KNIGHT GLOBAL

Servo Hoist Operation Manual

THIS MANUAL CONTAINS IMPORTANT INFORMATION REGARDING INSTALLATION, SAFETY, MAINTENANCE, AND OPERATION OF KNIGHT GLOBAL SERVO HOIST AND SHOULD BE AVAILABLE TO ALL PERSONNEL RESPONSIBLE FOR USING THE HOIST.

REV:3_3_13_2017

This manual provides important information for all personnel involved in the installation, operation and maintenance of the Knight Global Servo Hoist. All personnel must read this document before operating the equipment.

Every effort has been made to provide complete and accurate product information in this manual. However, due to product improvements and changes, discrepancies and omissions may be present. Visit our website at www.knight-ind.com for the updated information on all our products.

It is the responsibility of the end user to exercise common sense and judgment when performing the tasks described in this manual. If any procedure seems inaccurate, incomplete or unsafe please put the equipment in a safe condition and contact Knight Global service department for assistance.

Throughout this manual there are steps and procedures that if not performed correctly can result in personal injury or equipment damage. The following signal words are used to identify the level of potential hazard.

⚠ WARNING! Indicates a hazard which will cause severe injury, death or substantial equipment damage.

⚠ CAUTION! Indicates a hazard which can or will cause injury or equipment damage.

NOTE Notifies personnel of installation, operation or maintenance information which is important but not hazard related.

1. SAFETY

Knight Global cannot be aware of or provide for all the procedures by which the Servo Hoist operations or repairs may be conducted and the hazards which may result from each method. If operation or maintenance not specifically recommended by Knight Global is conducted, it must be ensured that product or personnel safety is not endangered by these actions. If not sure of an operation or maintenance procedure or step, personnel should place the Servo Hoist in a safe condition and contact a supervisor and/or Knight Global's service department for technical support.
Modifications to upgrade, re-rate or otherwise alter this equipment shall be authorized only by the original equipment manufacturer.

If a below-the-hook lifting device or sling is used with the Servo Hoist, refer to ANSI/ASME B30.9, "Safety Standard for Slings" or ANSI/ASME B30.20, "Safety Standard for Below-the-Hook Lifting Devices".

Electrical equipment described in this manual are designed and built in compliance with ANSI/NFPA 70, "National Electrical Code". It is the responsibility of the system designer, system manufacturer, crane or rail manufacturer, installer and user to ensure that the installation and associated wiring of the Servo Hoist and components are in compliance with ANSI/NFPA 70, and all applicable Federal, State and Local Codes.

Hazardous voltages are present in the Servo Hoist and components. Only properly trained and competent personnel should perform inspections or repairs on the Servo Hoist or accessories.
Prior to performing any maintenance (mechanical or electrical) on the Servo Hoist, de-energize (disconnect) the main switch supplying power to the Servo Hoist. Lock out the power supply following standard plant procedures.

Ensure that the installation, inspection, testing, maintenance and operation is in compliance with ANSI/ASME B30.16, "Safety Standard for Overhead Hoists", OSHA Regulations, ANSI/NFPA 70, National Electric Code, and applicable ANSI/ASME standards is the responsibility of the owner/operator.

All personnel that will install, operate, inspect, test or maintain the hoist should read this manual and be familiar with all applicable portions of the referenced standards.

If clarification of any information in this manual or additional information is required, contact Knight Global. Do not install, operate, inspect, test or maintain the hoist unless all information is understood.

A. General Safety Precautions

- Do not operate the Servo Hoist before reading this technical manual.
- Allow only personnel trained in safety and operation of this Servo Hoist to operate the Servo Hoist.
- If the Servo Hoist is locked out or a “DO NOT OPERATE” sign is on the Servo Hoist or controls do not operate the Servo Hoist until the lock or sign is removed by designated personnel.
- Do not use the Servo Hoist if hook latch has been sprung or broken.
- Ensure the hook latches are engaged before using.
- Before each shift or prior to use inspect the Servo Hoist in accordance with the procedures defined in the Maintenance section of this manual.
- Never place your hand or fingers inside the throat area of a hook.
- Never operate a Servo Hoist with twisted, kinked or damaged chain.
- Only operate a Servo Hoist when the chain is centered over the hook. Do not “side pull” or “yard”.
- Do not force the hook into place by hammering.
- Ensure the load is properly seated in the saddle of the hook.
- Never run the chain over a sharp edge.
- Pay attention to the load all times when operating the Servo Hoist.
- Ensure no personnel are in the path of the load.
- Do not lift the load over personnel.
- Never use a Servo Hoist for lifting or lowering people.
- Do not allow anyone to stand on a suspended load.
- Do not swing a suspended load.
- Never leave a suspended load unattended.
- Never cut or weld a suspended load.
- Do not operate a Servo Hoist if the chain is jumping, jamming, overloading or binding or if there is excessive noise.
- Avoid collisions or bumping of the Servo Hoist.
- Do not operate Servo Hoist when damaged or malfunctioning.
- Do not remove load or handling device until tension is released from the chain.
- Discontinue operation of Servo Hoist after multiple unresolved faults. (Red light on Run/Stop button will continuously flash)

B. Safety Devices

Fail Safe Brake

A fail safe braking system engages and holds the unit in place in the event of a power outage or when the run/stop button is pushed.

Overload Capacity Protection

Protects the equipment and prevents the operator from lifting or moving more weight than the system is rated for. If load parameters exceed the programmed capacity, the hoist will not lift any further until the load is removed. Downward motion is permitted when overloaded to allow the user to safely set the weight back down.

Run/Stop Push Button

If an operator needs to shut down the system immediately, the operator pushes the Run/Stop button. The system will not function until it is reset. To reset the system from the run/stop condition, the operator turns the button clockwise to release it from the depressed position. All virtual limits and programs remain intact.

2. INSTALLATION

Prior to installation, visually inspect the Servo Hoist for signs of damage or missing parts.

⚠ CAUTION!
Prior to installation, the chain must be lubed using a SAE 50 to 90 EP oil.

⚠ CAUTION!
Prior to placing this unit into service the owners and user are advised to examine specific local and/or other regulations, including ANSI and OSHA regulations that may apply to the use of this product.

⚠ WARNING!
A falling load can cause injury or death. Before installing this hoist read the “Safety” section of this manual.

Follow all procedures in this section for installation and set-up of the Servo Hoist.

Retain all product information supplied with the Servo Hoist for future reference.

Ensure that the supporting structure is able to support the weight of the system and load. The structure should be able to support 300 percent of the combined weight of the Servo Hoist and load. Do not use a supporting structure that tilts the Servo Hoist to one side or the other.

For safe and proper installation into a rail system, refer to the installation manual provided by the rail system manufacturer.

When installation is complete and prior to placing the Servo Hoist into operation, inspect the Servo Hoist following the “Periodic Inspection” procedure on page 4-4 of the “Maintenance” section.

A. Introduction

Prior to installing and operating the Knight Servo Hoist, all operators using this device should be familiar with the main components of the lifting system. (See Figure 2-1)

Servo Hoist: The Servo Hoist assembly is a powered lifting device. The upper drive assembly contains the servo motor with fail-safe brake, gearbox, servo drive, power contactor, 24 VDC Power Supply, regen board, chain bucket, chain guide assembly, and 230 VAC Plug.

Coiled Cable Assembly: 19 pin coiled cable carries the signals from the control handle to the Servo Hoist. Signals include: lift mode, float mode, command of direction, emergency stop, and virtual limit positions.

Control Handle: The main interface between the operator and lifting device. The handle can be an inline handle, a fixture handle, or a discrete UP/DOWN handle.

