

creative conners, inc.

# Stagehand Mini<sup>2</sup> Manual

Version 1.0





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## Getting Started

The Stagehand Mini<sup>2</sup> is the most versatile controller in our Stagehand family. The Mini<sup>2</sup> is built to control a wide variety of machines from small DC motors, to large brushless servo motors, to hydraulic proportional valves. Unlike our other Stagehands, the Mini<sup>2</sup> does not include any built-in amplifier to power a machine directly, but rather it outputs a standardized control signal that can be used with many third-party amplifiers.

The Mini<sup>2</sup> packs two independent motion controllers in a single, convenient, 3U rack mount enclosure. This double-headed approach allows you to control two machines from a single Stagehand, which is another unique feature of the Mini<sup>2</sup> that makes this controller a great choice for many shows.

This manual will guide you through:

- Unpacking
- Installation
- Powering up
- Operation
- Troubleshooting

If you need help along the way contact us on our website ([creativeconners.com](http://creativeconners.com)), via email ([support@creativeconners.com](mailto:support@creativeconners.com)), or by phone (401-289-2942)

## What's in the box?

Inside the box you should find:

- Reference manual (this document)
- Stagehand Mini<sup>2</sup> motion controller
- Two (2) control cords for connecting the Mini<sup>2</sup> to your amplifier
- Locking IEC power cable
- Two (2) D-Sub 15-pin shorting plugs to disable Brake Fault and Drive Fault inputs

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.

## Stagehand Mini<sup>2</sup> Features

The Stagehand Mini<sup>2</sup> is essentially two motion controllers built into a single 3U rack case. The motion controllers are identical to the brains found inside the Stagehand Pro and is the most versatile controller we have ever produced. It features:

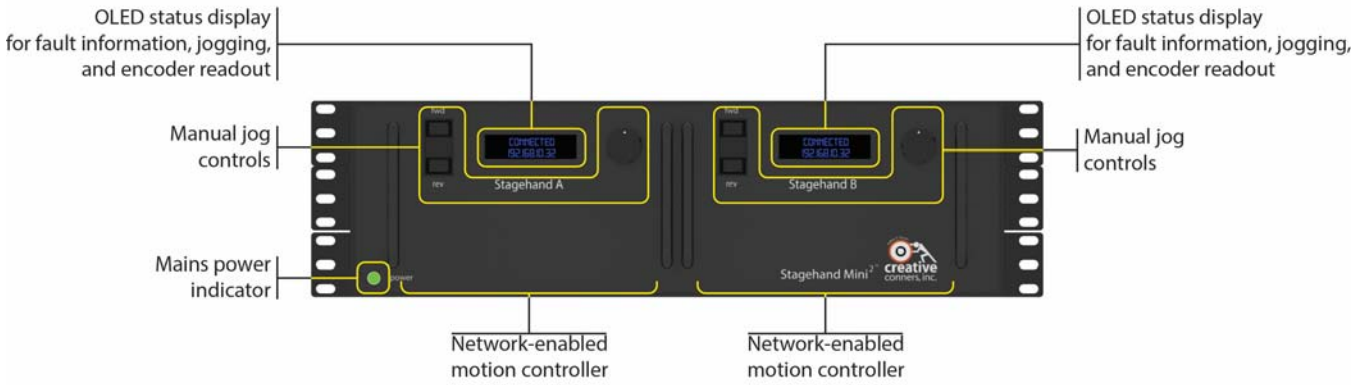


Figure 1

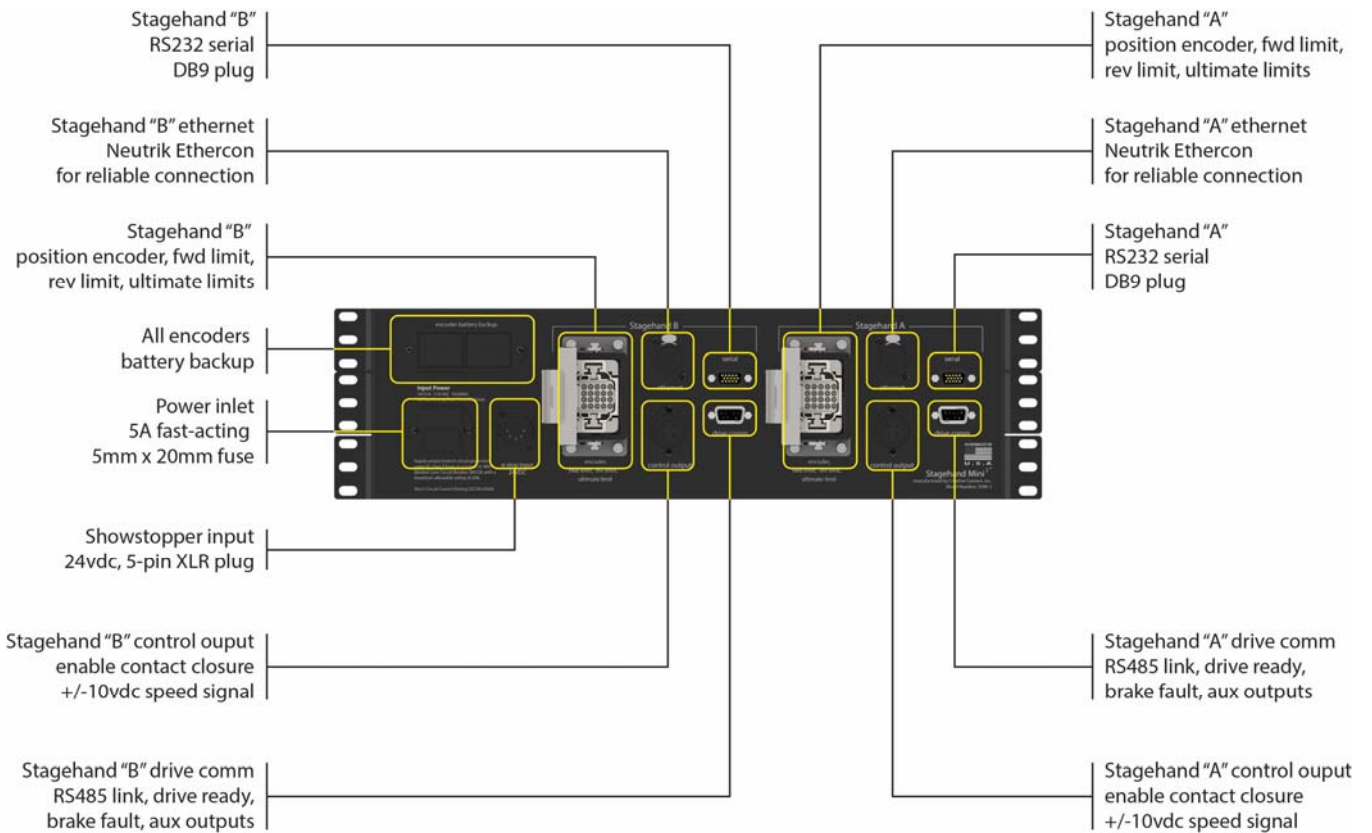


Figure 2

## Typical Applications

The Stagehand Mini<sup>2</sup> cannot power a machine directly. Unlike our Stagehand Pro AC, Stagehand AC, or Stagehand DC, the Mini<sup>2</sup> lacks an internal power amplifier opting instead to output low-power control signals that can be used with almost any external amplifier. This offers enormous flexibility, at the cost of requiring you to fabricate housings for the amplifier you want to use and then do a bit more wiring to connect the pieces together.

There are two common reasons to choose a Stagehand Mini<sup>2</sup> for an automation project. The first is that you need to control a piece of equipment that can't be powered by a dedicated Stagehand. Examples of such a machine (as of July 2014) are: a brushless dc motor, an electro-hydraulic valve (servo or proportional), a motor with a horsepower rating higher than 10HP. The second common reason to choose a Stagehand Mini<sup>2</sup> is that you may have an existing inventory of amplifiers (VFD's or DC regen drives) and want to preserve that investment. In either situation, the Mini<sup>2</sup> is a great way to get your machine running on the Stagehand platform and cue it with our Spikemark software.

