



STAGEHAND HYDRAULIC™

REFERENCE MANUAL v1.0

GETTING STARTED

Congratulations on your purchase of the **Stagehand Hydraulic** from Creative Conners, Inc. The **Stagehand Hydraulic** is a purpose built motion controller for hydraulic effects using **Spikemark** software. The **Stagehand Hydraulic** is designed to control a single proportional valve connected to a fixed speed hydraulic pump. To turn the pump on and off, you may need additional controls, such as a **Stagehand FX**.

The **Stagehand Hydraulic** incorporates the valve power supply, safety interlock circuitry, and motion controller all in a 3U rack enclosure. Tiny is mighty, this one product now replaces 3 products to control a hydraulic effect while incorporating bumper switches and interlocks to keep motion safe. The **Stagehand Hydraulic** is the only controller you need to *Make It Move!*, hydraulic style.

This manual will guide you through:

- Unpacking
- Installation
- Powering up
- Operation
- Troubleshooting

If you need any help along the way, contact us!

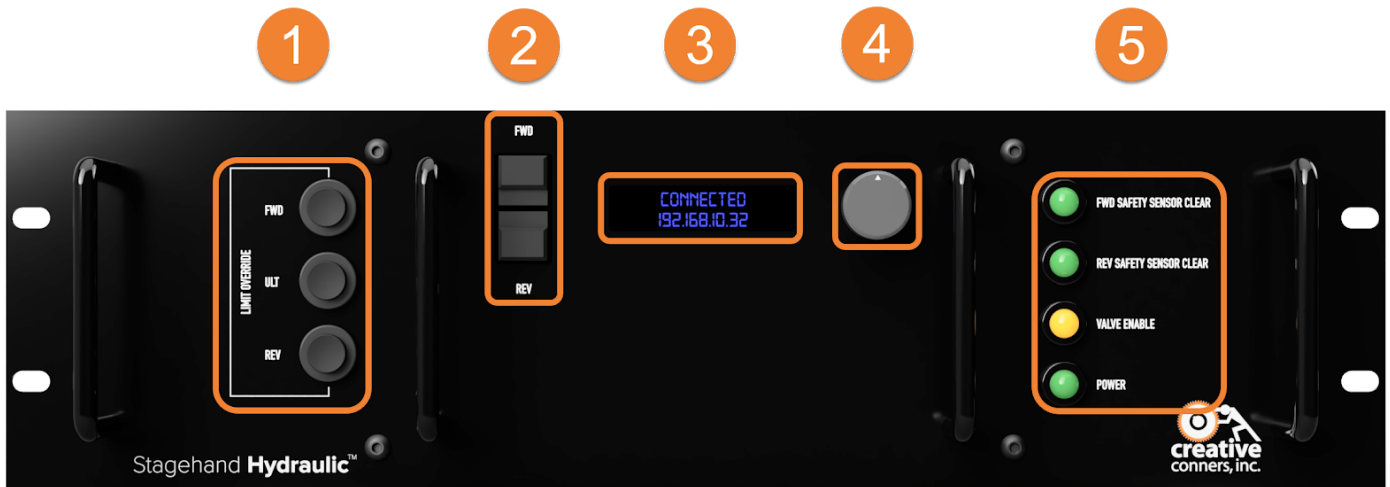
- Online: www.creativeconners.com
- Email: support@creativeconners.com
- Phone: 401-289-2942 x2

What's in the box?

Inside the box, you should find:

- **Stagehand Hydraulic** Motion Controller
- 5 ft. IEC power cord
- 2 **Interlock** safety jumpers
- 2 auxiliary limit jumpers
- #10-32 rack mount screws with nylon washers (x4)

Stagehand Hydraulic Features



1. Forward, Reverse, and Ultimate Limit Override Buttons
2. Forward and Reverse Jog Buttons
3. OLED Status Display
4. Knob
5. Forward Safety Sensor, Reverse Safety Sensor, Valve Enable, and Power Indicator Lights

Limit Switch Override Buttons

Ever hit a limit switch and grumbled about having to grab a screwdriver to adjust the switch during initial installation? Grumble no more, you can press the corresponding override button to temporarily disable the limit signal.

Forward and Reverse Jog Buttons

Press and hold the FWD or REV jog button, then turn the speed knob, to manually move your hydraulic effect.