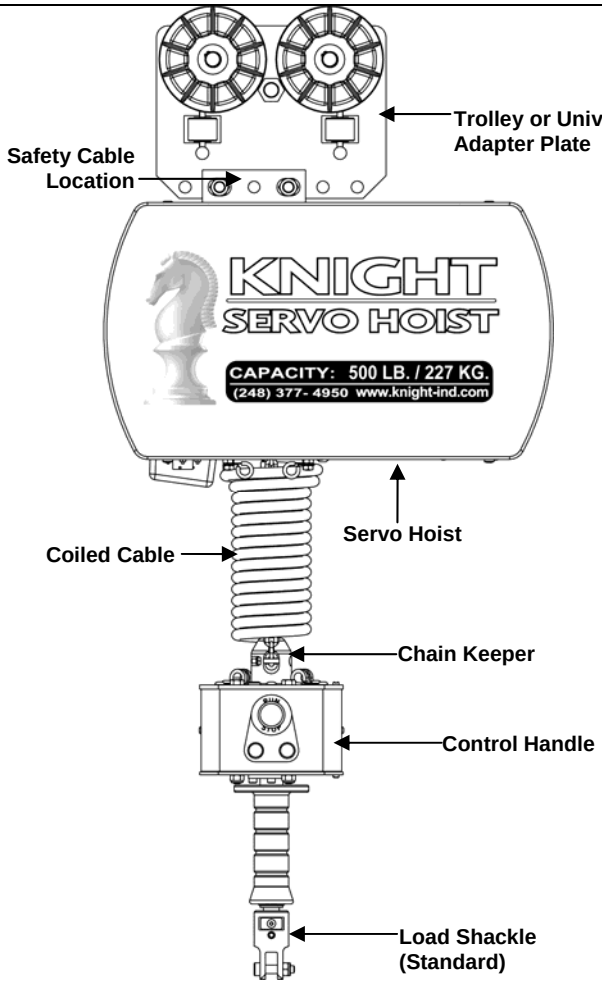


Figure 2-1

B. Initial Set-up

Step 1. Unpacking

1) Unpack Servo Hoist. Lift the hoist carefully out of packaging.
2) Keep the accompanying documents with the hoist or near the site of operation.

Step 2. System Assembly

Knight Servo Hoists are typically delivered pre-assembled, if not, read the following sections.

Step 2a) Servo Hoist Trolley Installation

Prior to installation visually inspect the trolley for signs of damage or missing parts.

1) Slide trolley or adapter plate into trolley mounting plate on top of the Servo Hoist.

> **NOTE**
> Ensure that there is a (2) two point connection when using the universal adapter plate (See Figure 2-3) to hang the hoist from a structure.

2) Insert the (2) two M12x50mm or ½-13x1 3/4 socket head bolts and (2) two washers.

> **NOTE**
> Trolley should be mounted offset for load distribution. (Refer to drawing set located in the back of the manual for trolley orientation.)

3) Secure the (2) two socket head bolts.
4) Install safety cable through the servo trolley or adapter and the trolley mounting plate. (Refer to Step 2b Safety Cable Installation on page 2-4)
5) Roll hoist into rail system.

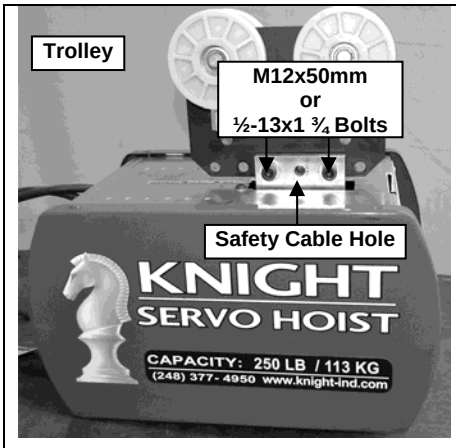


Figure 2-2

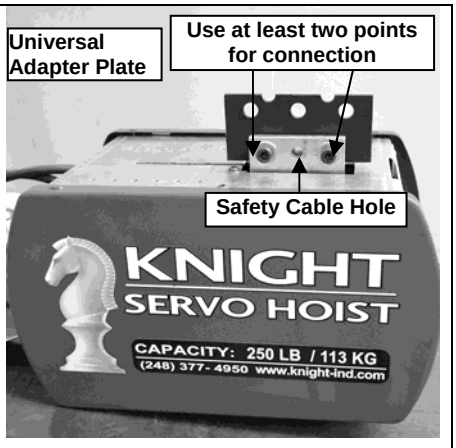


Figure 2-3

Step 2b) Safety Cable Installation

1) Slide thimbles together. (See Figure 2-4).
2) Slide (2) two cable clamps onto cable.
3) Loop end of cable around thimble and run end through cable clamps. (See Figure 2-5) The cable saddle (forged part) rests on the “live” (longer) end of the cable. The U-bolt rests on the “dead” (shorter) end of the cable.
4) Tighten nuts on clamps, alternating sides.
5) Follow the steps below for trolley or adapter plate.
6) Insert cable through center hole on trolley and trolley bracket on hoist (See Figure 2-6) and place (2) two Crosby clamps on the cable.
7) Secure the (2) two Crosby clamps snug to the thimble repeating step 3.
8) Install cable so that the Servo Hoist has a drop of not more than 1 in. [2.54 cm].
9) Trim excess cable and tape ends of cable to prevent fraying.

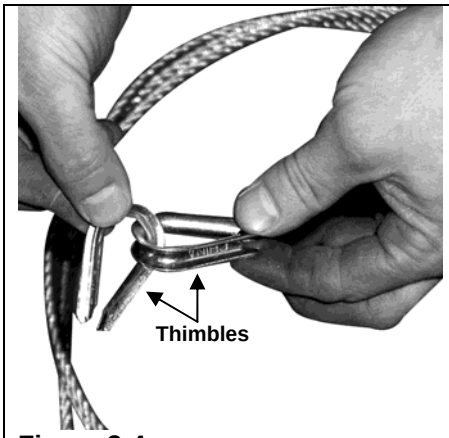


Figure 2-4

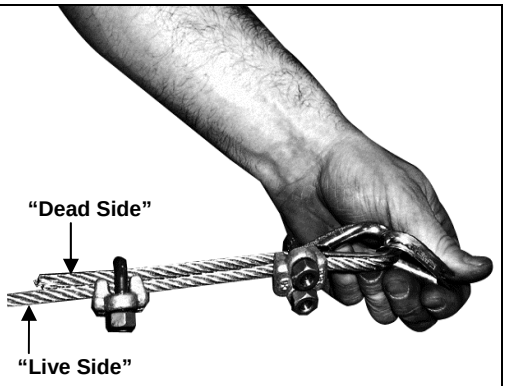


Figure 2-5

Figure 2-6

Figure 2-7

Step 2c) Coiled Cable Installation

1) Ensure power is removed from hoist.
2) Slide coil cable upward over the chain.
3) Secure the (3) three M6 nuts on the coiled cable clamping assembly from the bottom of the Servo Hoist. (See Figure 2- 8).
4) Connect the 19-pin connector to the bottom of the Servo Hoist. (Refer to Figure 2-9)
5) Seat the chain into the control handle shackle. Secure the retaining bolt through the control handle shackle. (Refer to Step 2d on page 2-6 for Chain Installation)
6) Remove (2) two M3 screw for the cable guard on the handle. (See Figure 2-10)
7) Connect the 19-pin connector to the side of the handle. (See to Figure 2-11)
8) Install cable guard to the handle.
9) Secure the (2) two M6 bolts for the handle coil cable clamping assemblies on top of the control handle. (See Figure 2-11)

