

creative conners, inc.

# Stagehand OEM Board Reference Manual

Version 1.0

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# Stagehand™ OEM Board Reference Manual

## 1 – Getting Started

Congratulations on your purchase of the Stagehand OEM Board scenic motion controller from Creative Conners, Inc. **Stagehand OEM Board** brings the excitement of automation to theatres of all sizes. **Stagehand OEM Board** is a unique motion controller that offers ultimate flexibility, allowing you to build a custom controller and leverage the Avista™ scenic automation software.

This manual will direct you through:

1. Unpacking
2. Installing & testing
3. Operation procedures

If you need help along the way contact us either on our website ([www.creativeconners.com](http://www.creativeconners.com)), via email ([support@creativeconners.com](mailto:support@creativeconners.com)), or by phone (401.862.2980)

### **1.1 What's in the box?**

Inside the box you should find:

1. Reference manual (this document)
2. Stagehand OEM Board motion controller
3. Wiring diagrams

If any of these items are missing, please contact us immediately for a replacement.

If you purchased any power cables, encoders, limit switches, or other accessories, those items are packaged separately.

### **1.2 What's not in the box? (stuff you need to buy)**

To complete construction of your motion controller, you will need a few additional components that interface between the Stagehand OEM board and the high voltage power sources it will control.

Figure 1.1 shows a listing of the components needed and some example parts that could be used. There are many manufacturers and vendors of similar components which are fine to use provided the specifications are similar.

*Figure 1.1*

Part	Specification	Example	Source
Brake & Enable Relay	4PDT 24VDC coil relay.	Omron MY4-IN1-D2 24VDC	Mouser 651-2834724
E-Stop contactor	3PST contactor with 24VDC coil & auxilliary contact	Fuji SC-E05/G & Fuji SZ-AS1/T & Fuji SZ-Z1	Automation Direct SC-E05-24VDC, SZ-AS1T, SZ-Z1
Power Supply	Triple output +5V @ 3A, +12V @ .5A, -12V @ .5A	Phihong PSA4541-R	Mouser 552-PSA-4541-R
Motor Drive	DC, AC, or Valve driver capable of speed control using a bipolar speed signal (+/-10vdc)	Automation Direct GS3 drive -OR- Minarik RG500UA-PCM	Automation Direct, Minarik, etc.

### **1.3 Stagehand OEM Board Overview**

The **Stagehand OEM Board** is designed to give you the powerful motion control capabilities of the **Stagehand AC**, **Stagehand DC**, & **Stagehand Mini** while allowing you to connect to your own motor drives. While the **Stagehand AC** & **Stagehand DC** can power a motor directly, the **Stagehand OEM Board** requires an external drive component to amplify its control signals to a level that can move a mechanical device. The **Stagehand Mini** also requires an external drive, but unlike the **Stagehand OEM Board**, it provides several accessory components and is pre-wired with connectors. Like its bigger siblings, the **Stagehand OEM Board** provides a complete

motion control solution and integrates seamlessly with other **Stagehand** products and the **Avista** automation software.

After unpacking your **Stagehand OEM Board**, take a moment to familiarize yourself with its various connections and features.

*Figure 1.1*

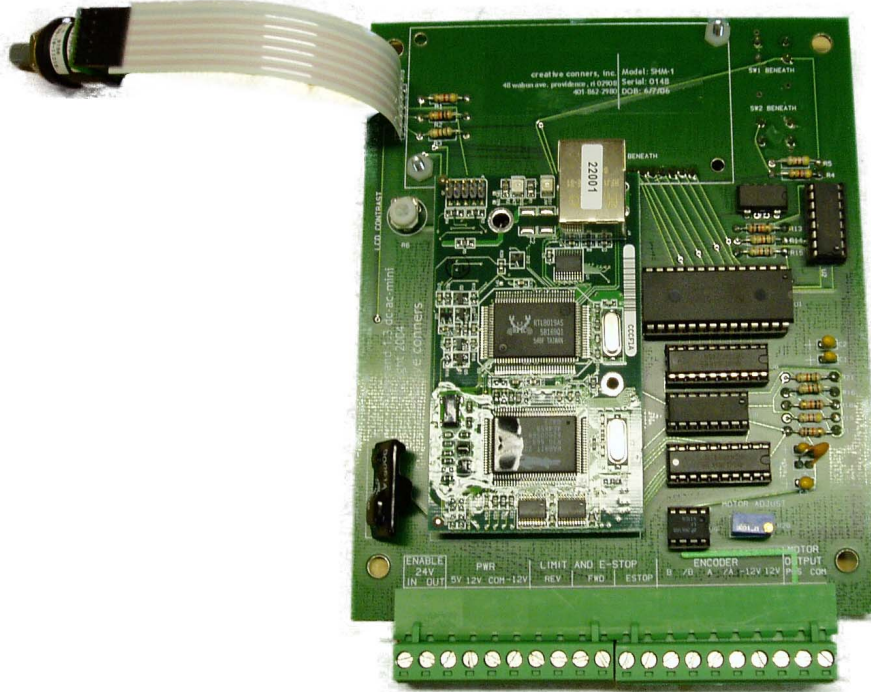


Figure 1.1 shows the connections located on the bottom of the **Stagehand OEM Board**. From left to right, these connections are:

Pin #	Label	Description
1	Enable In	24V constant power input.