OLED Status Display

A two-line display shows handy, at-a-glance info. It's OLED which makes it easy to see backstage in the dark.

Knob

When used with the jog buttons, turning the knob will adjust the speed from 0%-100%. The knob, when pressed, is also a button for network configuration.

Status Indicator Lights

On the **Stagehand Hydraulic**, there are 4 LEDs to indicate the status of the controller. The 4 indicator lights display the following information

-
- **FWD Safety Sensor Clear:** A green light indicates that the forward safety sensors are not engaged. If a safety sensor is struck (e.g. bumper switches, pressure mats), the light will turn off and no further motion in the forward direction will be allowed.
- **REV Safety Sensor Clear:** A green light indicates that the reverse safety sensors are not engaged. If a safety sensor is struck, the light will turn on if no safety sensor (e.g. bumper switches, pressure mats) are engaged in the REV Safety control loop the light will turn off and no further motion in the reverse direction will be allowed.
- **Valve Enable:** A yellow light will turn on if the hydraulic valve is enabled
- **Power:** A green light will turn on if the **Stagehand Hydraulic** is receiving input power

Persistent Position

Stagehands used to require a battery backup to maintain encoder position data through a power loss. However, we never loved this solution. Wouldn't it be better if the **Stagehand** could remember the machine's position without a battery? Yes, we thought so too. We developed a nifty feature in the **Stagehand** firmware that records the encoder position to flash memory and then reads that position back if it loses power. This bit of engineering removes the need for a battery backup inside the **Stagehand Hydraulic**.

INSTALLATION

The **Stagehand Hydraulic** is designed to be mounted horizontally in a standard 19" equipment rack. Use the included rack mount screws to fasten the controller into an equipment rack.

Making the Connections



1. Input Power
2. Ethernet
3. Forward Safety Sensor Connections
4. Reverse Safety Sensor Connections
5. Auxiliary Limit Connections
6. Sensor Input
7. Valve Output
8. **Showstopper** E-stop Input

Input Power

The **Stagehand Hydraulic** requires 110VAC, 1.4A input power. The power inlet is an IEC-320 C-14 inlet with a built-in 5mm x 20mm 5 amp fast acting fuse. Power up your **Stagehand Hydraulic** with the included locking IEC cable, or any other IEC cable you have.

Ethernet

To program motion and run cues, the Stagehand Hydraulic communicates to Spikemark through the Ethernet connection. In addition to a physical cable connection, you will need to set the IP Address to be compatible with your Spikemark computer (see *Setting the IP Address* later in this manual).

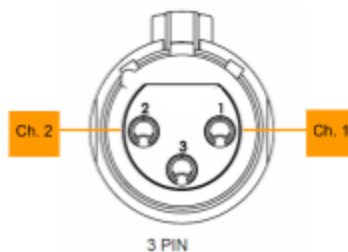
Choose your favorite CAT5 or CAT6 Ethernet cable (EtherCON or standard RJ45 are both compatible) and plug one end into the **Stagehand Hydraulic** and the other end to a Network Switch or directly to a PC running Spikemark.

Safety Sensor Connections

The **Stagehand Hydraulic** includes safety relays that add support for any 4 wire safety sensors (e.g. bumper switches and pressure mats) in both the Forward and Reverse directions. The safety relay circuits function by interrupting the Forward and Reverse limit switch signals, thus aborting motion in the corresponding direction when a safety sensor is engaged.

A 4 wire safety circuit, when used in conjunction with the internal safety relay, allows monitoring for the following four conditions:

1. Disconnected - the safety relay sends an electrical signal through the sensor and expects the signal to return. If that signal does not return the safety relay will go into a faulted state and disallow any further motion by interrupting either the Forward or Reverse limit switch circuit.
2. Contacted - If a safety mat or bumper switch is pressed, the internal conductors of the safety sensor create a short-circuit. That short-circuit is detected and no further motion is allowed in the direction of the engaged sensor by interrupting either the Forward or Reverse limit switch circuit.
3. Cross Circuit - if the wiring is crossed, and the electrical signal is sensed on the opposite channel the safety relay will go into a faulted state and interrupt either the Forward or Reverse limit switch circuit.
4. Clear - if none of the above conditions occur the safety relay will allow movement.