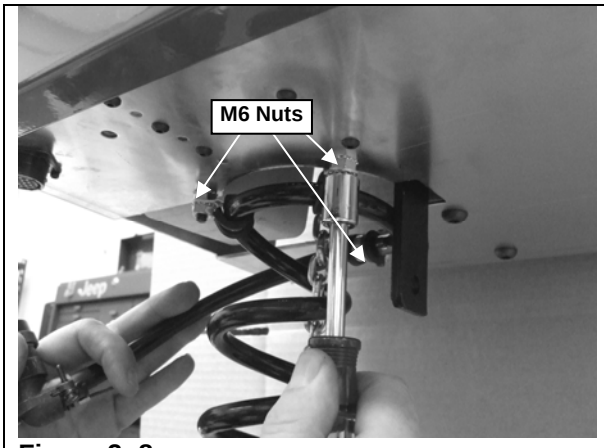


Figure 2- 8

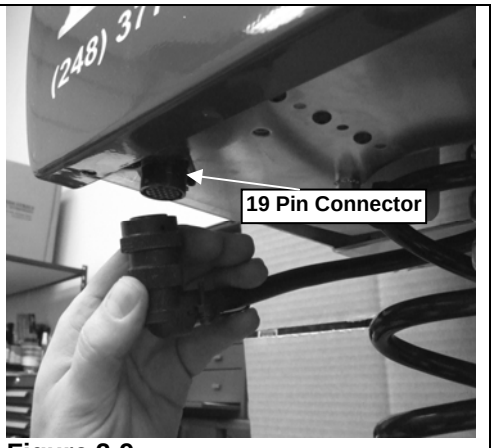


Figure 2-9

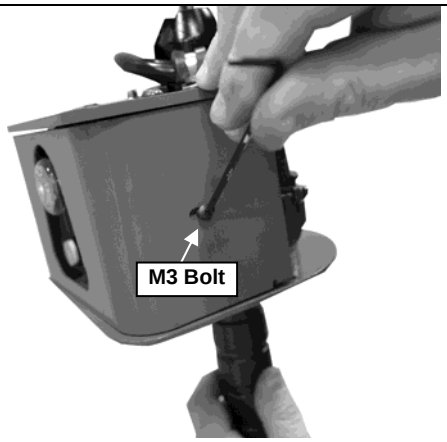


Figure 2-10

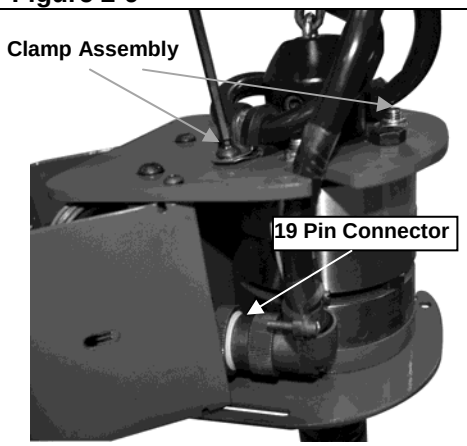


Figure 2-11

Step 2d) 4mm Chain Installation

> **⚠ CAUTION!**
> ***DO NOT CUT CHAIN!*** Chain will be reeled into hoist in Step 5 Control Handle Set-up.

1) Place the chain into the chain keeper. (Refer to Figure 2-12)
2) Insert M6 bolt thru chain keeper in front of chain link inside chain keeper. (Refer to Figure 2-13)
3) Place M6 nut on other end of bolt and tighten. (Refer to Figure 2-14)
4) Completed installation of chain to chain keeper on handle. (Refer to Figure 2-15)

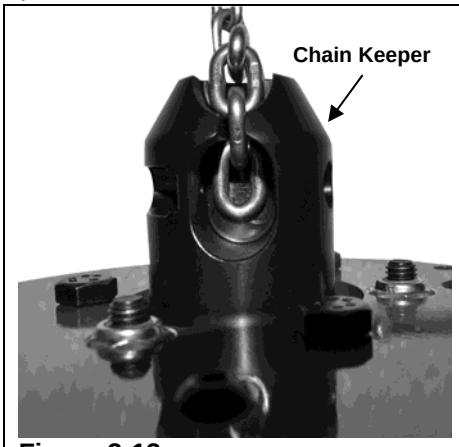


Figure 2-12

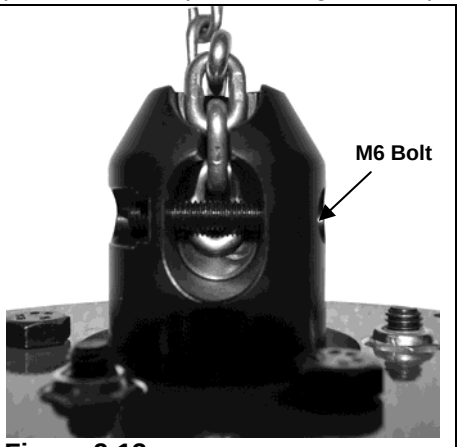


Figure 2-13

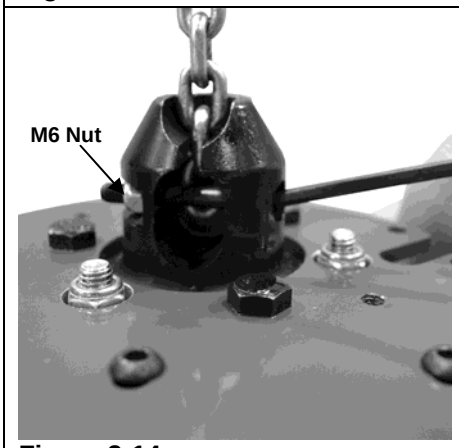


Figure 2-14

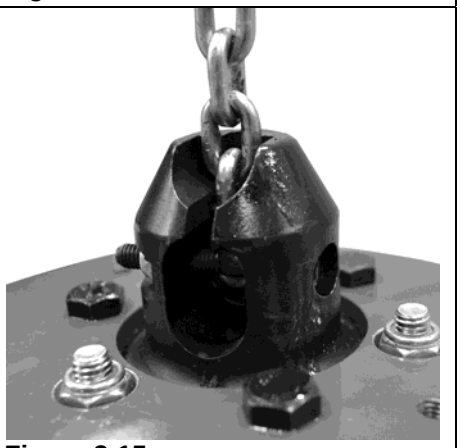


Figure 2-15

Step 2e) 5mm Chain Installation

> **⚠ CAUTION!**
> ***DO NOT CUT CHAIN!*** Chain will be reeled into hoist in Step 5 Control Handle Set-up.