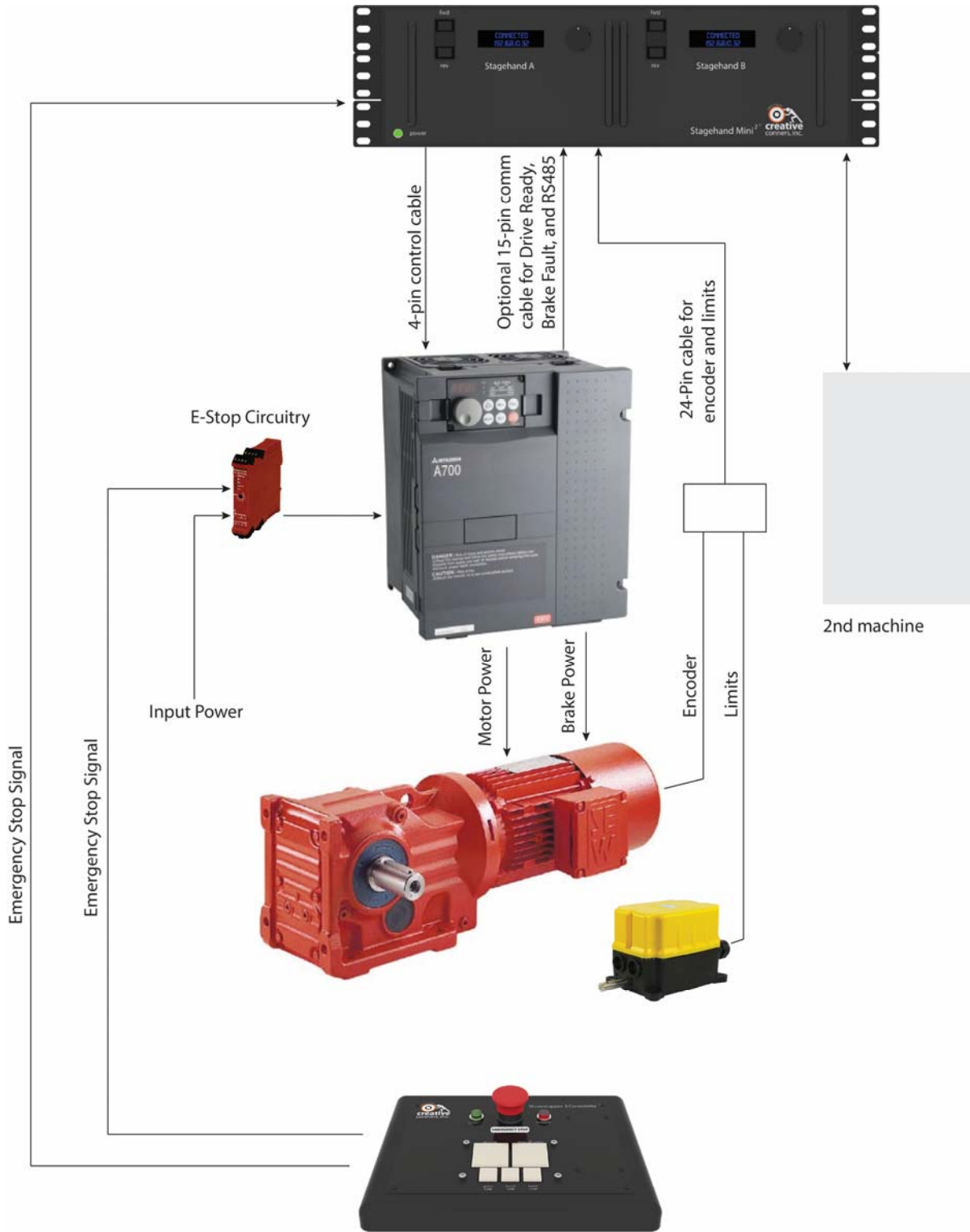
The primary control output from the Stagehand Mini<sup>2</sup> is a speed signal and an enable circuit for each of its two, independent controllers. The enable circuit informs the amplifier when it should start listening to the speed signal supply power to the machinery. The speed signal indicates both how fast and in what direction the machinery should move.

To sense how the amplifier and machinery are responding to the control output, the Mini<sup>2</sup> expects a quadrature encoder signal as input. That signal is useful in measuring how far and fast the machinery is moving. The control output and encoder input form the minimum closed-loop system that is required for motion. Any machine/drive combination that you connect to the Mini<sup>2</sup> must accept the control signals and provide an encoder signal in return.

Let's take a look at some common scenarios that show how this works in practice. Keep in mind that since the Mini<sup>2</sup> has two independent controllers, you can hook up two different machines to the Mini and cue each from Spikemark.

### Stagehand Mini<sup>2</sup> with a Variable Frequency Drive (VFD)

Whether you have an old VFD that you'd like to control with Spikemark, or you have a brand-new 20HP VFD your system will look similar to the diagram below.



Z

Figure 3

### Stagehand Mini<sup>2</sup> with a Electro-Hydraulic Valve

Hydraulic systems have a several attractive traits that make them tempting to use on stage. You can keep the HPU (hydraulic power unit) in a remote location out of earshot and run hoses to actuators on stage reducing the noise of the motion to practically nothing. Hydraulic systems also offer tremendous power to be packed into relatively small actuators. However, automating hydraulics with programmable speed and positioning has traditionally been tricky. However, using a either a servo valve or electric proportional valve either with on-board electronics (OBE) or a discrete valve driver and a Stagehand Mini<sup>2</sup> makes the process painless... well... if we are honest hydraulics are still finicky and a bit tricky, but at least it is possible with some planning and patience.

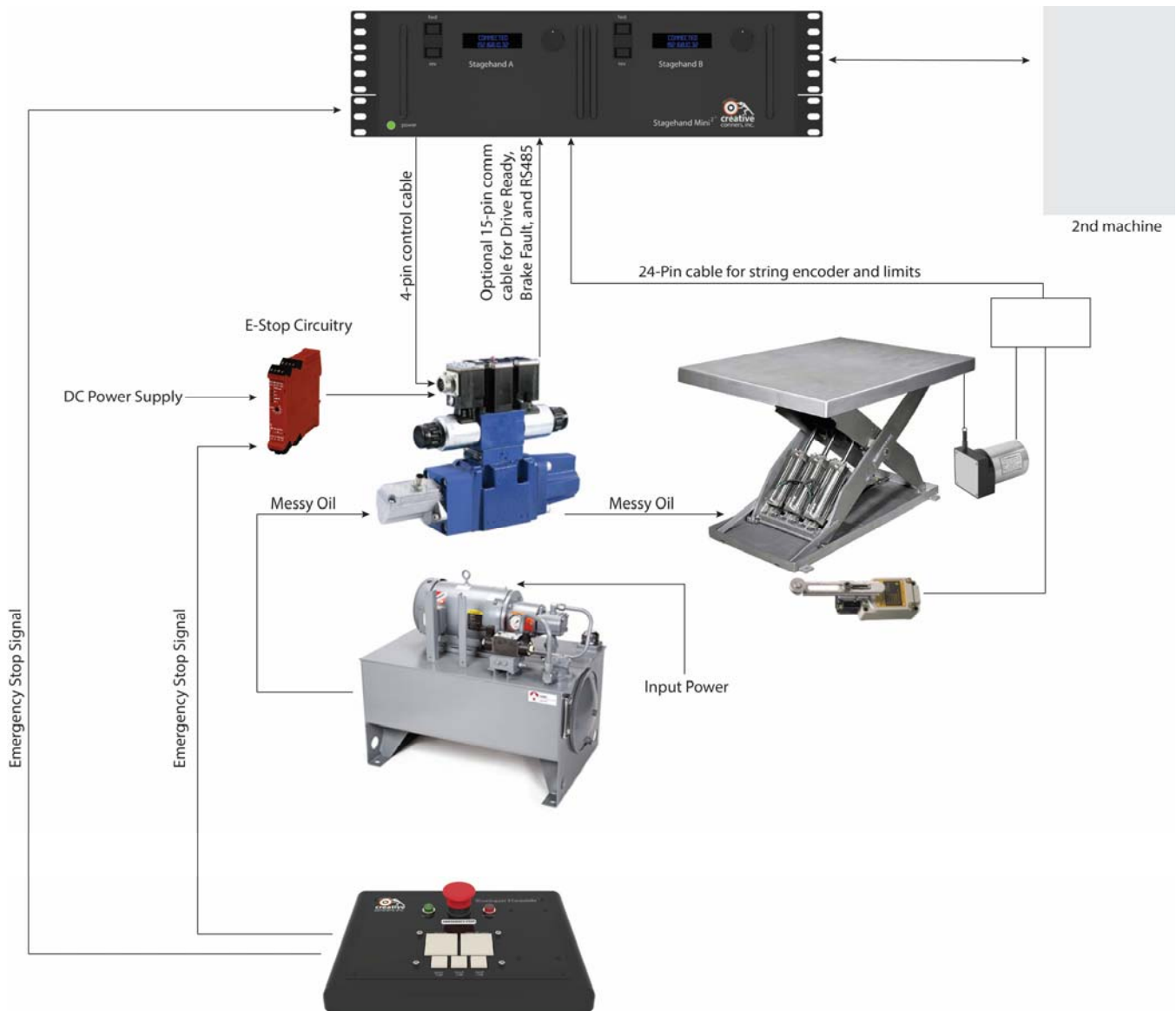


Figure 4



### **Stagehand Mini<sup>2</sup> with DC Drive**

DC motors used to be a staple of stage automation. Although their popularity has waned over the years as quieter AC induction motors and VFD's have become more economical and provide a better solution in many situations. However, there is still a lot of DC equipment with a useful life left and using a Mini<sup>2</sup> to breathe new life into old equipment can be a great way to expand your automation capacity. The hookup is similar to a VFD, with the addition of a signal isolator card which protects the Mini<sup>2</sup> from dangerous voltage levels.

