 = 12.5um resolution

38mm diameter rod pitch 71.2mm / 4096 = 17.38um resolution

If 10um resolution is required, or if the Hall state sequency needs to be changed, then CME can be used to modify the configuration and save it to a .ccx file for future use.

1. Connect to the Copley drive using serial communication. Copley recommends using the Copley USB to Serial adapter. Part# SER-USB-RJ11.
2. On the Setup screen, adjust motor pitch and interpolation for various motors if a 10um resolution is required for the controller.



The screenshot shows a 'Setup' window with a 'Motor Feedback' section. It contains three input fields: 'Electrical Cycle Length' set to 71.2 mm, 'Counts/cycle' set to 71200, and 'Interpolated Resolution' set to 0.001 mm.

Parameter	Value	Unit
Electrical Cycle Length	71.2	mm
Counts/cycle	71200	
Interpolated Resolution	0.001	mm

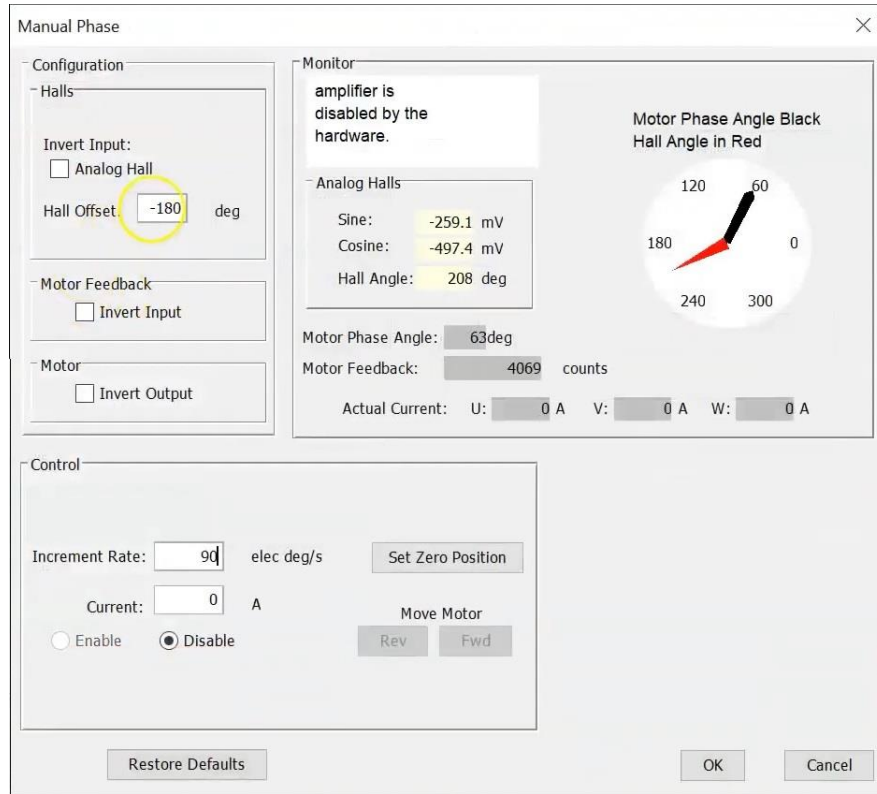
11mm diameter rod pitch 25.6mm/ 2560 = 10um resolution

25mm diameter rod pitch 51.2mm / 5120 = 10um resolution

38mm diameter rod pitch 71.2mm / 7120 = 10um resolution

**Note:** Accuracy is based on magnet spacing. The resolution is based on interpolation. 12-bit A/D is more than sufficient given the variation in magnet spacing, but high resolution can be obtained using 16-bit A/D

- Use CME to configure the phasing angle and feedback direction. Open the Tools menu and select the Manual Phase option.
- In the Manual Phase screen use the various configurations to configure the phasing angle and feedback direction. For example, to advance 180 Deg type, +/-180° for Hall Offset.



- Once finished, click the OK button to save the current configuration.
- The default Hall state is given by default Configuration U Hall OUT1 30 deg, V Hall OUT2 150 deg, W Hall OUT3 270 Deg.

To configure the Hall state outputs, go to the Tools menu and select the ASCII Command Line option. Type the syntax for each output separately and press the Enter key.

Output	Hall	Syntax
Output 1	Hall U	s f0x70 8 30
Output 2	Hall V	s f0x71 8 150
Output 3	Hall W	s f0x72 8 270

## Verification

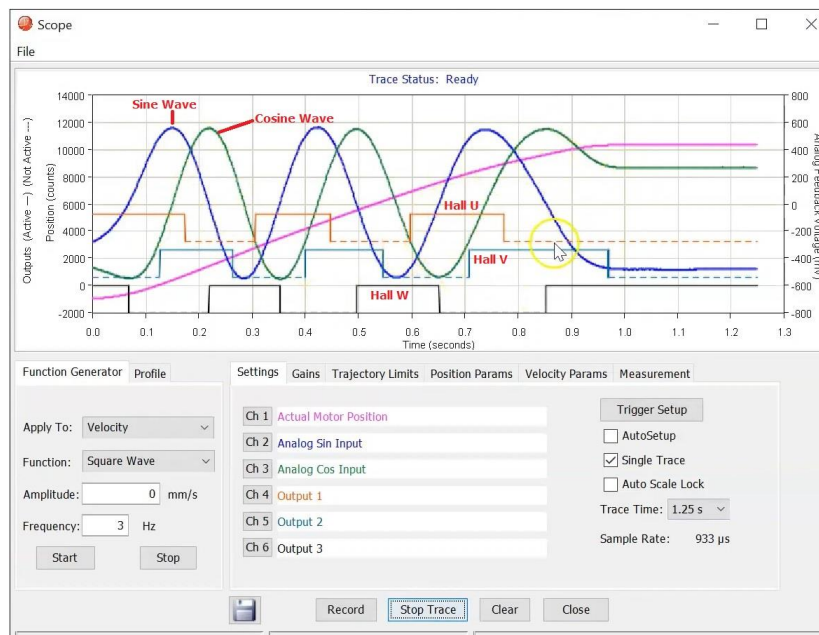
Once all connections and CME setup are done, the built-in Scope tool in CME can be used to verify all the configurations.

Open the Amplifier menu, and select the Scope option. In the Scope screen, select the following options for each scope channel:



**Note:** For the trigger setup, select rising edge for the trigger type.

When moving the ServoTube by hand the results in the Scope screen should look similar to the image below. Note that the sine & cosine waves (+or - 500 millivolts peak to peak) should be 90° apart, and the Halls states should be proportional:



## Revision History

Date	Version	Revision
11/2/2021	Rev 00	Initial release