1) Place the chain into the chain keeper. (Refer to Figure 2-16)
2) Insert M5 bolt thru chain keeper in front of chain link inside chain keeper. (Refer to Figure 2-17)
3) Place M5 nut on other end of bolt and tighten. (Refer to Figure 2-18)
4) Completed installation of chain to chain keeper on handle. (Refer to Figure 2-19)

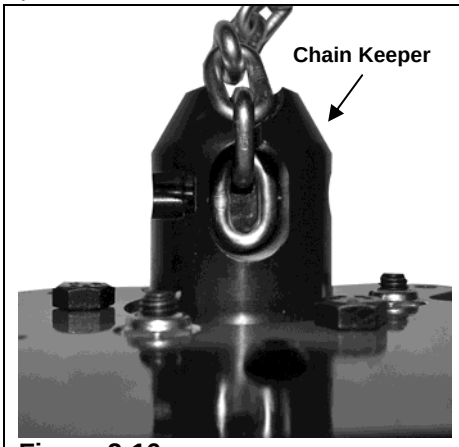


Figure 2-16

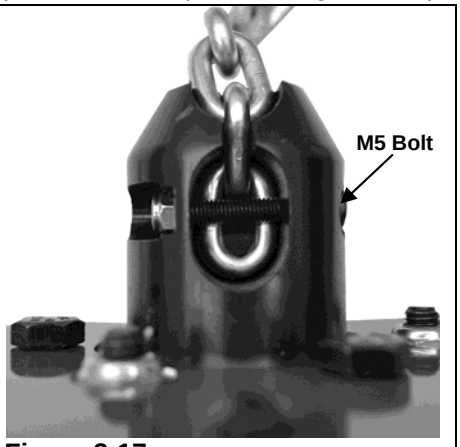


Figure 2-17

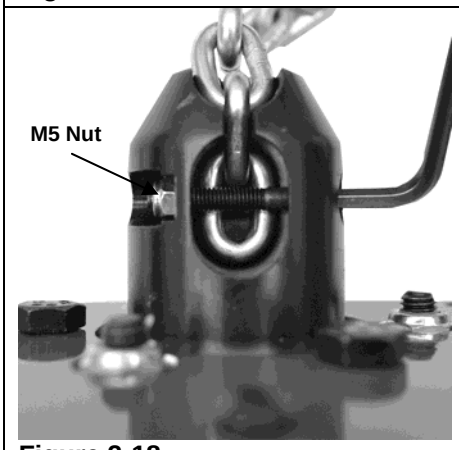


Figure 2-18

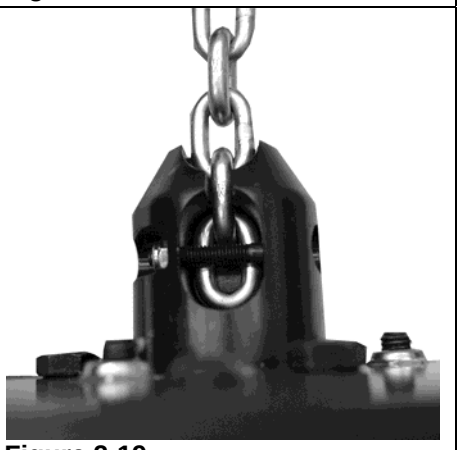


Figure 2-19

Step 3. Power Supply to Servo Hoist

Prior to installation visually inspect the Servo Hoist for signs of damage or missing parts.

Power Requirements:
Standard 240 VAC Single Phase 50/60 Hertz. Refer to system specific documentation for power requirements.

1) The Servo Hoist power is connected by a twist lock plug (See Figure 2-20 Standard) or fed by a hard wired circuit, provided by end user (See Figure 2-21 CE Compliant).
2) Provide power to Servo Hoist system. The red light on the Run/Stop will illuminate.

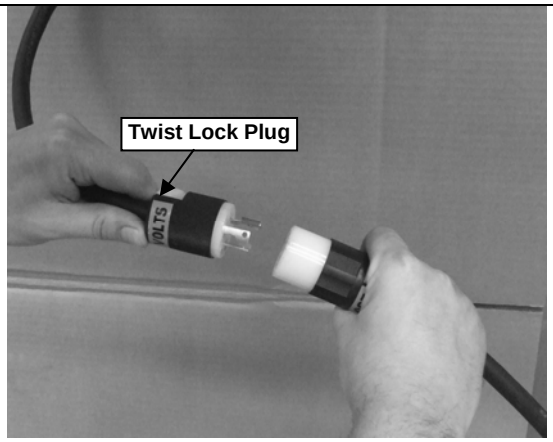


Figure 2-20 Standard

Figure 2-21 CE Compliant

Step 4. Releasing Run/Stop

The Run/Stop button is engaged for shipping purposes.

1) Turn Run/Stop button a quarter of a turn clockwise to release Run/Stop and wait for red light to turn off. (See Figure 2-22) Refer to Run/Stop Operation on page 3-3.

Figure 2-22

Step 5. Control Handle Set-up

There are (3) three control handle configurations:

- Inline Handle
- Fixture Handle
- Discrete UP/DOWN Handle

Step 5a) Inline Handle

1) Hold inline handle with one hand and hold the chain away from the inline handle with other hand. (See Figure 2-23) Apply upward pressure on inline handle until green light flashes.
2) Once green light starts flashing, release the inline handle until GREEN light illuminates.
3) Grasp inline handle and apply upward pressure until the chain starts feeding into the hoist and the inline handle is hanging from the hoist.

Figure 2-23

Step 5b) Fixture Handle

1) Set-up the fixture handle into the orientation in which it will be used in the application. (Refer to layout drawings of the application.)
2) Apply upward pressure on fixture handle until green light flashes.
3) Once green light starts flashing, release the fixture handle until GREEN light illuminates.
4) Grasp fixture handle and apply upward pressure until the chain starts feeding into the hoist and the fixture handle is hanging from the hoist.

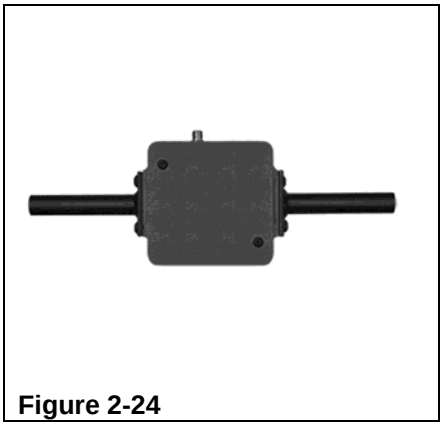


Figure 2-24

Step 5c. Discrete UP/DOWN Handle Set-up

1) Press the UP lever until green light starts to flash. (See Figure 2-25)
2) Once green light starts flashing, release the UP lever until GREEN light illuminates.
3) Press the UP lever again until the chain starts feeding into the hoist and the fixture is hanging from the hoist.

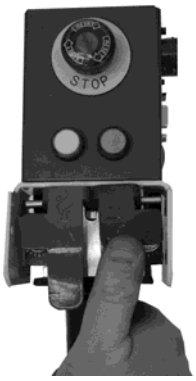


Figure 2-25

NOTE

Flashing GREEN light indicates safe start activation fault. The system sensed force on the lift handle during Power-up. Release handle and verify GREEN light illuminates. If GREEN light still flashes, refer to Balancing the Analog Handle on page 5-10 in the Software section.

Step 6. Test Hoist Movement

Test Servo Hoist movement by applying upward and downward pressure on inline handle or fixture handle. If using a discrete UP/DOWN handle, press the UP and DOWN levers to move the hoist up and down.

Step 7. Back-Up Software

Knight Servo Hoists are pre-programmed per application prior to delivery. It is a good practice to back-up this software before initial operation. Refer to the Section 5 Software, steps A thru C, for instructions to connect to a Servo Hoist and backing up software.

Step 8. Software Adjustments (If necessary)

After making the Software Back-Up in step 7, it may be necessary to make minor software adjustments. Refer to the following adjustments in Section 5 Software.

- Change Max Load Limit (Page 5-8)
- Modify Chain Payout (Page 5-9)
- Balance Analog Handle (Page 5-10)
- Adjust Fixture Weight (Page 5-11)
- Enabling Float, Lift, Digital, or Analog Mode (Page 5-12)
- Adjust Speed of an UP/DOWN Pendant Handle (Page 5-13)

3. OPERATION

A. Principle of Operation

The Servo Hoist system receives a command to move upwards or downwards along the “Z” axis from any input force applied to the handles or by pressing UP / DOWN levers.