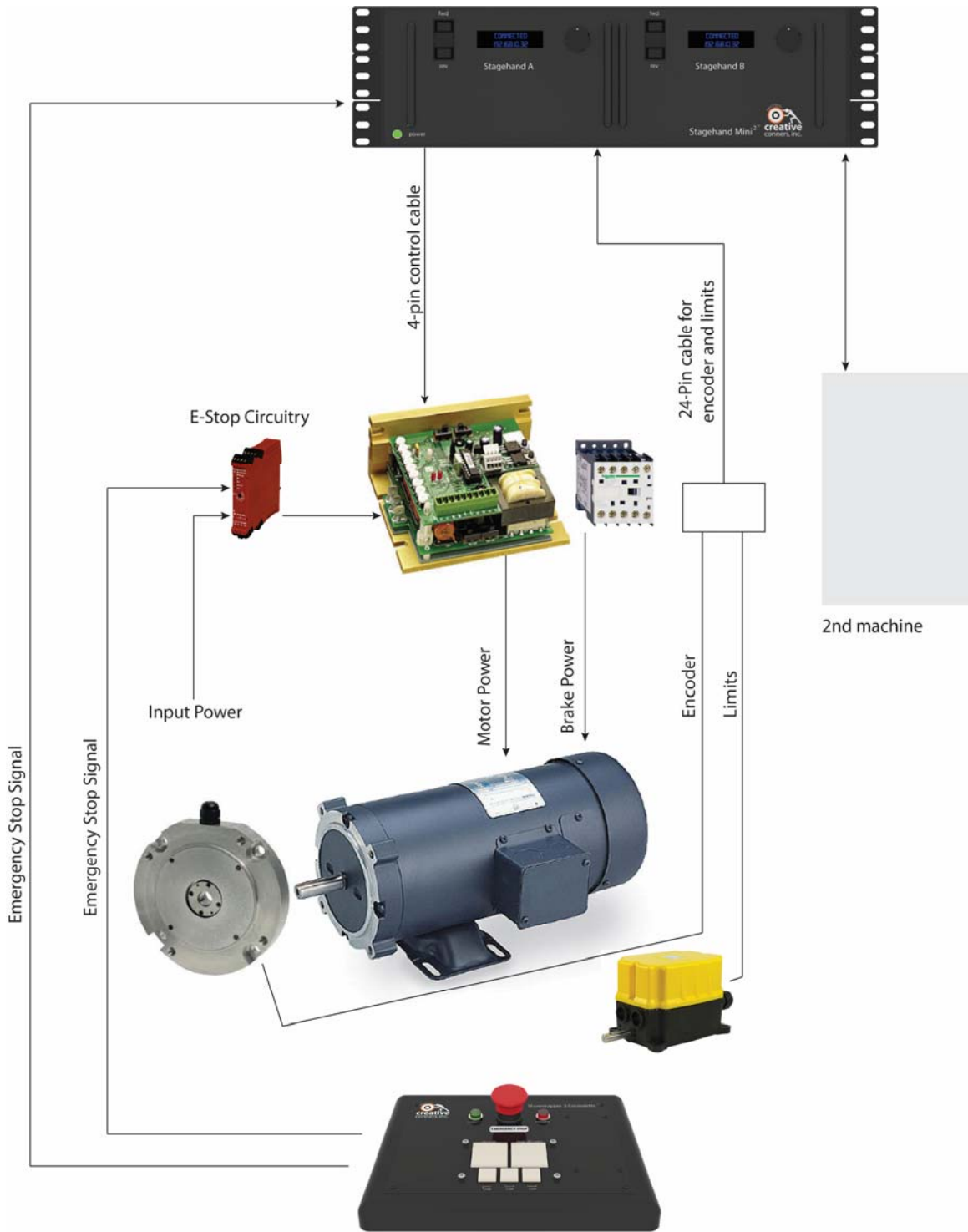


Figure 5

## Installation

The Stagehand Mini<sup>2</sup> has been designed primarily for mounting in a standard 19" equipment rack. It occupies a 3U space measuring 5.25" vertically. For easy operation, it is most convenient to mount the Mini<sup>2</sup> horizontally, you can also safely mount it vertically.

Figure 6

## Rack Mount

For touring applications, or permanent installations the Stagehand can be rack mounted in a standard 19" equipment rack using the included mounting ears. However, the rack must be orientated horizontally so that the Stagehand remains vertical in the rack for proper heat ventilation.

## Electrical Connections

Once the Mini<sup>2</sup> is installed in your rack it's time to take a look at the back side of the case and figure out all the electrical connections.

### Power Input Connection

The power inlet is a standard IEC C14 cord like many consumer electronics (computers, projectors, TV's, etc). The power inlet has a small fuse compartment next to the cord that slides out for easy replacement.

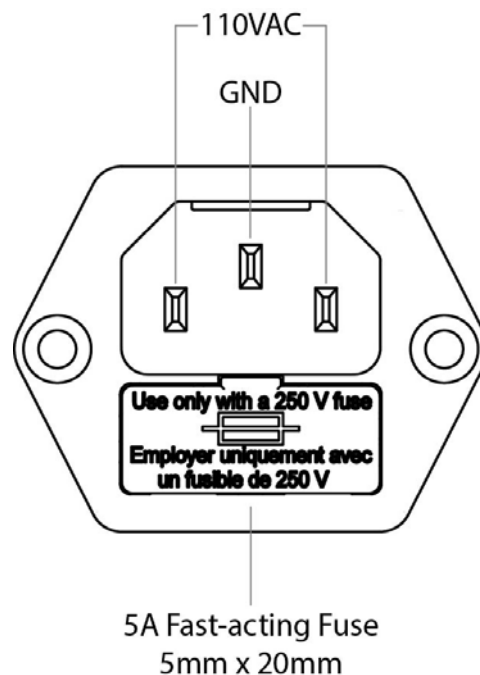


Figure 7

Included with your Stagehand Mini<sup>2</sup> is a 6' power cord with a locking IEC connector on one end and an Edison plug on the other. The locking connector presses onto the power inlet and automatically locks into position to

resist accidentally kicking the cord out and losing power. To release the locking connector, pull back on the orange tab and then pull the cord out of the inlet.



*Figure 8*

### **Showstopper (Emergency Stop) Connection**

The Stagehand Mini<sup>2</sup> requires a 24vdc Emergency Stop signal from a Showstopper to allow any motion signals to be output to your machine amplifier. Internally, the Stagehand Mini<sup>2</sup> has a redundant, self-monitoring circuit to insure that power will be removed from the amplifier enable signal instantly if the 24vdc Emergency Stop signal is interrupted. However, since the Mini<sup>2</sup> does control power directly to the amplifier (VFD, DC drive, valve driver, etc.) you must install appropriate safety contactors to interrupt power to your external amplifier. The external safety contactors that you install in your amplifier enclosure should be signaled by the same Showstopper that is connected to the Mini so that both devices are controlled by the same Emergency Stop signal. Here is an example, bear in mind that you must implement the safety circuitry appropriate for your application.