Included with the **Stagehand Hydraulic**, there are two safety bypass jumpers. These jumpers are short 3 pin XLR cables, just like a conventional audio cable. These may be used to bypass the safety

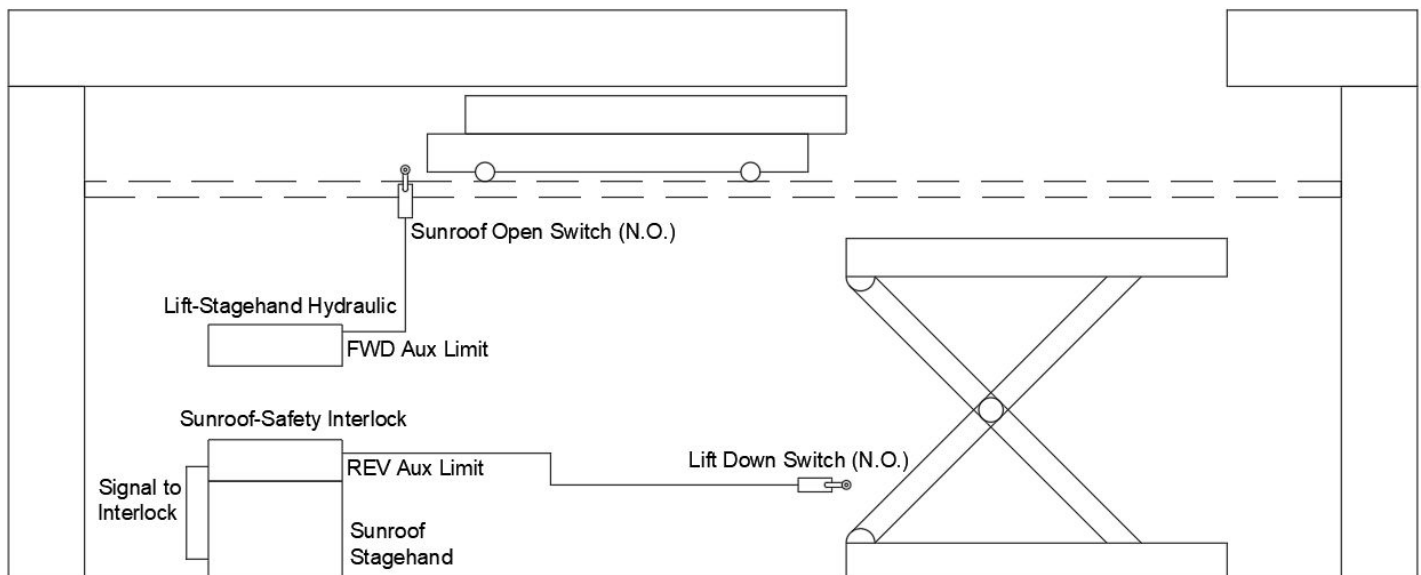
circuit either during initial setup, troubleshooting, or when using the controller without a safety sensor.

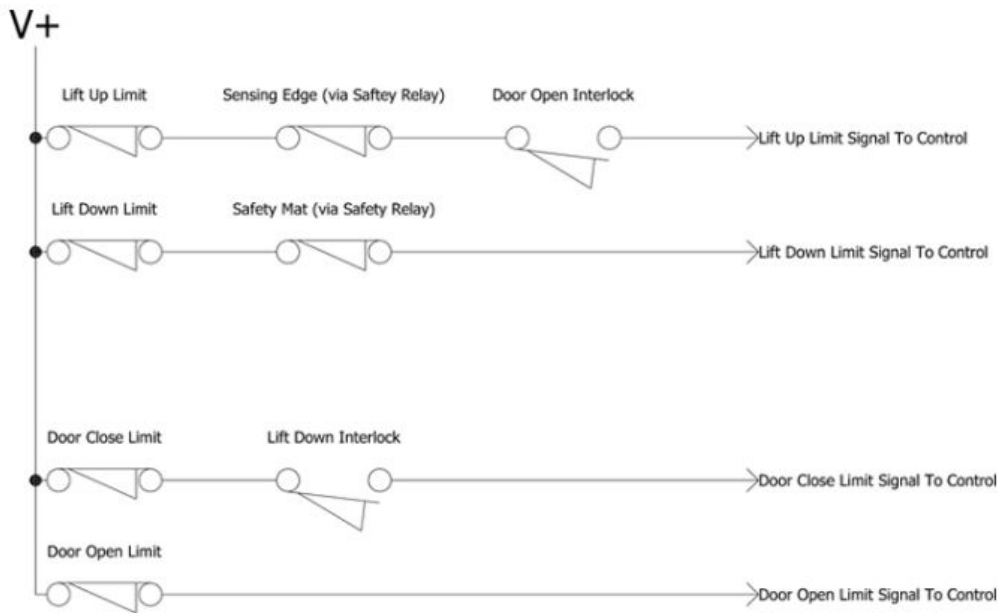
Caution: When the safety sensors are bypassed, pay close attention to any possible crush or shear hazards. Be vigilant to avoid damage, injury, or death.