B. Model Number

The Servo Hoist model number designates the Servo Hoist type and specifications. The letters indicate the Servo Hoist type; refer to Table 3-1. The numbers preceding the Servo Hoist model letters reference the rated capacity. The next (3) three characters indicates the voltage and the last number indicates the phase.

The model number and serial number can be found on the identification label located on the Servo Hoist.

Letters	Servo Hoist Type
KSH	Single Chain
KSHTC	Twin Chain
KSHTCDM	Twin Chain Dual Motor
KSHFA	Floor Mounted Articulating Arm
KSHCA	Overhead Carriage Articulating Arm
KSHEA	Extension Arm
KSHVA	Vertical Arm
KSHVAA	Vertical Articulating Arm
KSHXZ	Servo Hoist and Tractor X and Z Movement
KSHXYZ	Servo Hoist and Tractor X, Y, and Z Movement

Table 3-1

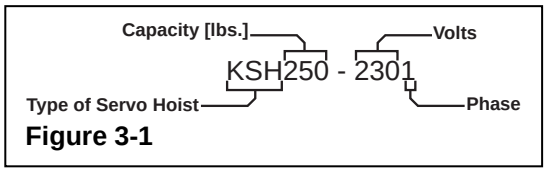


Figure 3-1

**For all models and specifications, refer to the website: http://www.knight-ind.com/servo.htm.

C. Servo Hoist Control Configurations

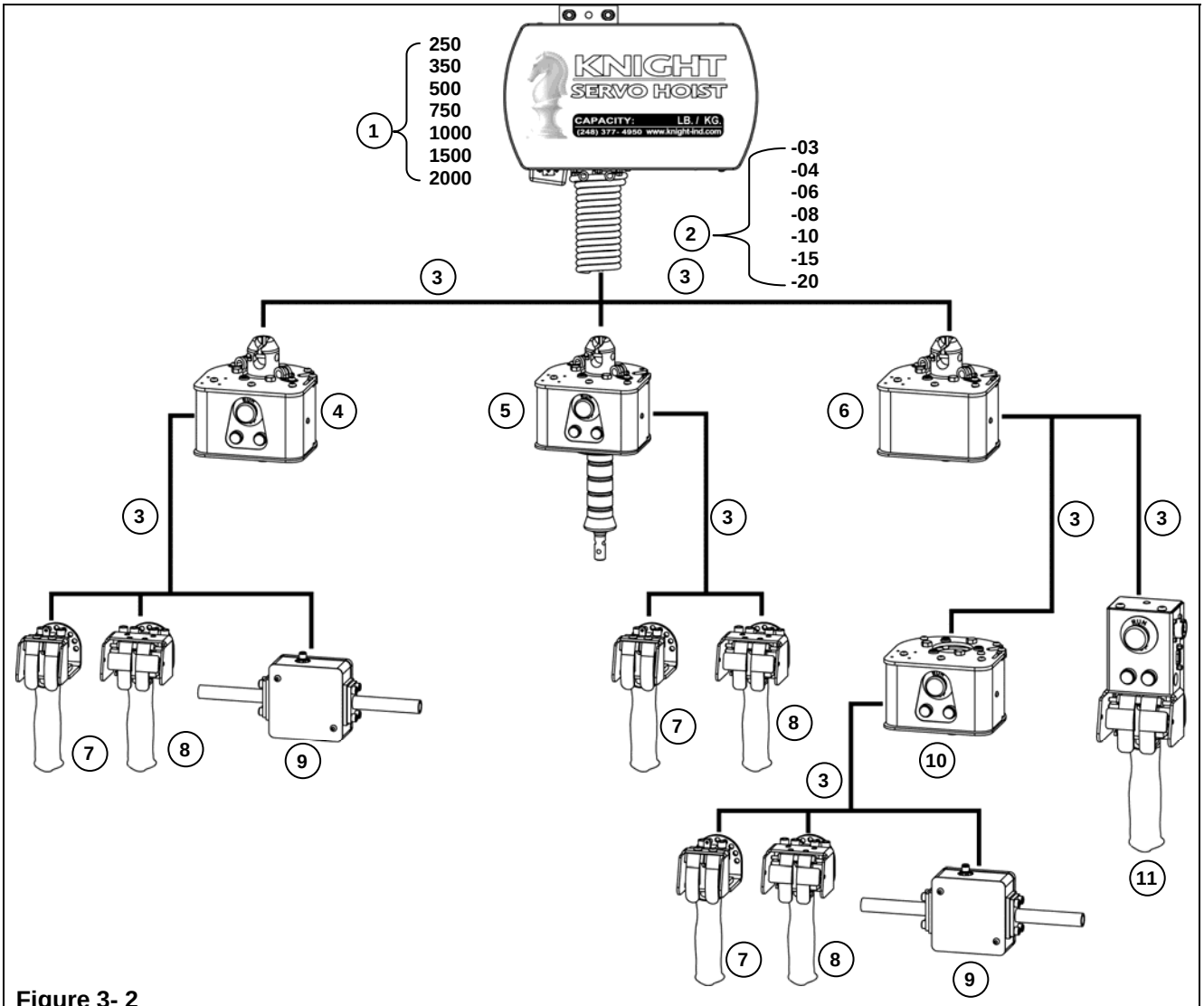


Figure 3- 2

NUMBER	DESCRIPTION
1	KNIGHT SERVO HOIST (xxxx = CAPACITY in LBS.)
2	KNIGHT COILED CABLE (xx = FT.)
3	KNIGHT ELECTRICAL STRAIGHT CABLE (xx = FT.)
4	KNIGHT LOAD MONITORING MODULE WITH OPERATOR CONTROL INTERFACE
5	KNIGHT ANALOG INLINE HANDLE
6	KNIGHT LOAD MONITORING MODULE
7	KNIGHT SINGLE SPEED HANDLE PENDANT
8	KNIGHT DUAL SPEED HANDLE PENDANT
9	KNIGHT LOAD CELL FIXTURE HANDLE
10	KNIGHT OPERATOR CONTROL INTERFACE
11	KNIGHT DUAL SPEED HANDLE WITH OPERATOR CONTROL INTERFACE

D. Servo Hoist Functionality Modes

Run/Stop

Step 1. Press the RUN/STOP button, located on the Operator Control Interface (OCI).

- Main power is removed and motion is disabled.
- The RUN/STOP button will illuminate red.

Recovery:

Step 1. Correct the situation that caused the Run/Stop.

Step 2. Follow the Start Up procedure to restore power to the unit.

Shut Down

Step 1. Press the RUN/STOP button, located on the Operator Control Interface (OCI).

Step 2. Disconnect the power supply to the unit (if required) Follow the warning labels on the Servo Hoist unit.

Start Up

Step 1. Connect the power supply to the unit.

Step 2. Reset the RUN/STOP button by twisting the Run/Stop button a quarter of a turn clockwise.

- The unit defaults to No Mode with the GREEN, BLUE, and RED indicators off.

No Mode

If the Servo Hoist is inactive for a continuous time period, factory default is 15 minutes, the unit will shift to an energy saving mode; the brake will engage and remove the power from the motor. When the unit is in No Mode, the GREEN, BLUE, and RED indicators will be off.

Lift Mode

Press the GREEN (Lift) button to place the Servo Hoist to Lift Mode.