Pin #	Label	Description
2	Enable Out	Outputs 24V power whenever the controller needs to enable the motor. Typically this will be connected to the Brake/Enable relay.
3	Power +5V	5V constant power input to power the logic functions of the controller.
4	Power +12V	12V constant power input to power the limit sensors, e-stop sensor, encoder, & motor speed signal amplifier.
5	Power Common	Power common.
6	Power -12V	-12V constant power input to power the limit sensors, e-stop sensor, encoder, & motor speed signal amplifier.
7	Reverse Limit	Outputs +12V to a normally closed limit switch.
8	Reverse Limit	Senses +12V from a normally closed limit switch. If no voltage is detected, the controller assumes that a limit switch has been hit.
9	Forward Limit	Outputs +12V to a normally closed limit switch.
10	Forward Limit	Senses +12V from a normally closed limit switch. If no voltage is detected, the controller assumes that a limit switch has been hit.
11	E-Stop	Outputs +12V to a normally closed auxiliary contact on the E-Stop contactor.
12	E-Stop	Senses +12V from a normally closed auxiliary contact on the E-Stop contactor. If no voltage is detected, the controller assumes that a E-Stop has been activated.
13	Encoder B	Connects to a quadrature encoder with differential line drivers.

Pin #	Label	Description
14	Encoder /B	Connects to a quadrature encoder with differential line drivers.
15	Encoder A	Connects to a quadrature encoder with differential line drivers.
16	Encoder /A	Connects to a quadrature encoder with differential line drivers.
17	Encoder -12V	Connect to the COM power terminal of a quadrature encoder. Note: This connection will supply the encoder with 24VDC. You can connect the encoder to a different power source if it requires a lower voltage.
18	Encoder +12V	Connect to the V+ power terminal of a quadrature encoder. Note: This connection will supply the encoder with 24VDC. You can connect the encoder to a different power source if it requires a lower voltage.
19	Motor Positive	Outputs a +/-10vdc speed control signal to a motor amplifier. +10vdc is full speed forward. -10vdc is full speed reverse.
20	Motor Common	Common reference for the speed signal.

Figure 1.2

Forward jog  
button

Reverse jog  
button

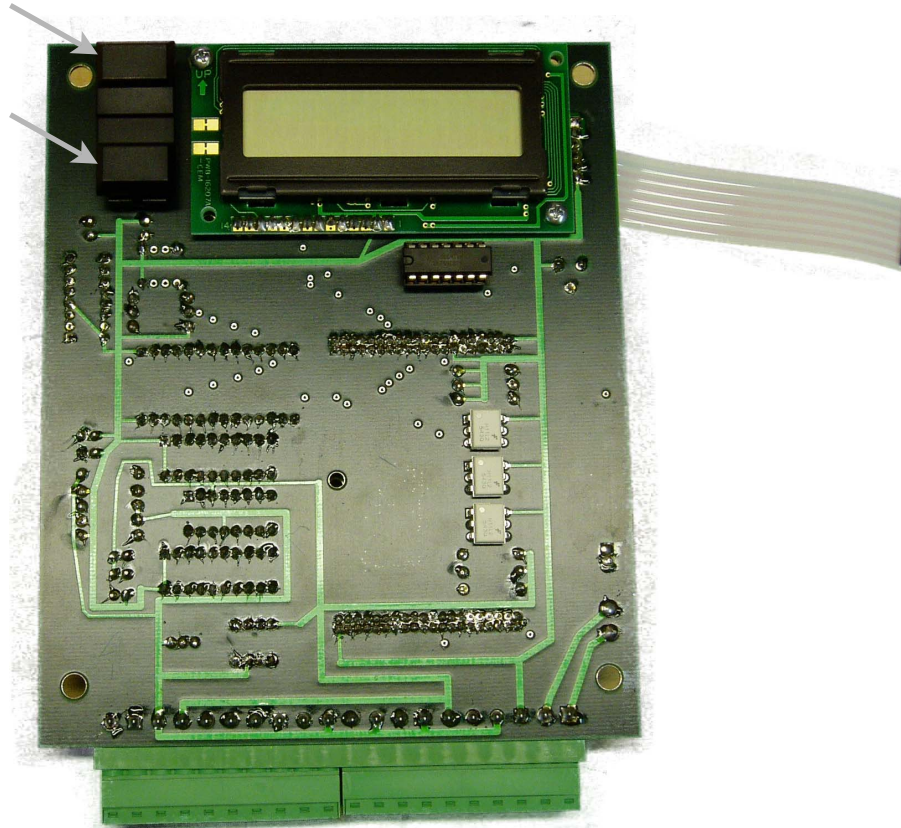


Figure 1.2 shows the controls located on the front of the **Stagehand OEM Board**. From left to right, top to bottom, the controls are:

1. **Forward jog button** – When pressed the **Stagehand** will switch to manual operation, and begin to jog in the forward direction.
2. **Reverse jog button** – When pressed the **Stagehand** will switch to manual operation, and begin to jog in the reverse direction.
3. **LCD Display** – The display shows information about the **Stagehand**'s status. When idle, it shows the current IP address and the status of the network connection between the **Stagehand** and a PC running **Avista**. If a limit switch or **E-Stop** has been activated, the condition will be displayed. In jog