Auxiliary Limits

The Stagehand Hydraulic will allow movement in either the Forward or Reverse direction provided the corresponding limit switch circuit is closed. The limit switch circuit is Fail Safe, and as such current must flow through every sensor in the circuit to allow motion. If the current is interrupted for any reason, either an open switch or disconnected wire, the motion in the corresponding direction will stop. As you read above, the Safety Sensors can interrupt the limit circuits to stop motion when a bumper switch or safety mat are contacted. Additionally, Auxiliary Limits can be used to add another limit switch to the limit circuit.

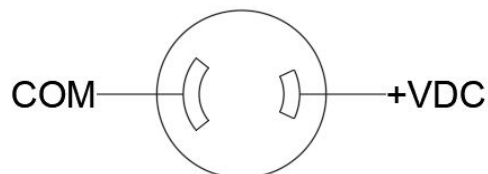
Why would you want an auxiliary limit? Typically auxiliary limits are used to inhibit the motion of the machine based on the position of another object on stage. Concretely, consider a common pair of machines used on stage: a lift and trap door. In this typical scenario, the lift should be prevented from moving up (FWD) until the trap door is open. Conversely, the trap door should be prevented from closing (REV) until the lift is down. This scenario is referred to as an interlock, where the position of one machine affects the allowed motion of another. Each machine is controlled by its own Stagehand, but the interlock signal fed into each Stagehand is activated by the motion of the other machine. A diagram and schematic of such a scenario is shown below:





Note that the Door Open Interlock and Lift Down Interlock switches would be wired Normally Open (N.O.). This will maintain the desired Fail Safe operation, since a failed cable or broken switch on the Door Open Interlock sensor would open the limit circuit and disallow forward motion on the lift.

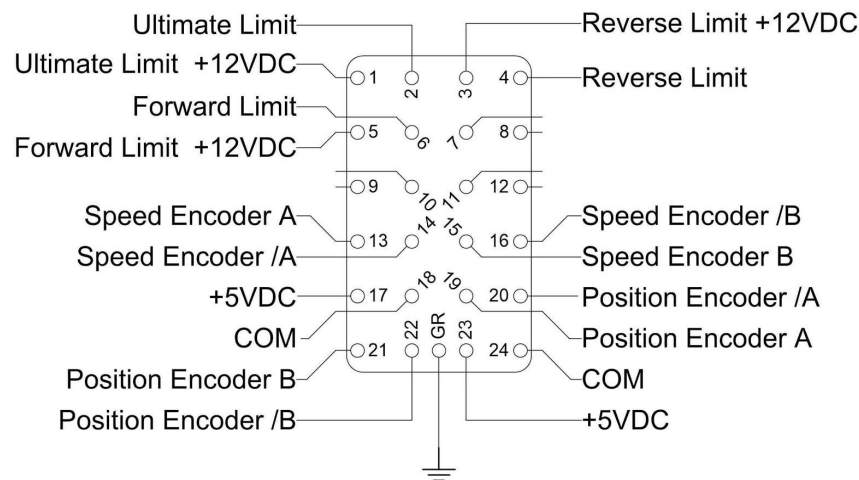
The Auxiliary Limits use a NEMA ML1P connectors.