- The GREEN (Lift) indicator will illuminate

> **NOTE**
> Flashing GREEN light indicates safe start activation fault. The system sensed force on the lift handle during Power-up. Release handle and verify GREEN light illuminates. If GREEN light still flashes, refer to Balancing the Analog Handle on page 5-10 in the Software section.

Systems with In-line or Fixture Style Lift Controls:

Step 1. Apply force to the handle in the desired direction of travel (upward or downward). Travel speed is proportional to the force applied to the handle.

Systems with Discrete UP / DOWN Lift Controls:

Step 1. Press the UP or DOWN button to move the hoist in the desired direction.

> **NOTE**
> If the system is in No Mode and a lift command is given to the system (force to the load cell or press the UP/DOWN levers), the system will automatically go into Lift Mode.

Float Mode

Step 1. Press the BLUE (Float) button to place the Servo Hoist to Float Mode. When the BLUE button is pushed, a snapshot (records a measurement of weight) is taken of the load that is attached to the end of the hoist. The BLUE (Float) indicator will illuminate.

Step 2. Apply pressure to the top of the part to move it down or lift up on the part to move it up. Do not use the lift controls to move the part as this will place the hoist into lift mode.

⚠WARNING!

An operator cannot release a load while in Float Mode. The operator must switch to Lift Mode in order to release the load.

To change from Float Mode to Lift Mode, follow either of the following steps:

- Use the lift control to move the hoist upward or downward
- Press the GREEN (Lift) push button and the unit will shift into Lift Mode.
- The Float Mode Timeout timer has expired, factory set to 5 minutes of non-use. To change timer, refer to page 6-8 Variable Descriptions F8L1:43.

NOTE

Part must be picked up with the unit in Lift Mode and then place the Servo Hoist into Float Mode.

NOTE

Do not rest hand on part when pressing the Float push button. This can cause a bias or an incorrect zero value measurement.

NOTE

Use of the Lift Mode control will prevent the unit from remaining in or changing to float mode.

Travel Limits

NOTE

During operation (lift or float mode) the hoist will ramp down in speed as the travel limits are approached.

NOTE

Programmable travel limits may be disabled for certain applications using global variable F8L2:70. Refer to Variable description section.

NOTE

The absolute upper and lower travel limits are factory set to the physical limits of the Servo Hoist. Contact a Knight Global Representative for information regarding changes to these absolute limits.

NOTE

Travel limits must be set at least 12 inches apart. Program mode will continue to flash until the hoist is 12 inches away from other travel limit.

Setting Upper Travel Limit

Step 1. Move the handle to the desired location (Lift or Float mode).

Step 2. Press and hold the GREEN push button for approximately three seconds until the GREEN and BLUE indicators begin to flash alternately for approximately three seconds. (Unit is in Program Mode).

Step 3. Press the GREEN push button.

- Upper limit is set.
- GREEN and BLUE indicators will stop flashing.
- GREEN indicator will remain illuminated.

Setting Lower Travel Limit

Step 1. Move the handle to the desired location (Lift or Float mode).

Step 2. Press and hold the GREEN push button for approximately three seconds until the GREEN and BLUE indicators begin to flash alternately for approximately three seconds. (Unit is in Program Mode).

Step 3. Press the BLUE Push Button.

- The lower limit is set.
- GREEN and BLUE indicators will stop flashing.
- BLUE indicator will remain illuminated.

Clearing Travel Limits

Step 1. Press and hold the GREEN push button.

- The GREEN and BLUE indicators will begin to flash alternately.
- When only the GREEN indicator is illuminated the limit stops are cleared from memory.
- Release GREEN push button.

Fault Mode

Red light will flash

Step 1. Press the RUN/STOP button, located on the Operator Control Interface (OCI).

- Main power is removed and motion is disabled.
- The RUN/STOP light will illuminate red.

Recovery:

Step 1. Correct the situation that caused the fault. Refer to Troubleshooting Section for possible faults.

Step 2. Follow the Start Up procedure to restore power to the unit.

4. MAINTENANCE

A. CHAIN INSPECTION

4.1 Inspection Overview

The inspection procedures and recommendations in this manual are based on ANSI/ASME B30.16 and ISO7592-1983 “Calibrated Round Steel Link Lifting Chains –Guidelines to proper use and maintenance. The following definitions and recommendations are from both specifications and pertain to the recommended inspection procedures in this manual.

Qualified Person: a person who, by possession of a recognized degree in an applicable field, or certificate of professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter at work.

Designated Person: a person selected or assigned by the employer or the employer’s representative as being competent to perform specific duties.

Abnormal Operating Conditions: environmental conditions that are unfavorable, harmful, or detrimental to the operation of a hoist, such as excessively high or low ambient temperatures, exposure to weather, corrosive fumes, dust laden or moisture laden atmospheres, and hazardous locations.

4.2 Use of Chain Safely in Any Application

Balance: Know the Load - determine the weight, center of gravity, angle and lift.	
Overload: Never Overload the Chain - check the working load limit on the identification tag.	
Knots, Twists and Kinks - Ensure chain is not twisted, knotted or kinked before lifting load. Chains should not be shortened with knots, bolts or other make-shift devices.	
Sharp Edges - Protect chain with padding when lifting sharp edged loads.	
Abrupt Movement - Lift and lower loads smoothly. Do not jerk.	
Extreme Temperatures - Do not expose alloy chain to temperatures of 400°F or higher or -40°F or lower.	

4.3 Determining the Frequency of Chain Inspections

Knight recommends utilizing load criteria and duty cycle data when determining the frequency of inspections. Inspection frequency should be identified by a qualified person and is based on factors such as severity of environment, percentage of capacity lifts, cycle time and shock loading. Each Servo Hoist should be rated individually and inspections performed in accordance with the rating.

Proper maintenance depends on an evaluation of the severity of usage to which the chain and the application, in which it is installed, are subjected.

4.3.1 Service Rating Load Criteria

Light Service: Chains and applications subjected very rarely to the maximum load and, normally, to light loads.

Moderate Service: Chains and applications subjected fairly frequently to the maximum load and, normally, to moderate loads.

Heavy Service: Chains and applications subjected frequently to the maximum load and, normally, to loads of heavy magnitude.

Very Heavy Service: Chains and applications subjected regularly to the maximum load.

4.3.2 Service Class (Duty Cycle)

Service Class is determined by the specified fatigue life of the lifter.

- Service Class 0 is 0 to 20,000 load cycles. (Light Service)
- Service Class 1 is 20,001 to 100,000 load cycles. (Light Service)
- Service Class 2 is 100,001 to 500,000 load cycles. (Moderate Service)
- Service Class 3 is 500,001 to 2,000,000 load cycles. (Heavy Service)
- Service Class 4 is over 2,000,000 load cycles. (Very Heavy Service)

Cycles Per Day	Desired Life (Years)				
	1	**5**	**10**	**20**	**30**
5	0	0	0	1	1
10	0	0	1	1	2
25	0	1	1	2	2
50	0	1	2	2	3
100	1	2	2	3	3
200	1	2	3	3	4
300	2	3	3	4	4
750	2	3	4	4	4
1,000	2	3	4	4	4

4.4 Type of Inspections

Inspection procedure is divided into two general classifications based upon the intervals at which inspection should be performed for chains in regular service. The general classifications are herein designated as "frequent" and "periodic" with respective intervals between inspection as defined below. (In addition, visual observations shall be conducted during regular service for any damage or evidence of malfunction which might occur between regular inspections.)