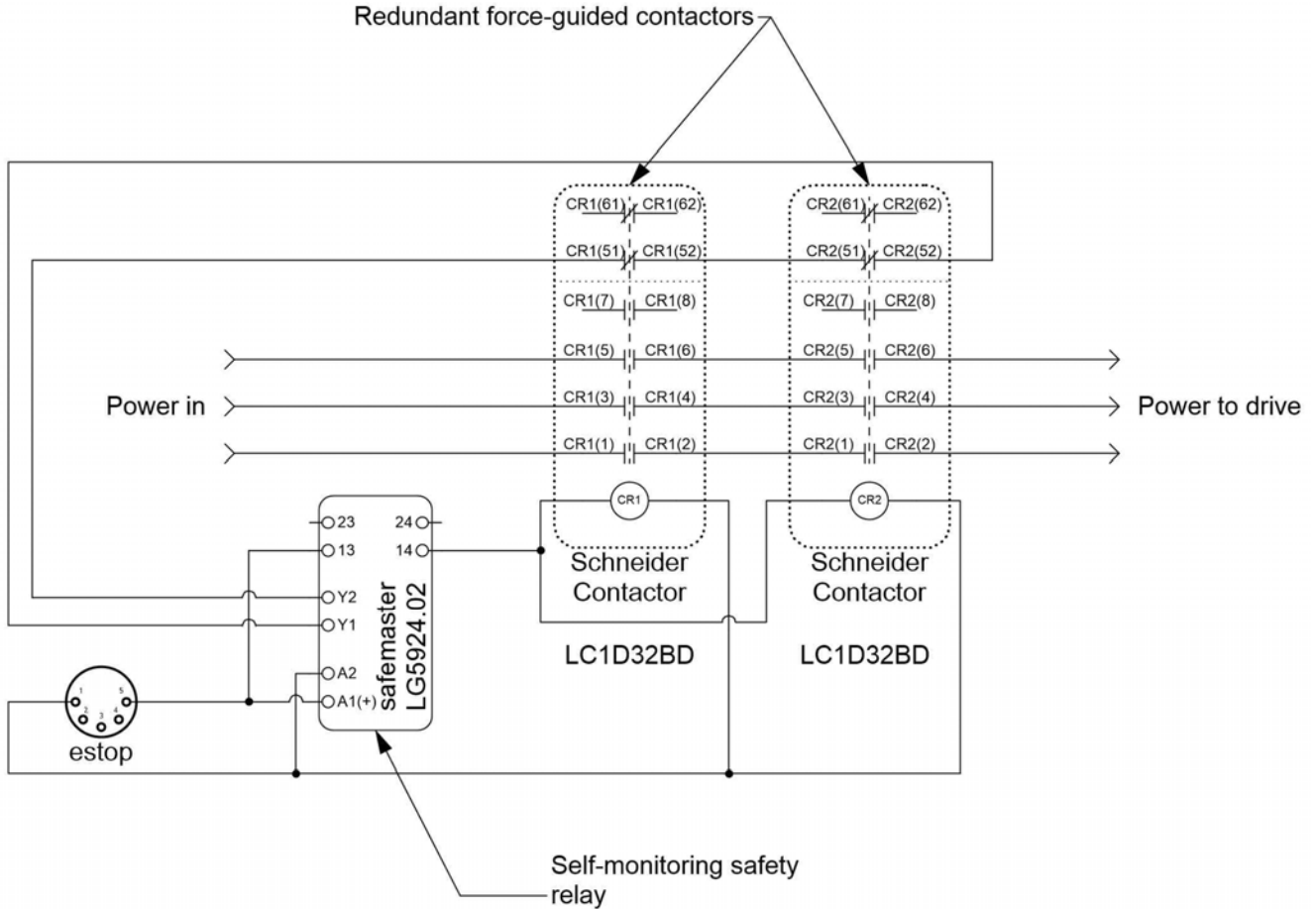


Figure 9

Before you can move any machine, you must connect the Stagehand to a Showstopper with a 5-pin XLR cable. The 5-pin XLR cable is not a DMX signal, but rather it was chosen as a convenient cable that is prevalent in many venues so you should always be able to find a spare cable when needed.

Below is the pin-out for the Showstopper Emergency Stop input:

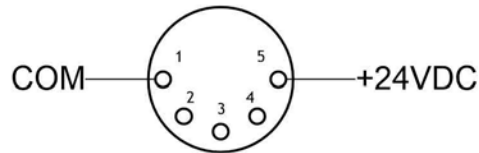


Figure 10

### Encoders and Limits Connections

Two sets of encoder signals (one for speed monitoring and one for positioning) and three sets of limit switches (forward, reverse, and ultimate) are combined in one rectangular connector (Harting connector: #09160243101, Harting plug: #09160243001 ).

All limit switch signals require Normally Closed (N.C.) switches. The Stagehand sources 12vdc on a pin of the each limit circuit and expects to see that 12vdc signal returned on the other pin when the limit is not activated. If the limit is either activated or disconnected or a wiring fault occurs, the 12vdc return signal is lifted and the Stagehand will enter a limit fault condition and disallow motion.

The limit switch inputs are used to protect against the motor traveling too far in a direction and causing damage or injury. When running in a cue, this is one of the safety features that guards against encoder failure. When jogging manually, this keeps you from accidentally traveling too far.

All encoder signals use differential line receivers which use a balanced signal transmitted over twisted-pair wires to drastically reduce electrical interference and thus reduce the opportunity for inaccurate encoder data. Encoders connected to the Stagehand must be equipped with differential line drivers to be compatible. Encoders are powered at 5vdc for broadest compatibility.

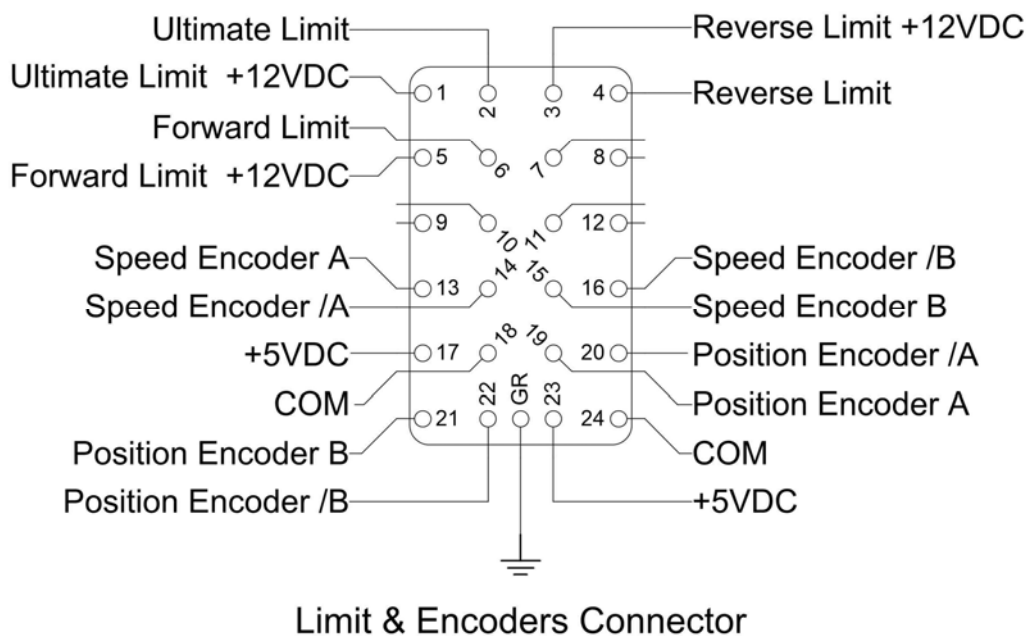


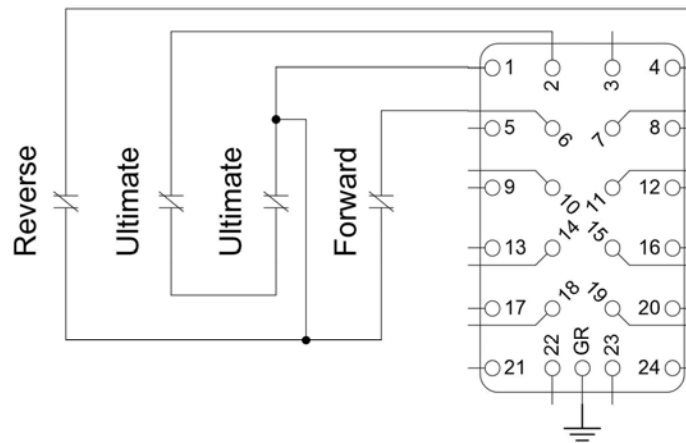
Figure 11

Let's start with the limit signals:

- **Ultimate Limit** – a pair of Normally Closed (N.C.) switches can be wired in series to this pair of terminals to provide protection against Forward and Reverse Limit switch failures. Typically, an Ultimate Limit switch is positioned just beyond both the Forward and Reverse Limit switch. If an Ultimate Limit is activated, the Stagehand will disallow any further movement until the limit is physically cleared. In normal operation, there is never a reason to strike an Ultimate Limit. An Ultimate Limit signal indicates an equipment problem with at least one of the primary limit switches. The faulty equipment must be repaired and the Ultimate Limit must be mechanically reset before the Stagehand will allow motion.