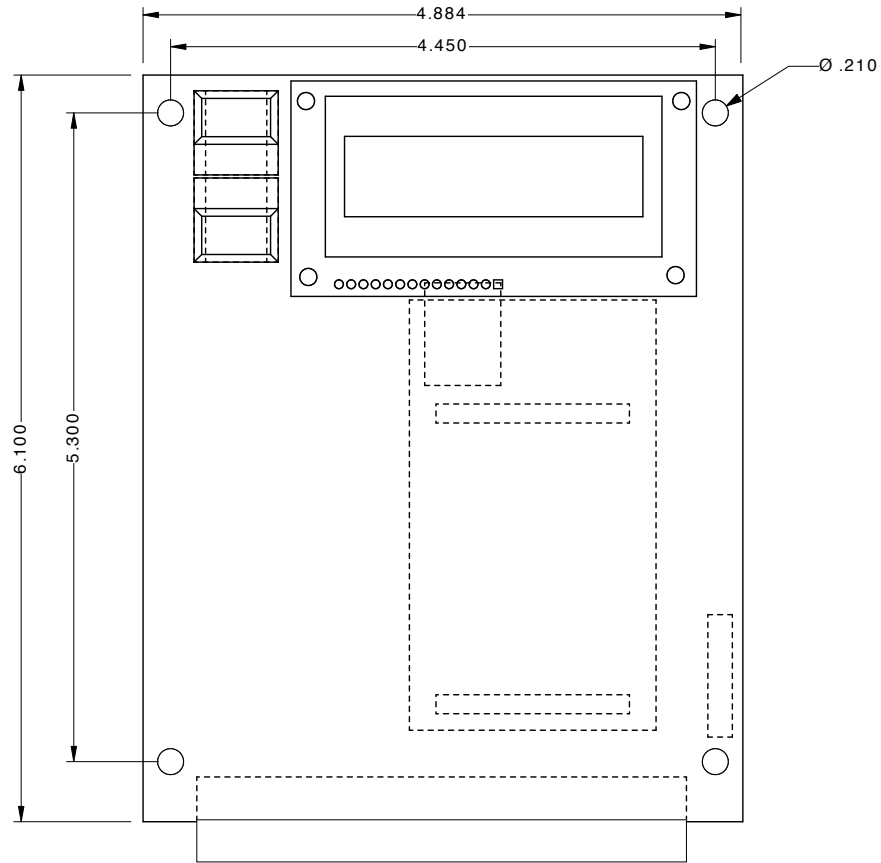
mode, it will display the jog direction and speed. In address mode, it will let you alter the current IP address.

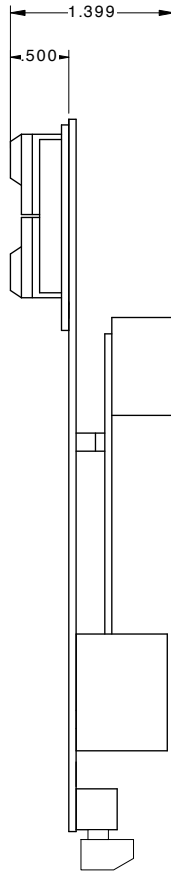
4. **Knob** – The **knob** performs different functions depending on the function being performed:
  - a. If either **jog button** is pressed, the **knob** will function as a speed dial.
  - b. To set the IP address, press the **knob** (it's also a button) and then turn the **knob** to adjust the address.

## 1.4 Installing Stagehand

### 1.4.1 Mounting Stagehand

Figure 1.4





The **Stagehand OEM Board** has four mounting holes, as shown in Figure 1.4, that can be used to mount the circuit board. The circuit board should be mounted with #8 x 1/2" nylon standoffs to keep the board from electrically shorting to its enclosure. The **Stagehand** should be mounted in a location that is moderate in temperature (40°F-90°F) as well as free from excessive dust and moisture.

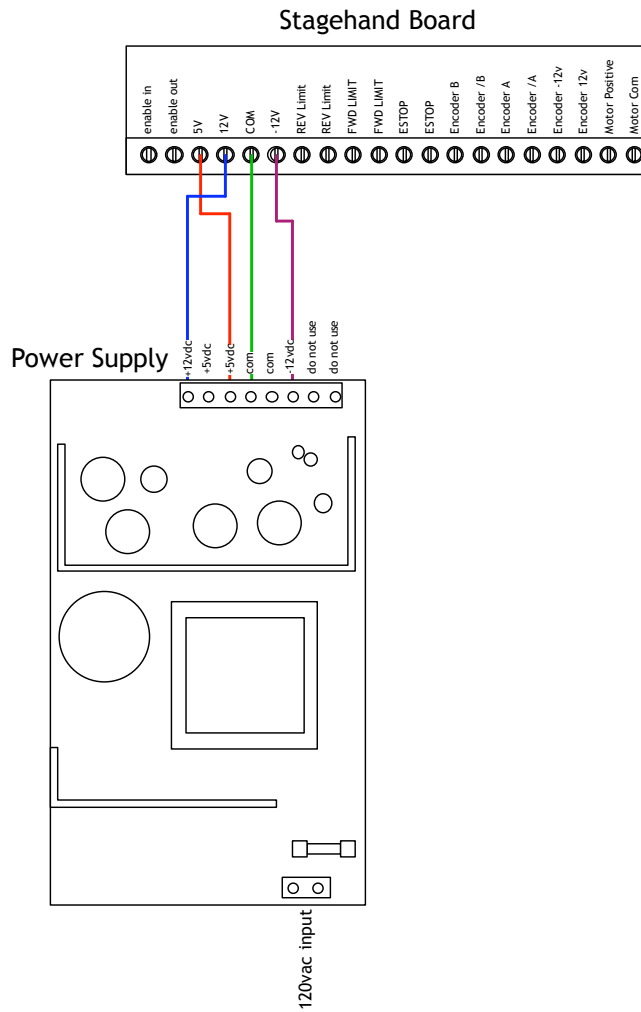
Typically, it is best to mount the **Stagehand OEM Board** within 6' of the motor it controls. This reduces cable clutter and minimizes the risk of electrical interference (both RFI & EMI). Longer distances are possible with motor, encoder, and limit cable extensions.

### 1.4.2 Hooking up power

**Stagehand** needs power to store a motor's position information. **Care should be taken to power the Stagehand from a source that is not likely to be interrupted. If power is lost to a Stagehand, the motor's position information will be reset to zero (0), regardless of the motor's actual position.**

**Stagehand OEM Board** should be connected to a triple-output power supply as shown:

*Figure 1.5*



Once you have applied power, the LCD display should light up and display the following (note: IP address may be different).