The Auxiliary Limit circuits must be closed (shorted) to allow motion in the corresponding direction. If you do not need one or both Auxiliary Limit inputs for your effect, then insert the included limit jumpers (aka shorting plug) to bypass the Auxiliary Limits.

Sensor Input

Like most of our controllers in the **Stagehand** family, the sensor input is a Harting 24-pin IRC connector. This carries the signal for the Position Encoder, Forward, Reverse, and Ultimate limits. Included below is the pin out of the Sensor Input connector for you to use when wiring in your hydraulic effect.

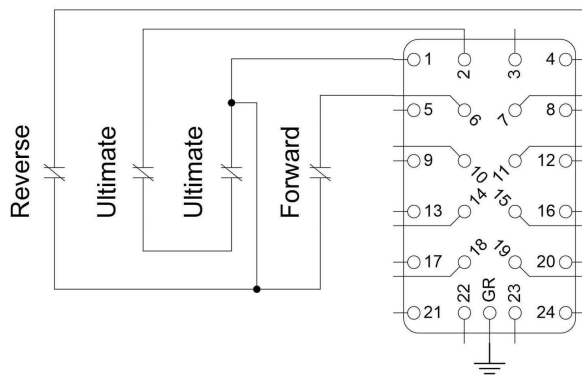


Fwd, Rev, and Ult Limit Connections

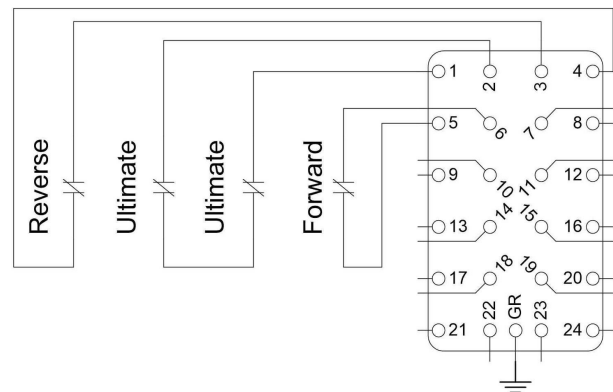
- The **Stagehand Hydraulic** motion controller monitors forward, reverse, and ultimate limit circuits. Ultimate Limit – a pair of switches can be wired in series to this pair of terminals to provide protection against Forward and Reverse Limit switch failures. These switches are wired Normally Closed (N.C.). Typically, an Ultimate Limit switch is positioned just beyond both the Forward and Reverse Limit switch. If either Ultimate Limit is activated, the **Stagehand Hydraulic** will disallow any further movement in any direction until the limit is physically cleared. An Ultimate Limit signal indicates an equipment problem with at least one of the primary limit switches. The faulty equipment must be addressed, and the Ultimate Limit must be mechanically reset before the **Stagehand Hydraulic** will allow motion.
- Reverse Limit – If any Reverse Limit switch is activated, the **Stagehand Hydraulic** 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. These switches are wired Normally Closed (N.C.) to protect against switch or cable failure.
- Forward Limit – If any Forward Limit switch is activated, the **Stagehand Hydraulic** 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. These switches are wired Normally Closed (N.C.) to protect against switch or cable failure.

Wiring the Limits

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 Limit Wiring



Discrete Limit Wiring

Pro Tip:

If you are not using the Ultimate Limit circuit, you will need to jump pins 1 & 2.

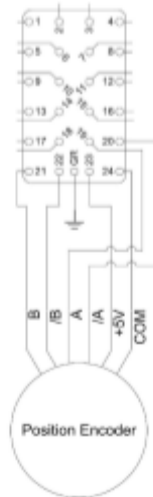
Position Encoder

The **Stagehand Hydraulic** requires encoder feedback for precise position accuracy. Any encoder connected to the **Stagehand Hydraulic** must be an Incremental, Quadrature, Differential Line Driver device, 5V tolerant. String encoders are a favorite for positioning a scissor lift - always ensure a solid, stable connection and go for the highest reasonable Counts Per Inch (CPI) or Pulses Per Revolution (PPR) you can.

Pro Tip: Persistent Position writes the encoder position to flash memory after the motor has stopped moving for 30 seconds, or when the e-stop is activated. This prevents spurious, frequent flash writes which can wear the memory prematurely. However, that also means that if you lose power mid-move, or before 30 seconds have elapsed at the end of a move, the recorded position will be wrong and you need to manually reset position within Spikemark.