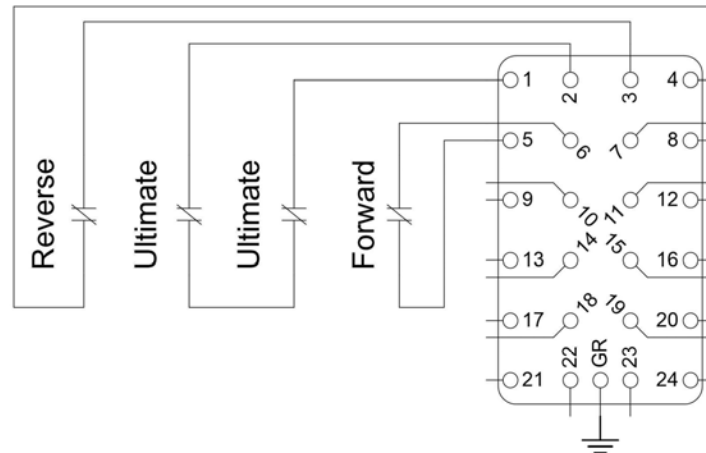
- Reverse Limit – a Normally Closed (N.C.) switch can be wired to this pair of terminals. If the switch is activated, the Stagehand will not allow further motion in the reverse direction until the limit is cleared either by adjusting the switch mechanically or by moving in the forward direction far enough to clear the limit switch.
- Forward Limit – a Normally Closed (N.C.) switch can be wired to this pair of terminals. If the switch is activated, the Stagehand will not allow further motion in the forward direction until the limit is cleared either by adjusting the switch mechanically or by moving in the reverse direction far enough to clear the limit switch.

Since the Stagehand provides three (3) separate pins that all source 12vdc, one for each limit signal, you can reduce the wiring in your machine to four (4) wires by using just one of the 12vdc source pins and three (3) wires for the three limit return signals. Sometimes it is more convenient to wire a pair of conductors for each switch, other times it may be better to reduce the number of conductors by sharing a common voltage source. Both options are shown below:



Shared Common Limit Wiring

Figure 12



Discrete Limit Wiring

Figure 13

Now let's take a look at the encoder signals:

- **Speed Encoder (optional)** – a set of quadrature signals that can be used by the Variable Frequency Drive (VFD) to accurately regulate speed. Internally, the Stagehand Mini<sup>2</sup> does not use the Speed Encoder but the pins are available to use if you have a VFD (or other amplifier) that can use the signal for tighter speed regulation.
- **Position Encoder** – a set of quadrature signals used by the motion controller to drive the motor to correct positions on cue. This encoder may be the same as the Speed Encoder or it may be a separate encoder. For instance, a scissor lift that is driven by a variable-speed pump needs a speed encoder on the pump motor, but the positioning encoder should be placed directly on the lift platform since the relationship between the motor rotation and platform position changes depending on the extension height of the lift as it raises and lowers. A deck winch however, can use a single encoder mounted on the motor for both speed and positioning.

As mentioned above, you can use either a single encoder mounted to the motor for both Speed and Position Encoder signals, or separate encoders mounted in different locations on the machine. Below are two drawings that show how to wire your encoder signals in both scenarios:



Single encoder:

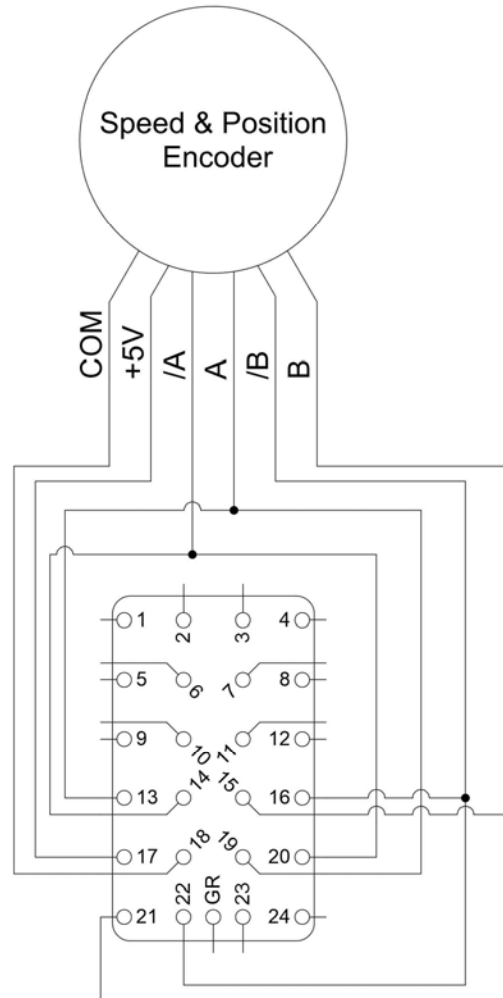


Figure 14

Dual encoders:

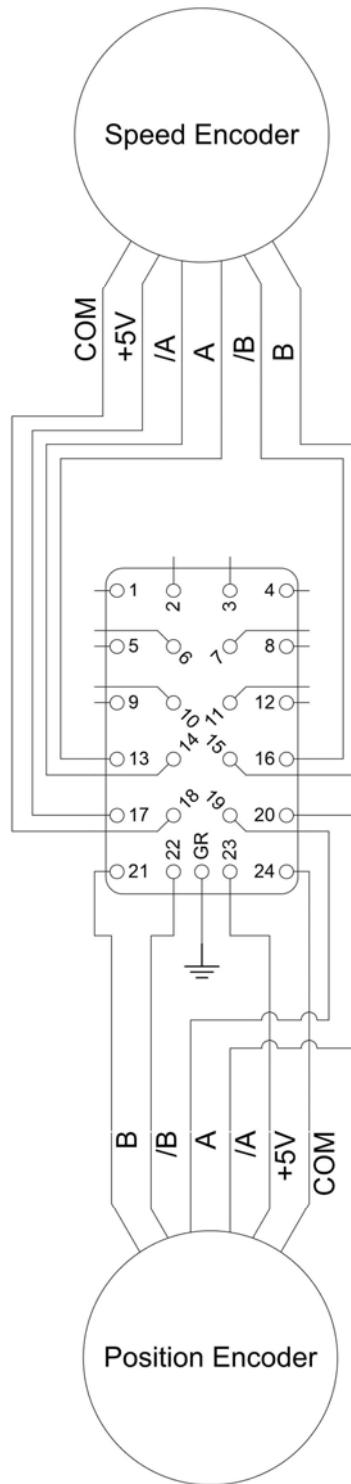


Figure 15

## Ethernet Connection

To communicate with Spikemark and run cues in a show, the Stagehand needs to be connected to a network. Located on the back side of the Stagehand, the Ethernet input will accept a CAT5 network cable with either a traditional RJ45 plug or a RJ45 plug with a Neutrik Ethercon shell installed (Mouser Part #568-NE8MC-B). The Ethercon shell is an XLR housing that slips over a network cable to provide additional strain relief and a positive-lock connection that makes it preferred backstage.



Figure 16

## Control Signal Output

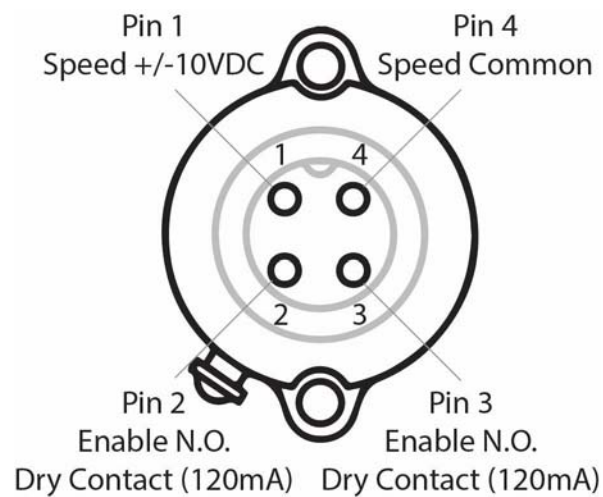
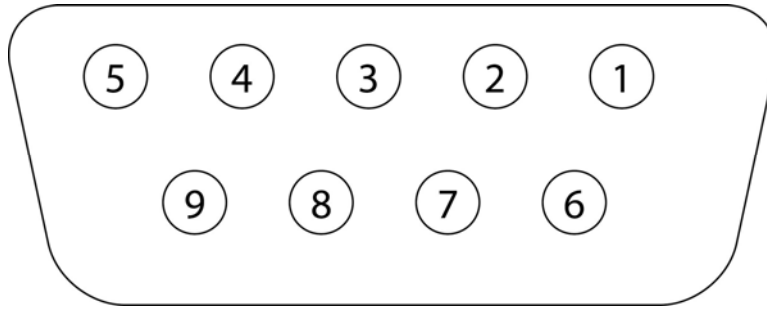