*Figure 1.9*



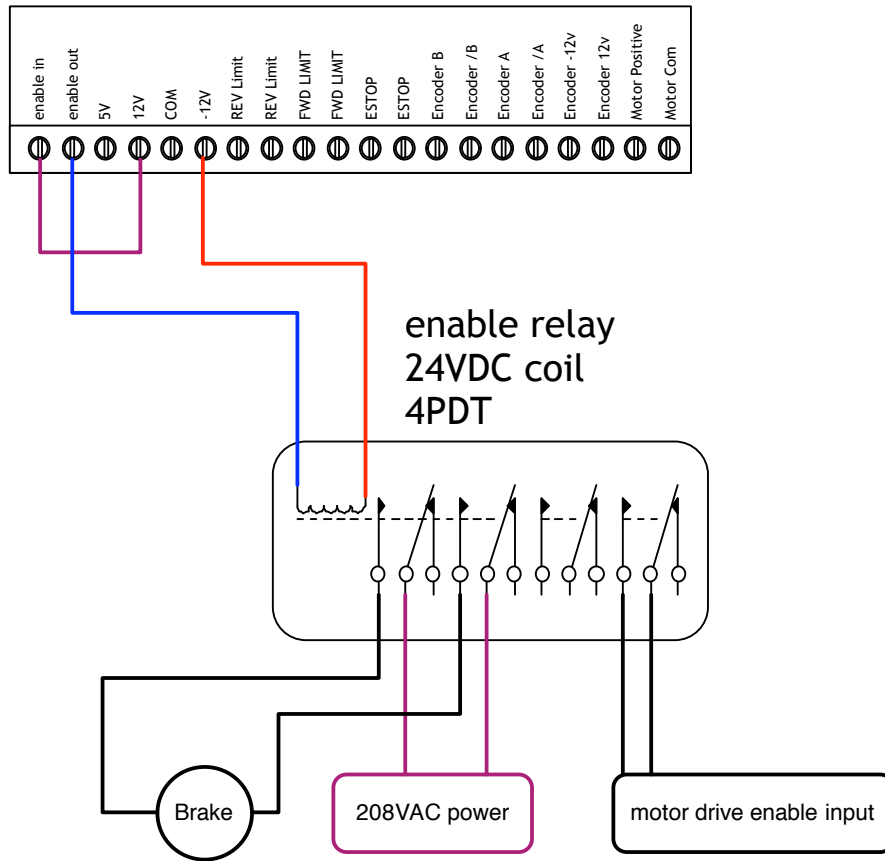
The “E-Stop!!” message is displayed because you have not yet hooked up the **Stagehand** with the E-Stop contactor. Since no voltage is detected on the **Stagehand** E-Stop sensor terminals, an E-Stop condition is assumed.

The number on the bottom line of the display is the **Stagehand's** IP address. We’ll look at changing the IP address in section 1.5. For now, disconnect the power supply and proceed to wire the rest of the connections.

#### **1.4.4 Hooking up the enable/brake relay**

The enable/brake relay serves two functions as implied by the unimaginative name. Whenever the **Stagehand OEM Board** is directed to move the motor, it will energize the **Enable Out** terminal. In most configurations this means that the motor amplifier should be enabled allowing it to follow the speed signal of the **Motor Output** terminals, and the motor’s brake should be released. This a mixture of high voltage and low voltage signals need to be triggered by the single **Enable Out** terminal. To isolate the **Enable Out** signal, we use a 24VDC relay that provides a dry contact closure for the motor amplifier enable signal and switches the brake power lines as shown in the figure below:

### Stagehand Board

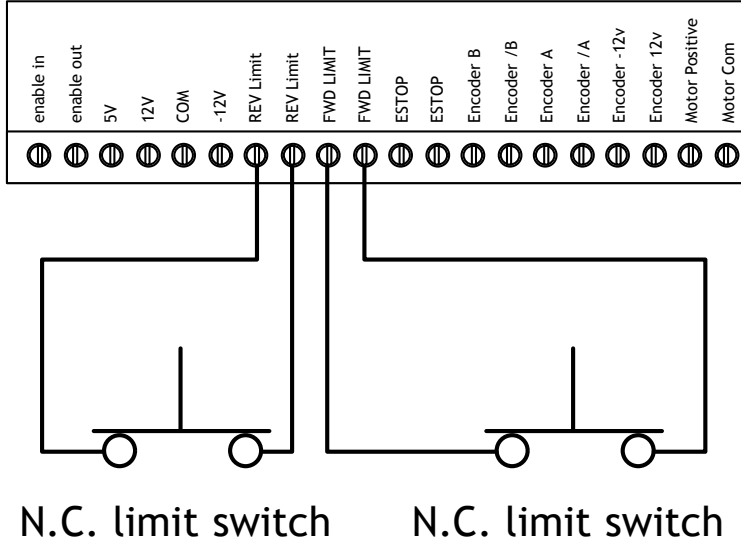


#### 1.4.5 Hooking up limit switches

The **REV** and **FWD** limit switch terminals should be connected to normally closed limit switches as shown in Figure \*\*\*. The leftmost terminal in each pair is a constant +12V signal that is supplied to each limit switch. The rightmost terminal in each pair senses the presence of the +12V signal. If +12V is present, the **Stagehand** assumes the limit switch is clear. If there is no voltage at the rightmost terminal, the **Stagehand** registers that a limit switch has been tripped and won't allow any further travel in that direction. If you want to bypass the limits for testing (or permanently in a machine such as a turntable)