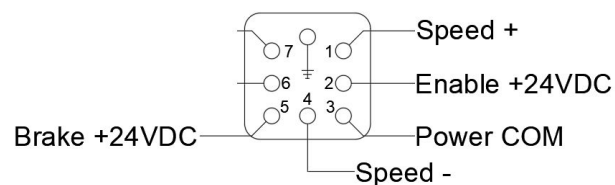
Encoder Wiring

Below is a drawing that shows you how to wire your encoder signals into the Harting 24-pin IRC connector that carries the control signal into the **Stagehand Hydraulic**.



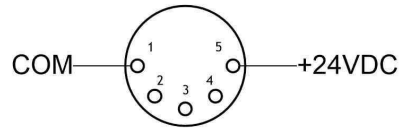
Valve Output

The Stagehand Hydraulic isn't spinning a motor, it is powering and controlling a Proportional Valve. It's ready to control a valve amplifier or to a valve with OBE (On Board Electronics). The 24VDC valve power is turned on when the motion controller is preparing to move the machine (Enable). Speed and direction are supplied through a +/-10VDC bipolar speed signal. There is also a separate 24VDC output available to control a brake valve (if required).



Showstopper

The Emergency Stop signal from a **Showstopper 3 Base** or **Showstopper 3 Hub** is sent over a 5-pin XLR connector. Inside, the **Stagehand Hydraulic** uses a SIL3 rated safety relay to remove power from the valve and brake circuits when the Emergency Stop is activated.



OPERATION

Manual Operation

Before you start writing cues in Spikemark, let's make sure the machine runs correctly when jogging it manually using the buttons and knobs on the face of the Stagehand Hydraulic. Follow the steps below to manually operate your hydraulic effect and verify that it is operating correctly.

- Release the Emergency Stop button on your all your Showstopper devices.
- Press and hold the Forward jog button on the Stagehand Hydraulic.
- While holding the Forward jog button turn the knob clockwise slowly. Your hydraulic effect should begin to move. Notice that the position encoder counts are displayed on the OLED Status Display. The counts must be increasing when you are jogging forward, if not the hydraulic effect and the encoder are out of phase and you'll need to rewire the encoder. See the troubleshooting section for more details.
- Gradually rotate the knob counterclockwise until the hydraulic effect stops.
- Release the Forward button.
- Press the Reverse button.
- While holding the Reverse button turn the knob clockwise slowly. Your hydraulic effect should begin to move in the reverse direction. The position encoder counts are displayed on the OLED Status Display. The counts must be decreasing. If not, the hydraulic effect and the encoder are out of phase and you'll need to rewire either the encoder. See the troubleshooting section for more details.

If you strike a limit while jogging in the direction of the limit, the Stagehand Hydraulic will immediately stop the motion in that direction. This is a necessary safety feature, though during machine prep and load in, running into the limits can be frustrating – especially when you are certain no accident will occur. To address this frustration, the Stagehand Hydraulic includes forward and reverse momentary limit override buttons to the left of the OLED Status Display.

To bypass a limit, press and hold either the FWD, REV, or ULT limit override and continue jogging the motor. Be extra careful when bypassing a limit to protect people, scenery, and your machine. Once the machine has been tested and functions correctly, you will need to set the physical hard limits before attaching scenery or running the machine in a cue.

Understanding the Status Display

The two-line alphanumeric display on the **Stagehand Hydraulic** 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 Hydraulic** is primarily controlled through our **Spikemark** software, but it is handy to have some bits of information displayed on the **Stagehand Hydraulic** 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 Hydraulic**.

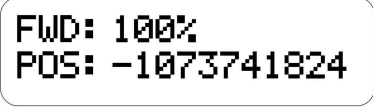
Network Connectivity



```
NOT CONNECTED
192.168.100.100
```

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

Encoder Position



```
FWD: 100%
POS: -1073741824
```

If you press either the Forward or Reverse jog button, the **Stagehand Hydraulic** 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 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 Hydraulic**, the raw encoder counts are displayed since the **Stagehand Hydraulic** 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 Hydraulic** 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 hydraulic effect and encoder polarity are mismatched and should be rewired before attempting to run cues.