Figure 17

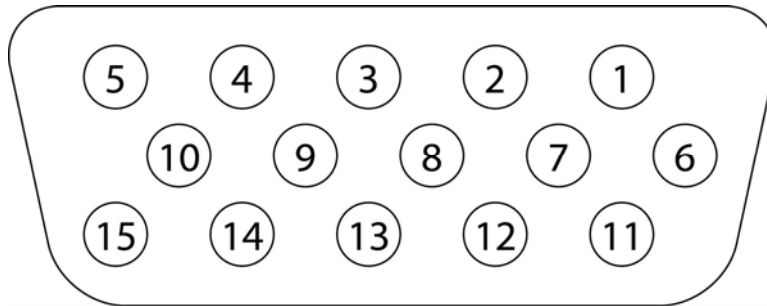
### Serial (DB9)



The Mini<sup>2</sup> has DB9 plugs to support upcoming accessories that operate over RS-232 serial. The connections are:

Pin Number	Connection
2	Serial Receive
3	Serial Transmit
5	Serial Common
9	+5VDC

### Drive Comm (HD15)



The Mini<sup>2</sup> has 15-pin high-density D-Sub connector that support a few nifty features, some are currently used in our Spikemark cueing software and others give access to upcoming capabilities.

Pin Number	Connection
1	Drive Ready Input
2	Brake Fault Input
3	Input Common
4	Aux Output 1 (120mA N.O.)

5	Aux Output 1 (120mA N.O)
6	Aux Output 2 (120mA N.O)
7	Aux Output 2 (120mA N.O)
8	RS485 A
10	RS485 B
11	Power Common
12	Power +12VDC

### *Auxiliary Outputs*

Each **Drive Comm** connector houses two dry-contact outputs that are rated for 120mA each. These outputs are unimaginatively named **Aux Output 1** and **Aux Output 2**. The purpose of these outputs is not set in stone, but as of the first release (July 2014, firmware v22) Aux Output 1 is programmed to open and close in the following situations:

Situation	Aux Output 1 Open/Close
Idle, no motion being commanded.	Open
Jogging initiated on manual mode, but 0% speed.	Open
Jogging at greater than 0% speed.	Closed
Programmed cue started, but running for less than 250ms.	Open
Programmed cue has been running for at least 250ms.	Closed

**Aux Output 1** behavior was created to help with a specific hydraulic system where additional lock valves need to be engaged and disengaged with a slight delay.

**Aux Output 2** is currently not used, but certainly will find some use in the future. If you have a need, please contact us to discuss your application.

### *RS485 Serial Link*

Each controller in the Stagehand Mini<sup>2</sup> has an RS485 serial link that will, in the future, be used to communicate directly with a VFD (Variable Frequency Drive) to garner status information from the drive. As of this writing, Spikemark does not yet support this feature but it is planned for future updates.

### *Brake Fault Input*

The Brake Fault Input is one of two inputs that can be used to get more information about the health of the machine that is being controlled by the Mini<sup>2</sup>. If you have a machine & suitable electronic sensor circuits that detect whether or not your mechanical brakes are functioning, you can use this input to pass that information along to the Stagehand Mini<sup>2</sup> and thereby display that status in Spikemark.

[Diagram needed]

Internally, the Brake Fault Input uses an opto-coupler to isolate the Mini<sup>2</sup> from external interference. When a voltage of at least 3.3VDC, in reference to the Input Common pin, is sensed the Brake should be operating normally and the Mini<sup>2</sup> is free to move the machine as commanded. However, if no voltage is detected then the Mini<sup>2</sup> believes that the brake is unreliable and will not allow any movement. If you do not want to use the Brake Fault Input, you must supply 3.3-24VDC to disable this fault. The included 15-pin shorting plugs will disable both the Brake Fault and Drive Ready inputs.

<b>Brake Fault Input Voltage</b>	<b>Stagehand Mini<sup>2</sup> Condition</b>
<b>&lt;3VDC</b>	Brake is faulty, will not move.
<b>3VDC – 24VDC</b>	Brake is operating normally, OK to move.

### *Drive Ready Input*

The other input available to gauge the health of a machine or drive connected to the Mini<sup>2</sup> is the Drive Ready Input. As the name suggests, when the Drive (aka Amplifier) is healthy and without a fault it can signal to the Mini<sup>2</sup> through this input pin that it is ready and waiting to move. If the drive has an internal fault that will prevent it from executing a movement, it can remove the signal on the input and the Mini<sup>2</sup> will no longer attempt to execute any motion until the fault is resolved.

[Diagram needed]

Just like the Brake Fault Input, the Drive Ready Input is isolated from external interference by an opto-coupler. A voltage (3VDC-24VDC) referenced to the Input Common pin must be present to indicate that the drive is healthy and fault-free. Many VFD's, electro-hydraulic valves, and some DC drives offer a fault-indicating output that can be connected to this input which is advantageous to use when available. Without this input, the Mini doesn't receive any feedback when the amplifier is unable to run for any reason and will blithely attempt to run cues and have no idea why nothing is moving. Since the Mini<sup>2</sup> has no idea why nothing is moving, the unlucky operator running Spikemark will also be in the dark about why the system isn't responding as expected. So, if you can, use this input it is definitely worth a little time spent wiring.

Similar to the Brake Fault Input, the Drive Ready Input requires that voltage is present to allow movement. If you don't want to utilize the Drive Ready Input, you must supply voltage to the pin to disable the feature. The included shorting plug will disable both the Drive Ready Input and the Brake Fault Input.

Drive Ready Input Voltage	Stagehand Mini <sup>2</sup> Condition
<3VDC	Drive is faulted, no movement allowed.
3VDC – 24VDC	Drive is operating normally, OK to move.

## Using the Stagehand

Once all of your connections are made, the next step is to test the basic machine functions with the Stagehand. The first time you apply power to your machine should be done without a load attached. It can be quite scary if a multi-ton piece of scenery is yanked around by a misbehaving machine, so make sure to do your first test run in the shop or on an empty stage without any scenery connected.

### Jog the Motor

Before you can write complex cues in Spikemark, let's make sure the machine runs fine with when jogging it manually using the buttons and knobs on the face of the Stagehand.

- Release the Emergency Stop button on your Showstopper
- Press the Forward Button.

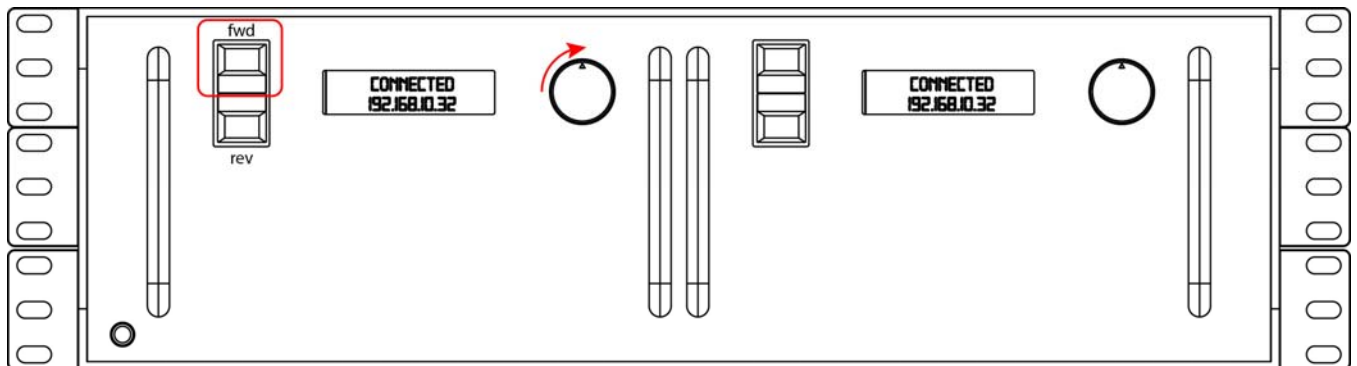


Figure 18

- While holding the Forward Button turn the Knob Clockwise slowly. The brakes should release and the machine should begin to move. The Position Encoder counts are displayed on the Status Display. The counts should be increasing in positive value, if not the motor and encoder are out of phase and you'll need to rewire either the motor or encoder. See the troubleshooting section for more details.
- Gradually rotate the Knob counterclockwise until the machine stops.
- Release the Forward Button.
- Press the Reverse Button.
- While holding the Reverse Button turn the Knob Clockwise slowly. The brakes should release and the machine should begin to move. The Position Encoder counts are displayed on the Status Display. The counts should be decreasing, if not the motor and encoder are out of phase and you'll need to rewire either the motor or encoder. See the troubleshooting section for more details.