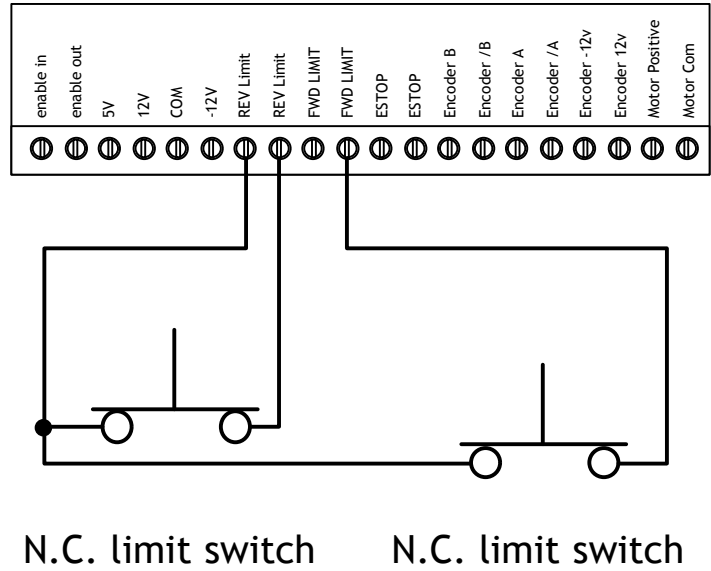
just add a jumper wire that connects between the two terminals in either the **REV** or **FWD** limit switch inputs.

### Stagehand Board



*Note: Since the leftmost terminal in each pair is electrically identical, you can optionally connect the limit switches using only 3 wires as shown in Figure \*\*\*.*

### Stagehand Board



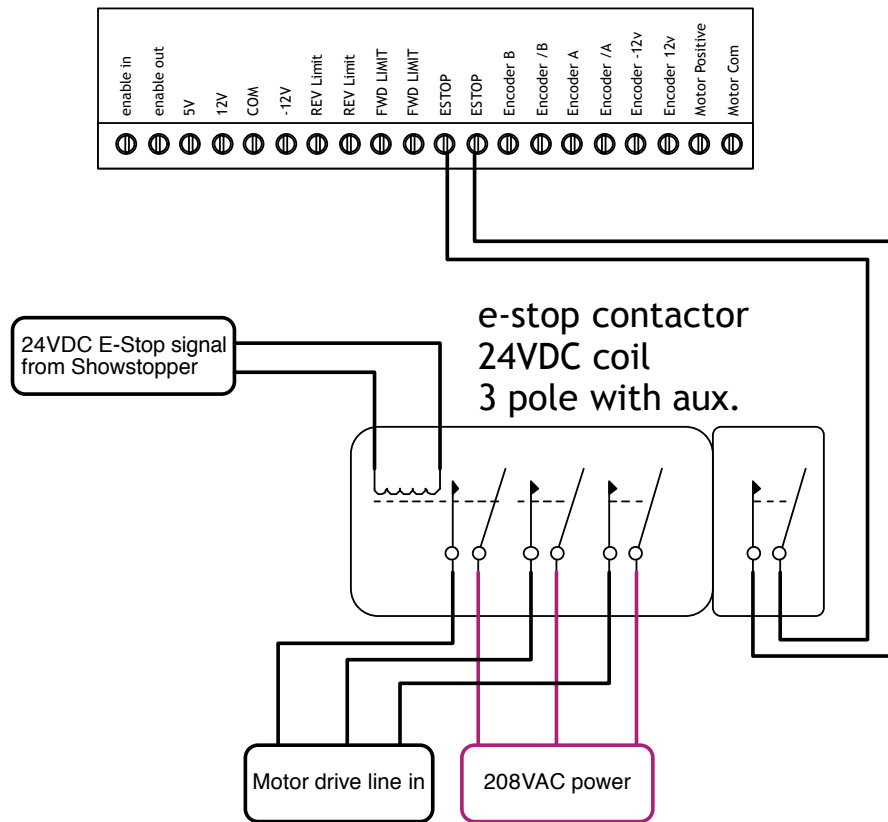
#### 1.4.6 Hooking up the E-Stop

The Stagehand will sense an E-Stop condition in a manner similar to the REV and FWD limits. The Stagehand provides a constant +12V signal on the leftmost terminal of the ESTOP pair. On the rightmost terminal of the ESTOP pair, the Stagehand will sense the presence of the +12V. If voltage is present, the E-Stop is presumed to be clear. If no voltage is present the E-Stop is tripped. Once the E-Stop is tripped the Stagehand will send a message back to the Avista software and disallow any further movement.

To provide a failsafe E-Stop circuit, the Stagehand board is not ultimately responsible for stopping the motor. Rather, a dedicated E-Stop contactor removes power from the motor directly. The coil of the E-Stop contactor is connected to a Showstopper (or your own 24VDC E-Stop circuit). The Stagehand ESTOP terminals are connected to a normally open auxiliary contact on the E-Stop contactor as shown in Figure \*\*\*.



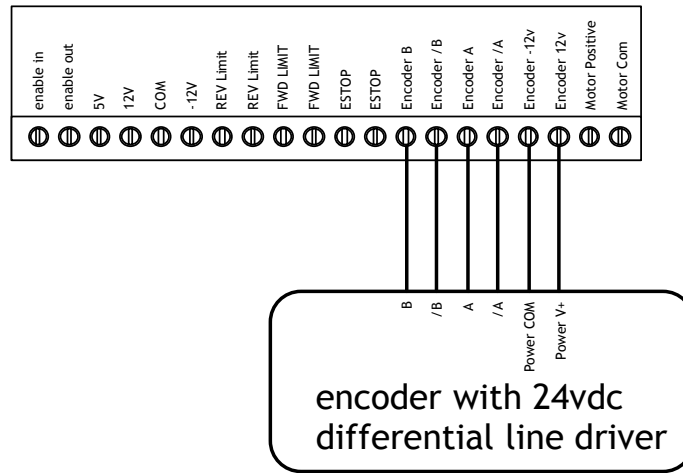
### Stagehand Board



#### 1.4.7 Hooking up the Encoder

A quadrature encoder needs to be connected the Stagehand so that it can track the motor’s position. To work with Stagehand, the encoder must have a differential line driver. The differential line driver will send out four signals from the encoder: **A, /A, B, /B**. If your encoder can be powered at 24VDC, you can use the **Encoder -12V & +12V** terminals to power the encoder as shown in Figure \*\*\*. If your encoder is low voltage (5V or 12V), you can power it from your triple output power supply directly and leave the **Encoder -12V & +12V** terminals empty.