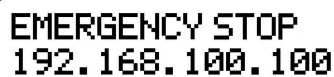
Limits



REV LIMIT
192.168.100.100

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 hydraulic effect 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.

Emergency Stop



EMERGENCY STOP
192.168.100.100

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 Hydraulic** immediately restart after an Emergency Stop fault is cleared since such behavior could pose a serious safety risk.

Setting the IP Address

Once your **Stagehand Hydraulic** is connected to a computer, you will need to set the IP address in order to communicate with **Spikemark**. This can be accomplished the same way as any other **Stagehand**.

- Click the jog wheel, the SET IP screen will be displayed.
- Scroll to the octet (each number set from 0-255 separated by a decimal point) you want to change and click the wheel.
- Turn the wheel to increase or decrease the number until you reach your desired value. Click the jog wheel to set the value.
- Repeat the process for all octets that need to be adjusted.
- Once complete use the jog wheel to highlight 'OK' and click the wheel.

Be sure to remember that each **Stagehand Hydraulic** needs to have its own unique IP address.

Setting the Subnet Mask

In addition to the IP address each **Stagehand Hydraulic** controller also has the ability to set the subnet mask. The default subnet mask is 255.255.255.0. If you find yourself in a position where you need to adjust the subnet mask, please take a step back and ask yourself if it is really necessary. If the answer is yes, click and hold the scroll wheel to reveal the SET SUBNET screen. Follow the same procedures used to set the IP address to adjust the subnet mask.

TROUBLESHOOTING

Although we strive to make performance automation plug and play, there is no denying that automation systems are complex. Setting them up and troubleshooting can be frustrating and stressful. Below is a list of common challenges and solutions to get you started. Feel free to reach out to us if you get to the end of the list and are still stuck.

Condition	Remedy
No indicator lights illuminated, OLED blank	Check main power
OLED Displaying DISCONNECTED and an IP Address	<ul style="list-style-type: none"> Confirm IP Address is set correctly on the Stagehand and in Spikemark Connect to the Stagehand from Spikemark
OLED displaying SET IP	<ul style="list-style-type: none"> Confirm the IP Address is correct Scroll to "OK" with the jog knob and click
OLED Displaying FWD/REV or ULT Limit faults	<ul style="list-style-type: none"> Confirm physical limits are connected and not engaged Check Safety Sensor status Check aux limit connections
Orange valve power indicator is illuminated, but no motion occurs when jogging or running a cue	<ul style="list-style-type: none"> Confirm valve is connected to the Stagehand Check valve wiring Confirm pump/HPU is powered on
FWD Safety Sensor is not illuminated	<ul style="list-style-type: none"> Clear any obstruction causing the fault Check any bumpers or mats connected to the FWD safety circuit Install Safety Sensor Jumper if no devices are connected
REV Safety Sensor is not illuminated	<ul style="list-style-type: none"> Clear any obstruction causing the fault Check any bumpers or mats connected to the REV safety circuit Install Safety Sensor Jumper if no devices are connected
Brake valve (if used) is not firing	<ul style="list-style-type: none"> Check wiring

Technical Support

If you get stuck, we're here to help. The best way to get in touch with a tech expert is via email - even during normal business hours - because most days we are spread around the shop and may not be near the phone. There's someone in the office from 8:30a-5pm EST Monday - Friday and will return an email or phone call quickly. After hours (honestly when most tech support issues arise) we have a crack team monitoring email and voicemail who will respond quickly to help get you moving.

- Online: www.creativeconners.com
- Email: support@creativeconners.com
- Phone: 401-289-2942 x2