4.4.1 Frequent Inspection (Visual)

This is a visual examination by the operator or other designated personnel, without requiring records to be made. Inspection should be carried out at the following intervals:

A. **Light Service** - Every Month

B. **Moderate Service** - Every Two Weeks

C. **Heavy Service** - Every Week

D. **Very Heavy Service** - Every Day

Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring (such as abnormal noises or binding).

4.4.1.1 Ideas Regarding What to Look for During A Frequent Inspection

Operator should examine the chain throughout its working length to detect any evidence of wear, distortion or external damage. Equipment should be operated under a load as near as possible to the usual operating load, in both directions and observe the functioning of the chain and wheels. The chain should feed smoothly into and away from the wheels in each case. Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring.

- Check for visual signs or abnormal noises (grinding etc.) which would indicate a potential problem.
- Ensure controls function properly and return to neutral when released.
- Check load chain feeds through the hoist and bottom block.
- If chain binds, is excessively noisy or “clicks”; clean and lubricate chain.

If any of the conditions listed above are evident, the Servo Hoist should be placed out of service and a detailed inspection and corrective action should be taken.

4.4.2 Periodic Inspection (Documented)

This is a thorough examination by an appointed person, making records of external conditions to provide the basis for a continuing evaluation. Inspection should be carried out at least at the following intervals:

A. **Light Service** - Yearly (equipment in place).

B. **Moderate Service** – Every Six Months (equipment in place unless external conditions indicate that disassembly should be done to permit detailed inspection).

C. **Heavy Service** – Every Three Months (equipment in place unless external conditions indicate the disassembly should be done to permit detailed inspection).

D. **Very Heavy Service** — Every Six Weeks (equipment in place unless external conditions indicate that disassembly should be done to permit detailed inspection).

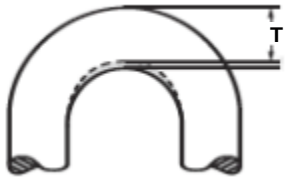
4.4.2.1 Recommendations for Periodic Inspections

Chains should be cleaned for inspection, using any cleaning method that will not cause damage.

Adequate lighting should be provided for the person inspecting the chain. The chain should be examined link by link for cracks, gouges or nicks, distortion, corrosion, deposits of foreign material and for interlink wear. To inspect for wear at the interlink contact points, slacken the chain and rotate adjacent links to expose the inner ends of the link. If wear is observed or if elongation is suspected, measure the chain using the supplied chain gauge shipped with the servo hoist.

A. Chain Link Thickness

If chain is worn to less than the minimum allowable thickness (T), remove the chain from service.

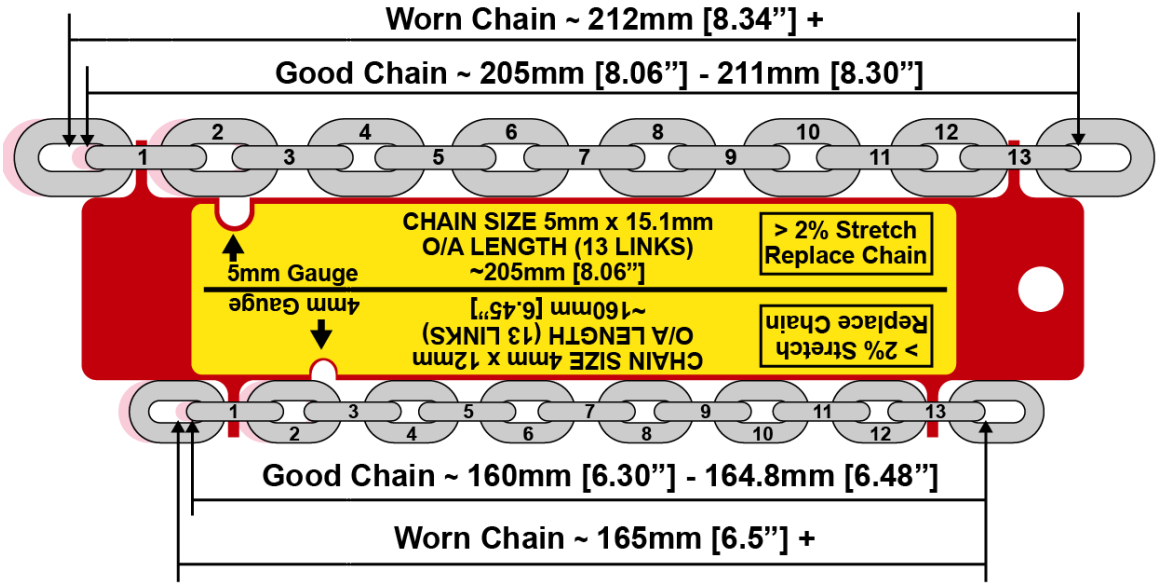


Minimum Allowable Chain Link Thickness at Any Point

Nominal Chain Size		Minimum Thickness "T"	
Inches	**mm**	**Inches**	**mm**
.157	4.0	.137	3.48
.196	5.0	.171	4.35

B. Chain Gauge Replacement Measurement for 4mm and 5mm Load Chains

1. Determine which type of chain is being inspected, either 4mm or 5mm, by placing a single link into the chain gauge where the arrows are located. (See Figure below).
2. Raise the hoist to the full up position and mark the chain.
3. Lower the hoist to the full down position.
4. Select 13 links starting with the link that was marked in step 2.
5. The 13 selected links will fit loosely onto gauge prongs as shown below. If links number 1 and 13 do not fit onto prongs or have to be forced into selection, replace the load chain. This length has stretched 2% or more and should be removed from service and replaced with new chain.
6. Perform this inspection in multiple sections of the chain working up to the sprocket.



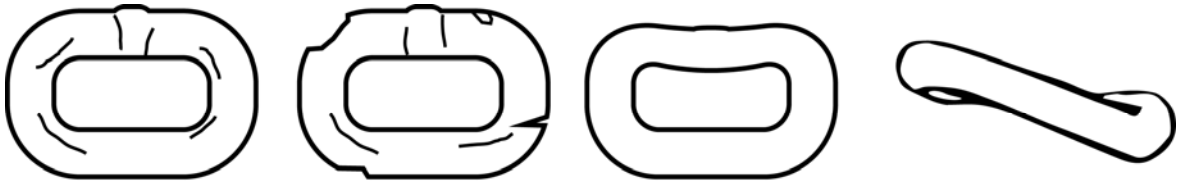
C. If Chain Gauge is Not Available

- Select an unworn, unstretched length of chain.
- Suspend the chain vertically under tension. Use a caliper type gauge to measure the accumulated pitch of between 5 and 13 links.
- Measure the same number of links throughout the used chain and calculate the percentage increase in length.
- The chain should be replaced if the gauge length measured over any 5, 7, 9, 11, or 13 links as appropriate exceeds that of the unused chain by 2 % if power driven.

D. Rejection Criteria

The chain should be rejected if any of the following conditions are observed:

- Cracked or worn links
- Severe nicks or gouges
- Twisted or bent links
- Severe corrosion
- Deposits which cannot be removed
- Increase in gauge length which exceeds the manufacturer's recommendations. In the absence of manufacturer's recommendations the chain should be replaced if the gauge length measured over any 5, 7, 9, 11, or 13 links as appropriate exceeds that of the unused chain by 2 % if power driven.



Worn Links | Gouged Links | Bent Links | Twisted Links

4.4.2.2 Recommended Record Keeping for Periodic Inspections

Adequate records as a part of periodic inspection are essential for the proper use of calibrated chains.
The chain record should include a complete description and identification of the new chain, the date and results of each inspection, the date and results of each test and the date and description of any maintenance.

The record is a continuous history of the chain and shows that it has been regularly inspected and maintained in good operating condition.