### Stagehand Board

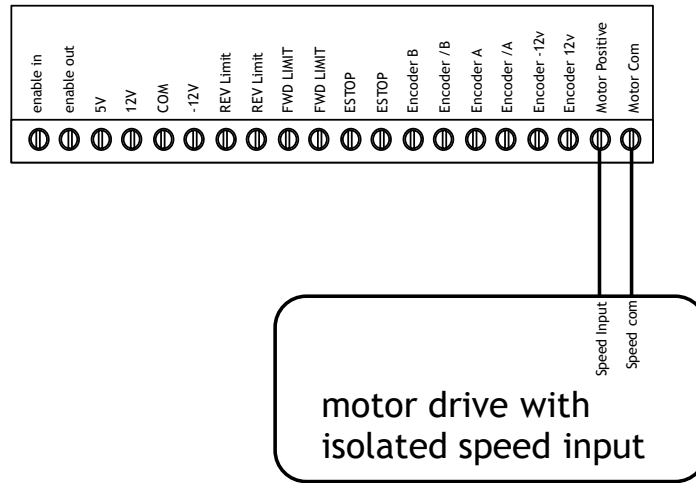


#### 1.4.8 Hooking up the motor drive

In addition to the Enable circuit that should be connected to your motor drive (as described in section 1.4.4), the **Stagehand Motor Output** terminals should be connected to the motor drive speed input terminals. The **Stagehand** uses a low-voltage bipolar signal to control the motor's speed. When the **Stagehand** sends a +10VDC signal on the **Motor Output POS** terminal, the motor should move full-speed in the forward direction. When the **Stagehand** sends a -10VDC signal on the **Motor Output POS** terminal, the motor should move full-speed in the reverse direction. Connect the motor drive to the Stagehand as shown below in Figure \*\*\*.

*Note: Confirm that your drive has isolated speed input signals. For example, when using the Minarik DC Regenerative drives make sure that the drive has a PCM card installed. If the speed input signals are not isolated you will likely damage the **Stagehand OEM Board**.*

### Stagehand Board



#### 1.4.9 Testing a motor

To confirm that your motor is properly connected to the Stagehand OEM Board you should reconnect the power supply and test these conditions:

1. *E-Stop* – Release the E-Stop button on **Showstopper**. You should hear a “click” from inside your control cabinet, this is the **E-Stop** contactor closing. The LCD display should show that the **E-Stop** is released by switching the status display to:

*Figure 1.11*



“Not Connected” indicates that the **Stagehand OEM Board** is not communicating with a computer running Avista.

2. *Brake release* – Press the **fwd** jog button. You should hear a distinct “click” from your brake. This is the sound of the

brake releasing. Release the **fwd** jog button. You should hear a click of the brake engaging.

3. *Motor Motion* – Press the **fwd** jog button and slowly turn the **knob** clockwise. The motor should begin moving. Turn the **knob** counterclockwise to slow the motor to a stop, then release the jog button. Repeat with the **rev** jog button.
4. *Limit Switches* – Manually activate (or unplug) first the forward limit, then the reverse limit. The LCD display should indicate when a limit is detected.

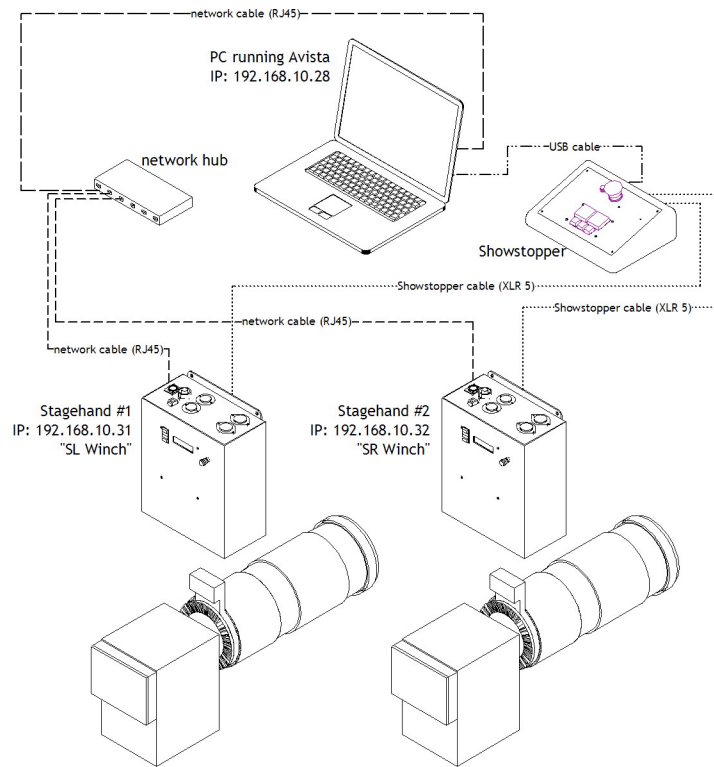
*Figure 1.12*



## **1.5 Configuring a Stagehand Network**

Many **Stagehands** can be controlled by a single PC running **Avista** software. **Avista** controls **Stagehands** through standard network cables and hubs. The following diagram shows a typical network of **Stagehands**.