If you strike a limit while jogging in the direction of the limit, the Stagehand will immediately stop the motor. If you strike a forward limit while jogging forward you will have to release the forward jog button and then jog in reverse. If you strike a reverse limit while jogging reverse you will have to release the reverse jog button and then jog forward. If you strike an ultimate limit, you will have to physically clear the limit switch before restarting motion in either direction.

### Understanding the Status Display

The two-line alphanumeric display on the Stagehand Pro (which is the brain of the Mini<sup>2</sup>) motion controller uses OLED technology to make it easy to read backstage without a distracting backlight. It also has excellent viewing angles making it easier for you and other operators to see status information at a glance. The Stagehand is primarily used through our Spikemark software, but it is handy to have some bits of information displayed on the Stagehand's faceplate for those times that you are working onstage near the machinery and not sitting in front of a computer running Spikemark. Also during shop setup, load-in, and strike you may not have Spikemark running and need to manually operate the Stagehand. The following list explains the information that you can glean from the Stagehand display.

#### Network Connectivity

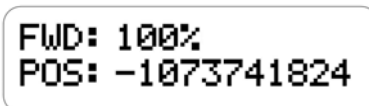


NOT CONNECTED  
192.168.100.100

Figure 19

When sitting idle, the Stagehand will display its IP address on the bottom line and whether the Stagehand is actively connected to Spikemark. **Connected** means that the Stagehand has an active connection with a Spikemark computer, **Disconnected** means that the Stagehand is not actively communicating with Spikemark.

#### Encoder Position



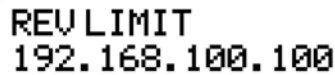
FWD: 100%  
POS: -1073741824

Figure 20

If you press either the Forward or Reverse jog button, the Stagehand will display the direction it is traveling and current speed as a percentage of full power on the top line. On the bottom line it will display the Position Encoder's counter in raw encoder counts. Inside Spikemark the position data will be shown in scaled units, such as feet or inches, but on the Stagehand the raw encoder counts are displayed since the Stagehand isn't aware of Spikemark's Position Scale. The position information is helpful when testing equipment in the shop prior to load-in. You can use a Stagehand to power up a machine and confirm that the encoder is working properly by watching the counts increase and decrease when running forward and reverse respectively. If counts decrease when running forward you know that the motor and encoder polarity are mismatched and should be rewired before attempting to run cues.



### Limits

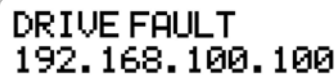


REV LIMIT  
192.168.100.100

Figure 21

When a Forward, Reverse, or Ultimate Limit is struck the top line of the display will flash an appropriate fault message in rotation with any other fault messages. If you strike a directional limit switch, either forward or reverse, you will have to run the motor in the opposite direction to clear the fault message. If you strike an ultimate limit you will have to physically clear the limit switch before the fault message will clear.

### Drive Fault

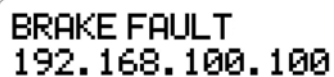


DRIVE FAULT  
192.168.100.100

Figure 22

The VFD has many fault conditions that can cause it to interrupt power to the motor and cease motion. Mechanical overload, encoder signal loss, over-speed, and under-voltage are just a few of the common faults that will render a Stagehand unresponsive. All of these faults register a common “Drive Fault” message on the status display and in Spikemark. Consult the Mitsubishi A700 manual for the exact fault description (the error code is displayed on VFD keypad). To clear a drive fault, correct the cause of the fault and then either cycle the Emergency Stop or press the STOP | RESET button on the VFD keypad.

### Brake Fault

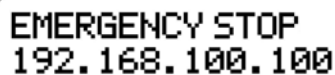


BRAKE FAULT  
192.168.100.100

Figure 23

The Stagehand monitors the force-guided relay switches which control power to both brake circuits. If the Stagehand detects that a relay has failed to operate properly, it will not allow the remaining, properly-operating brake to release nor will it allow the motor to move. In order to clear this fault, the Stagehand must be returned to Creative Conners for service.

### Emergency Stop



EMERGENCY STOP  
192.168.100.100

Figure 24

When the Emergency Stop circuit is activated, or unplugged, the Emergency Stop fault message will be added to the flashing fault messages. Any motion that was occurring when the Emergency Stop was detected will be

stopped. To clear the fault, release the Emergency Stop button on the Showstopper. Once the fault is cleared, any motion that you wish to execute will have to be restarted. If you were jogging, you will need to release the jog button and start again. If you were running a cue through Spikemark, that cue will need to be re-loaded and run again. At no time will the Stagehand immediately restart after an Emergency Stop fault is cleared, since such behavior could pose a serious safety risk.

### Set an IP Address for Spikemark Cueing

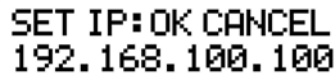


Figure 25

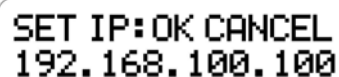
When you are ready to write and run complex cues with Spikemark, you may need to assign a new IP address to each controller in the Stagehand Mini<sup>2</sup>. Every device on the automation network must have a unique, but similar, static IP address. Remember that the Mini<sup>2</sup> is really just two completely independent motion controllers packaged into one case, so each controller must have a unique address. The easiest address scheme to adopt is to share the first three segments of the IP address and just alter the last segment. We typically use addresses that start:

192.168.10.xxx

The last number can be any value from 0 – 255, but no devices on the network can share the same value.

To set the IP address of the Stagehand:

- Press the Knob. The Knob serves double-duty as a typical rotary knob and a button (much like a car stereo knob).
- The SET IP address screen will be displayed just like the picture below:



- There is a blinking cursor on the display, turning the knob will scroll the cursor through the various fields. By turning the Knob, scroll over to the last segment of the IP address which is 32 by default.
- Press the Knob to select the last segment and make it adjustable.
- Turn the Knob to set a new value.
- Once you are happy with the new value, press the Knob to accept the value.
- By turning the Knob, scroll over to the OK and then press the Knob to set the new address and return to the primary display screen. If you want to cancel the changes you made to the IP address, place the cursor over CANCEL and press the **Knob**.

## Battery Backup for Encoder Position

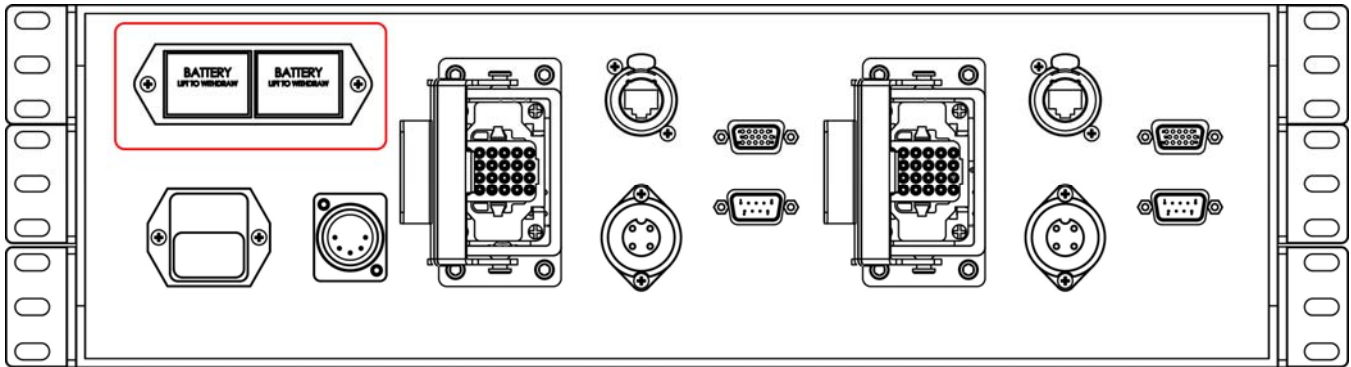


Figure 26

As the machine moves, the Position Encoder sends pulses to the motion controller. The motion controller adds or subtracts those pulses from a position counter that is kept in memory. If power is lost, the counter is cleared from memory and when the Stagehand powers up again the position counter will be reset to 0. With a little imagination you can envision the trouble this can cause onstage if a Stagehand power cord is kicked out of the wall between cues, or fuse blows, or a brown-out occurs. Motors that are sitting out in the middle of the stage will look to Spikemark like their position is off in the wings. If the next cue is run without noticing the issue the motor will try to run either way too far, or not far enough and possibly cause a collision.