SPECIFICATIONS

Physical Specifications

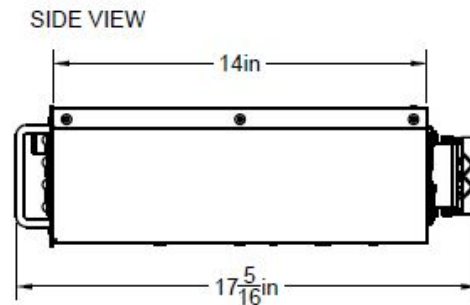
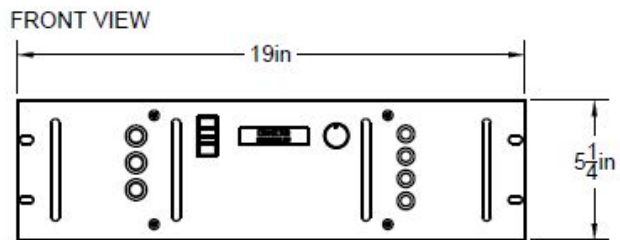
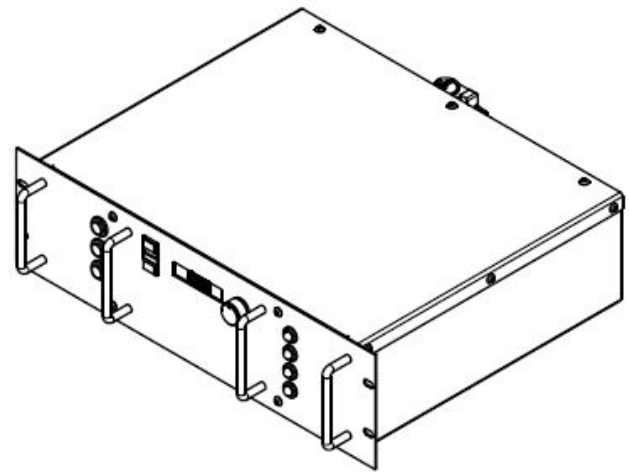
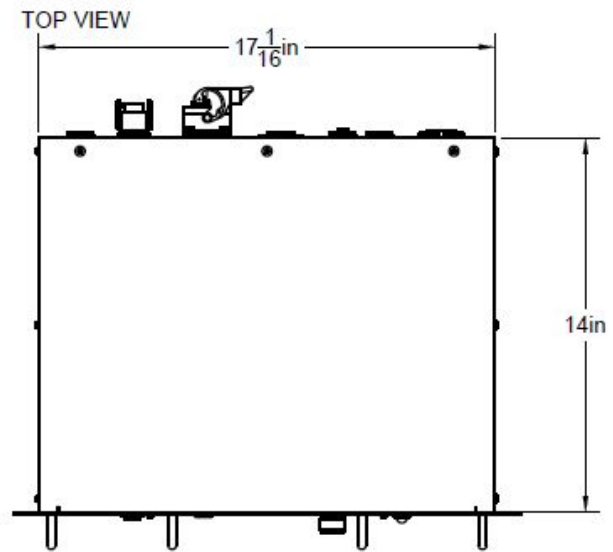
	Height	Width	Depth	Weight
Stagehand Hydraulic	5-1/4"	19"	17-1/2"	24lbs
Shipping Specifications	12"	22"	22"	25lbs

Electrical Specifications

Description	Value
Input Voltage	110VAC Single Phase 50/60 HZ
Max Input Current	1.4A
Valve Power Output Voltage	24VDC
Valve Power Output Max Current	2.5A
Valve Speed Control Output Voltage	+/- 10VDC
Emergency Stop Input Voltage	24VDC
Emergency Stop Input Current Typical	60mA
Emergency Stop Input Current Max	90mA
Forward Limit Switch Voltage	12VDC
Forward Limit Switch Current	10mA
Forward Limit Switch Contact Type	Normally Closed (N.C.) dry contact
Reverse Limit Switch Voltage	12VDC
Reverse Limit Switch Current	10mA
Reverse Limit Switch Contact Type	Normally Closed (N.C.) dry contact
Ultimate Limit Switch Voltage	12VDC
Ultimate Limit Switch Current	10mA
Ultimate Limit Switch Contact Type	Normally Closed (N.C.) dry contact
Auxiliary Limit Voltage	24VDC
Auxiliary Limit Current	1.5A
Auxiliary Switch Contact Type	Normally Closed (N.C) dry contact
Safety Sensor Connection Voltage	24VDC
Safety Sensor Connection Current	130mA
Position Encoder Input	5VDC Incremental, Quadrature, differential line driver
Encoder Power Supply Voltage	5.5VDC
Encoder Power Supply Current Rating	2.4A
Control Input	10Base-T Ethernet

DRAWINGS

Overview Drawing



Wiring Diagram

The next page has a reduced scale copy of the **Stagehand Hydraulic** wiring diagram.