Figure 1.13



Every component on the network must have a unique IP address. Though you can alter any of the four segments of the Stagehand's IP address, it is often easiest to alter the last number (valid ranges for each segment are 0 to 255). To change the address of a Stagehand, follow these steps:

1. If the **E-Stop** is engaged, release the **E-Stop** on **Showstopper**.
2. Push the knob on the front panel of the **Stagehand**. The LCD display will change to show that you can edit the IP address.

Figure 1.14



3. By turning the knob, move the cursor over the segment you wish to change. In this example, move the cursor until it is flashing over the number “32”.
4. Press the **knob** to edit the number “32”.
5. Turn the **knob** to dial in a new number, for example rotate clockwise until you reach the number “36”.
6. Press the **knob** to stop editing the number.
7. Rotate the **knob** until the cursor is flashing on “OK”.
8. Press the **knob** to accept the changes.

*Note: To discard a changed IP address, you can click on Cancel in step 7.*

## 2 – Using a Stagehand OEM Board

The Stagehand can be used to drive a motor either manually or through a computer running Avista.

### 2.1 Manual Operation

Using the jog buttons on the face of the Stagehand you can control when the motor stops & starts, and how fast it moves. When moving the motor with the jog controls, **Stagehand** is constantly tracking the position of the motor’s encoder. Regardless of whether you move the motor with the jog controls, or with a computer running **Avista**, the motor’s position will always be known.

Stagehand will detect limit switches when a motor is moved manually. If a limit switch is hit, **Stagehand** will stop the motor and prevent it from traveling any further in the direction that the limit switch was detected, until the limit switch is released.

***Before moving a motor, make sure that everyone on stage is clear of the motor's path & aware of what is about to move.***

*To move a motor manually:*

1. Press either the **FWD** or **REV** jog button on the face panel.
2. Turn the **knob** clockwise to increase speed.
3. Turn the **knob** counter-clockwise to reduce speed.
4. Release the jog button to stop the motor and engage the brake.

## **2.2 Computer Control with Avista**

The real benefit of **Stagehand** is achieved when using it in conjunction with a PC running **Avista** software. **Avista** allows you to program multiple motors to move at specified speeds to exact locations on stage. These moves are written as *cues* and can be edited and run in a similar fashion to a lighting console.

**Stagehand** receives cue information from **Avista** over standard network cables and hubs. **Avista** will inform **Stagehand** where to move, at what speed, and how fast to accelerate. When **Avista** sends a "GO" command, **Stagehand** will begin to move and will guide the motor to the exact position on stage.

In order for Stagehand to know where the motor is at any given time it must receive position information from the motor's encoder. ***If the Stagehand loses power, when it regains power it will reset the encoder position to zero ("0"), regardless of the motor's actual position.*** Should this happen, drive the motor manually to the true zero position (usually the reverse limit switch) and reset the position. There are two ways to reset position:

1. Cycle power to the **Stagehand**.

***-OR-***

2. Press the **Define Home** button in the **Avista** software.

To learn more about controlling motors with **Avista**, refer to your Avista software manual.

### ***2.3 Adjust the Stagehand OEM Board Control Output***

The **Stagehand OEM Board** is shipped calibrated to produce a motor control signal of 0VDC at 0% output speed. The signal can be adjusted if calibration is lost, or if a voltage bias is required for a particular application.

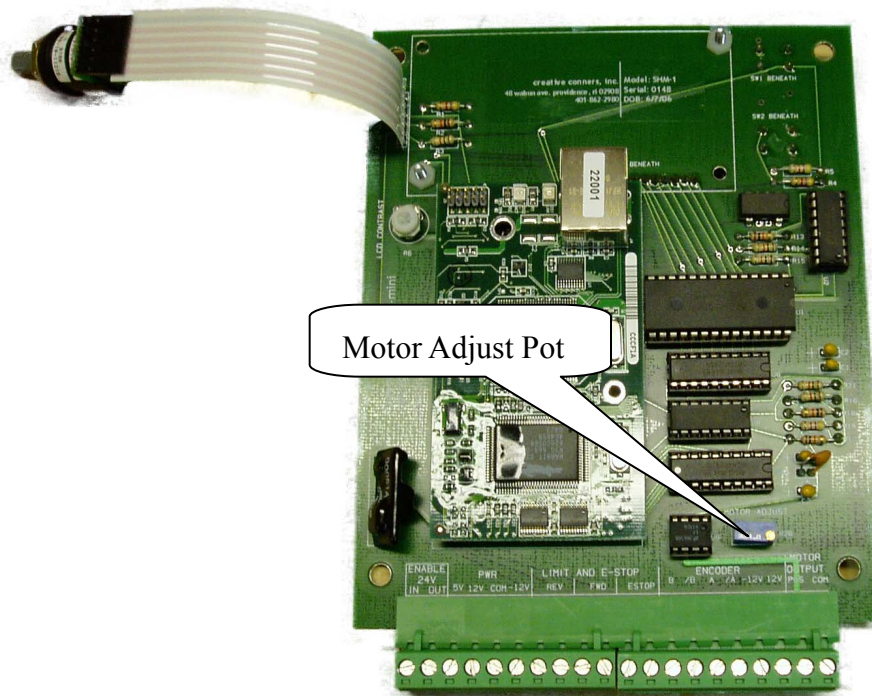
**To calibrate the bias of the control signal, adjustments must be made with the enclosure open and power applied. As with any power electronics, there is a very real risk of electric shock. Be sure to use insulated tools, and extreme caution. If you are not confident in your ability to make such adjustments, please contact Creative Conners, Inc. and we will arrange to have the calibration done by one of our technicians.**