To prevent mishaps on stage during the show, the Stagehand has two slots on the face for a pair of 9V batteries. The batteries will power the motion controller if main power is temporarily lost. This battery backup will keep the position counter from resetting and thus eliminate problems associated with power outages.

The batteries only provide about an hour of power, so they shouldn't be relied upon for long power outages. In cases where power will be lost for an hour or more, record the position of the Stagehand and then power it down by removing the batteries. When power is restored, use the Reset Position feature in Spikemark to reset the Stagehand counter to the position you recorded during the power outage.

## Troubleshooting

If you've reached this section of the manual, things aren't going well. Take a look at some of the common problems and solutions. If none of those help get you up and running, please get in touch with us. Our various methods of communication can be found in the Technical Support section.

### Common Problems

Problem	Solution
<p><b>When running forward, the encoder position decreases. When running reverse, the encoder position increases</b></p>	<p>The encoder and motor have electrically inverse polarity. You need to either change the motor wiring or the encoder wiring.</p> <p>Re-wire the motor to match the encoder polarity:</p> <ul style="list-style-type: none"> <li>• Swap two power legs on the motor by swapping the wires on Pin 1 and Pin 2 inside the motor plug.</li> </ul> <p>– OR –</p> <p>Re-wire the encoder to match the motor polarity:</p> <ul style="list-style-type: none"> <li>• Swap signal A with signal B</li> <li>• Swap signal /A with signal /B</li> </ul> <p>You may need to rewire both the Position and Speed encoder signals.</p> <p>– OR –</p> <p>Re-wire the speed output signal to reverse the drive direction:</p> <ul style="list-style-type: none"> <li>• Swap pins 1 &amp; 4 on the control cable</li> </ul>
<p><b>The OLED status display is dark, but the main power indicator is on.</b></p>	<p>The motion controller may be disconnected internally, to fix it:</p> <ul style="list-style-type: none"> <li>• Unplug the power cord from the Stagehand. Remove the motion controller by loosening the four (4) #10 socket head</li> </ul>

	<p>cap screws surrounding the motion controller.</p> <ul style="list-style-type: none"> <li>• Gently pull the faceplate forward to view the back side of the circuit board behind the faceplate.</li> <li>• Check that all terminal blocks are securely mated onto the circuit board.</li> </ul>
<b>Motor runs roughly or makes strange noises when jogging manually.</b>	Run the auto-tuning procedure outlined on page <b>Error! Bookmark not defined..</b>
<b>Both the FWD LIMIT and REV LIMIT fault messages are displayed on the status screen and the motor won't move.</b>	<ul style="list-style-type: none"> <li>• Make sure the Encoder/Limits cable is plugged into the rear of the Stagehand.</li> <li>• Check the placement of your limit switches, if both are physically activated, adjust the placement to clear one or both switches.</li> <li>• Check the limit switch wiring, confirm that the switches are wired Normally Closed (N.C.)</li> </ul>
<b>I'm trying to jog the motor, but the status display shows "SET IP".</b>	<p>The motion controller is in IP Address setting mode, which happens when the knob is pressed (either intentionally or just bumped in passing). Turn the knob until the cursor is blinking over the word CANCEL and then press the knob. The motion controller will now be in normal mode and can jog the motor again.</p>

### Technical Support

Despite our best efforts and intentions to provide reliable equipment and clear instructions, there may come a time that you need more direct, personal help. We are happy to do that too. Please get in touch in whatever way is most convenient:

- Phone: 401-289-2942. We're open weekdays 8:30am – 5:00pm EST. If you call outside of normal business hours (like during tech, or pre-show check, or intermission), one of us will be on-call with a cell-phone gaff-taped to his hand. Listen to the message on our main phone number to get the cell phone number of the technician on-call.
- Fax: 401-289-0259. Honestly, I don't think anyone uses the fax for tech support, but you are free to be the first.

- Email: [support@creativeconners.com](mailto:support@creativeconners.com). Email can be really convenient for tech support if you don't have a time-critical problem. If you are having trouble with a specific cue in a show, please email us your show file and log file from Spikemark with a description of the issue. We respond within 24 hours, but usually it's just a matter of minutes.
- Web forum: <http://creativeconners.com/phpBB3/>. Our forum has some cobwebs these days, not too many folks prefer it over the phone or email, but we still check it religiously every day and answer any questions that come up.

## Specifications

### Electrical Specifications

Description	Value
<b>Input Voltage</b>	120VAC 50/60Hz 1P
<b>Max Input Current</b>	<p>5 amps. Supply proper branch circuit protection using UL Class T fuses or a Listed UL 489 Molded Case Circuit Breaker (MCCB) with a maximum allowable rating of 20A.</p> <p>Supplemental circuit protection is provided by the fused power inlet. Replace with 5mm X 20mm fast-acting fuse rated for no more than 5amps.</p>
<b>Control Output Voltage</b>	Variable voltage 0 to +/-10VDC
<b>Control Output Current</b>	30mA max
<b>Enable Circuit Output</b>	<p>1 N.O. dry contact</p> <p>30VAC/42VDC max</p> <p>120mA max</p>
<b>Auxiliary Serial Port</b>	<p>RS232</p> <p>DB9 plug (male)</p>
<b>Drive Communication</b>	<p>RS485</p> <p>Included in 15-pin high-density d-sub connector (female)</p>
<b>Auxiliary Output 1</b>	<p>1 N.O. dry contact</p> <p>30VAC/42VDC max</p> <p>120mA max</p>
<b>Auxiliary Output 2</b>	<p>1 N.O. dry contact</p> <p>30VAC/42VDC max</p> <p>120mA max</p>

<b>Drive Ready Input</b>	Optically isolated input 3VDC – 26VDC 60mA max current draw
<b>Brake Fault Input</b>	Optically isolated input 3VDC – 26VDC 60mA max current draw
<b>Emergency Stop Input Voltage</b>	24VDC
<b>Emergency Stop Input Current</b>	65mA
<b>Forward Limit Switch Voltage</b>	12VDC
<b>Forward Limit Switch Current</b>	10mA
<b>Forward Limit Switch Contact Type</b>	Normally Closed (N.C.) dry contact
<b>Reverse Limit Switch Voltage</b>	12VDC
<b>Reverse Limit Switch Current</b>	10mA
<b>Reverse Limit Switch Contact Type</b>	Normally Closed (N.C.) dry contact
<b>Ultimate Limit Switch Voltage</b>	12VDC
<b>Ultimate Limit Switch Current</b>	10mA
<b>Ultimate Limit Switch Contact Type</b>	Normally Closed (N.C.) dry contact
<b>Position Encoder Input</b>	5VDC (12VDC tolerant) with differential line driver
<b>Encoder Power Supply Voltage</b>	5VDC
<b>Encoder Power Supply Current Rating</b>	2.4A
<b>Control Input</b>	10Base-T Ethernet

### Performance Specifications

Description	Value
<b>Maximum Encoder Position</b>	1,073,741,823 counts



<b>Minimum Encoder Position</b>	-1,073,741,824 counts
<b>Maximum Encoder Velocity</b>	15,999,023 counts/second
<b>Maximum Acceleration</b>	15,999,023 counts/second/second

## Physical Specifications

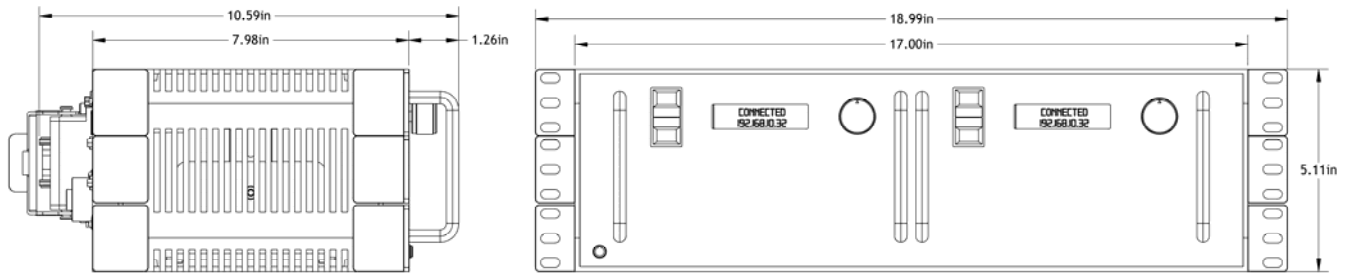


Figure 27

## Wiring Diagram

The following page is a B-size print of the Stagehand Mini<sup>2</sup> wiring diagram.