To adjust the voltage of the motor control signal:

1. Disconnect power from the Stagehand OEM Board.
2. Remove all screws from the cover.
3. Gently lift-the cover off of the enclosure, rotate it clockwise 90 degrees, and lay it down next to the base of the enclosure. There is a wiring harness that connects the cover to the base, be careful not to damage the harness.
4. With the cover open locate the **Motor Adjust** pot on the back of the cover.
5. Connect a voltmeter to pins 1 & 4 of the control output cable.
6. Reconnect power to the Stagehand OEM Board. **Be very careful, there is now line voltage present inside the enclosure.**
7. Turn the screw on the **Motor Adjust** pot until you achieve the desired voltage across pins 1 & 4 of the control output cable.
8. Disconnect power from the **Stagehand OEM Board** and fasten the cover to the enclosure.



Figure 2.1



### 3 – Troubleshooting

Though the combination of **Avista**, **Stagehand**, and **Showstopper** strives to make automation easy, there are certainly times when things don't work. This part of the guide will give you some earned advice about what to culprits to look for when motors refuse to move.

#### **Stagehand lost power and now the position information is incorrect.**

Move the motor to the true zero (“0”) position manually and reset the position be either cycling power to the **Stagehand**, or using the **Define Home** button in **Avista**.

### **Motor won't run in cue.**

Try moving the motor with the jog controls on the **Stagehand**.

### **Motor won't run with jog controls.**

Check the power being supplied to the **Stagehand**.

Check the LCD status display on the **Stagehand**.

- E-Stop! – Either the **Showstopper** is activated, or the **Stagehand** isn't connected to the Showstopper so check your cables.
- Forward Limit – The motor is sitting on the limit switch, so you won't be able to move forward. Or the limit switch is unplugged or wired incorrectly. Limit switches need to be wired normally closed (n.c.)
- Reverse Limit – Same as Forward Limit.
- Both Limits – Either you've engaged both limits and need to move one, or the limits aren't plugged in (or they're wired incorrectly).

Meter the voltage coming out of the Motor Power socket on the external drive as you use the jog controls.

Meter the voltage coming out of the brake socket, you should see either 120vac or 230vac as soon as you press either jog direction button.

### **Motor runs fine with jog controls, but won't run from Avista.**

Check the Stagehand LCD's network status. Connected means it is communicating with your PC, Not Connected means there is either a break in the network cabling or Avista hasn't connected to the Stagehand. Use the Motor Setup to connect to the Stagehand.

Make sure you have a tuning filter loaded. From the Motor Setup>Tuning click Load Filter.

If the motor stopped in the middle of a cue and now won't restart, chances are that Avista shut down the motor because it exceeded the Max. Position error. Press the Stop button on Cue Control or Showstopper and then try to reload the cue.

**When running a cue, the motor speeds fast in the wrong direction and then turns off.**

The polarity of the motor is reversed. Open up the motor plug and switch the white and black wire.

**When running a cue, the motor speeds fast in the right direction and then turns off.**

Check to make sure that the encoder is still attached to the motor securely.

Check the encoder connector.

***Technical Support***

Though we try our best to produce reliable software and clear instructions, there may come a time when you need personal support.

**Phone Support**

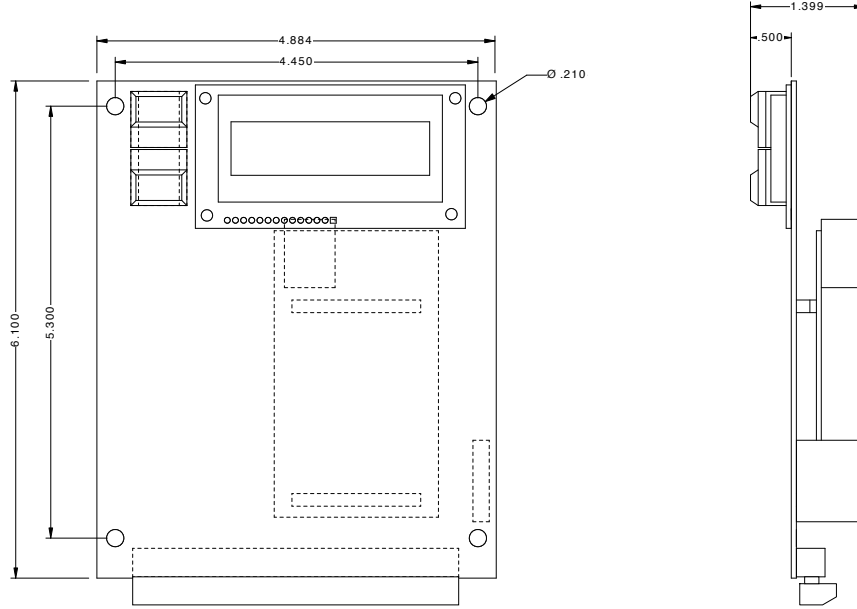
You can call our technical support at 401-862-2980 Monday-Saturday from 8am – 5pm EST. Phone support is free for 90 days, after that a rate of \$30/hr. applies to support calls.

**Email**

If you have a technical question you can email technical support [support@creativeconnors.com](mailto:support@creativeconnors.com).

**4 – Specifications**

## 4.1 Physical Specifications



## 4.2 Electrical Specifications

Input voltage	+5V @ 3A
	+12V @ 500mA
	-12V @ 500mA
E-Stop input	N.O. switch
Fwd limit input	N.C. switch
Rev limit input	N.C. switch
Control input	Ethernet RJ45
Control output	0 to +/-10vdc speed signal
Encoder input	Quadrature encoder with differential line drivers