When the chain is removed from service, a new record should be prepared for the replacement chain.

4.4.3 Chain Lubrication:

Keep chain well lubricated. Never operate a hoist when the load chain does not flow freely and smoothly into and out of the chain wheel(s), or when it makes noises indicative of binding or other malfunctions. If the chain is visibly damaged, replace the chain and examine the chain wheel and chain guard. Install a new guard if the old one is broken or distorted.

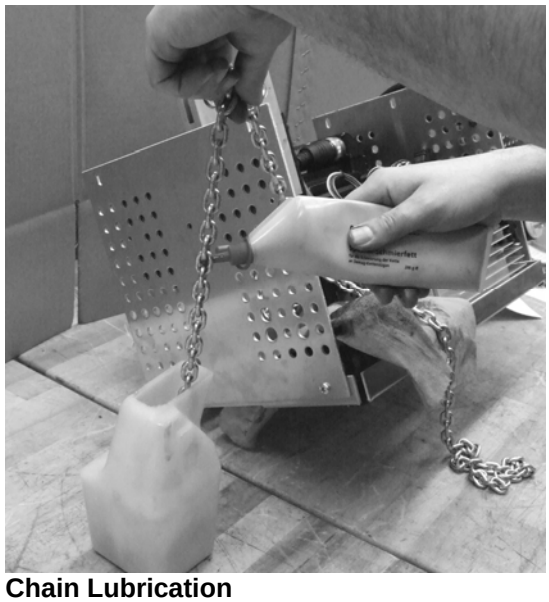
Clean, lubricate, and inspect load chain based on frequent inspection criteria described in section 4.4.1. In a corrosive environment, lubricate more frequently than normal. Failure to maintain clean and well lubricated load chain will result in rapid load chain wear that can lead to chain failure which can cause severe injury, death or substantial property damage.

If required, clean chain with acid free solvent to remove rust or abrasive dust buildup and lubricate chain.

Lubricate each link of the chain with a light coat of SAE 50 to 90 EP oil or equivalent machine/gear oil. Ensure that oil is applied to the bearing surfaces of the load chain links. Wipe off excess oil from the load chain surfaces.
Substitute a dry lubricant for use in dusty environments.

Lubricate hook and safety latch pivot points with same lubricant used on the load chain.

Lubricate chain without load on chain. This will allow lube to penetrate between links.
Failure to maintain clean and lubricated load chain will void the manufacturer's warranty.



Chain Lubrication

4.4.4 Load Chain Replacement:

When replacing a worm chain with a new chain it is generally advisable to install a new pocket wheel and to verify correct chain guide action.

Care should be taken to re-install chain without any twist between the chain wheels or between a wheel and an anchored end. Proper orientation of the entering link should be established since a twist cannot be corrected except by removing and re-installing the chain.

Refer to page 4-14 for further instructions on how to replace load chain.

4.4.5 Double Roller Chain :

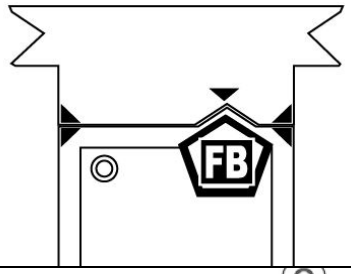
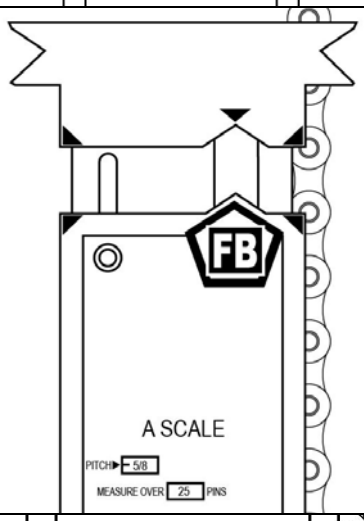
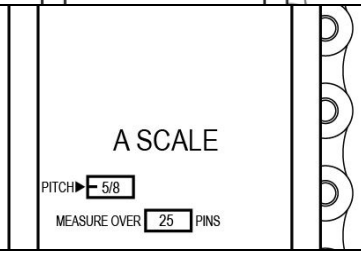
Over time chain elongates as it wears leading to a significant increase in actual pitch and potential chain failure. When the normal pitch length has extended by 2-3%, the fatigue life is reduced and the ultimate breaking strength is considerably lower. At 2% elongation a service technician must set a safe time limit for replacement. At 3% the chain must be replaced immediately.

Knight Global provides a Roller Chain Gauge with each roller chain hoist.

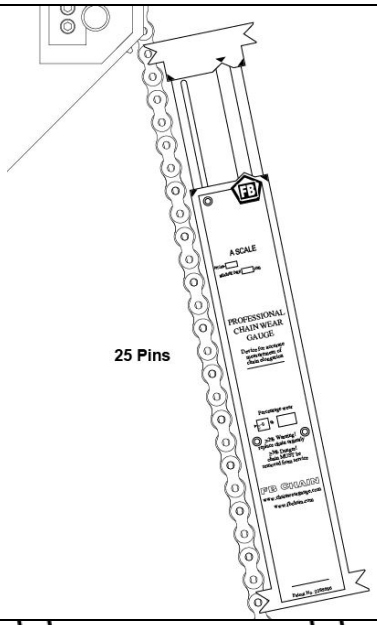
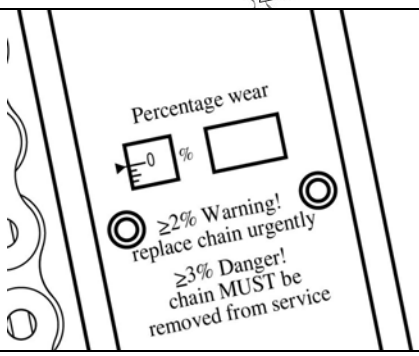
The roller chain should be checked at intervals depending on the service and load conditions. (Refer to section 4.3.)

4.4.5.1 FB Chain Roller Chain Gauge Replacement Measurement

Roller Chains should be cleaned for inspection, using any cleaning method that will not cause damage.

1. Close gauge to confirm calibration. Check the calibration by closing the slide fully and reading from the 'Percentage Wear' window. If the arrow moves into the +- zones, the gauge will not give an accurate measurement and should not be used. Similarly if the 'V' jaws are damaged the instrument may also not perform accurately.	
2. Identify the pitch Align the red arrows within the center of the pins on ONE of the OUTER link plates. Depending on ease of access, one pair of arrows will be more suitable than the others. The normal pitch will appear in the 'Pitch' window. The number of pins (n) that the chain is to be measured over will appear in the 'Measure over pins' window.	
3. Select the Correct side of the gauge Select the correct scale according to pitch size. Once the pitch is determined, the number of pins to measure is displayed. Knight's Roller Chain uses Scale Side A. Scale side "A" = 3/8", ½", 5/8", ¾", 1", 1 ¼", 1 ½", 2 ½", and 3". Scale side "B" = 1 ¾" x 2"	

Continued on next page

4. Measure the Chain Chains should be cleaned and measured in its location while placed under approx. 1% of the minimum breaking load. If a set of check weights is not available, it is sufficient for chains to be tensioned by the weight of the carriage and lift assist. Identify the section of the chain that regularly runs over the pulley as this part of the chain is most susceptible to wear. Measurements must then be made in at least 3 separate locations on this section. Place the 'V' jaw of the instrument over the first pin of the selected sections and then extend the slide until the other 'V' jaw reaches the final pin as previously determined in step 2.	
5. Read off the Percentage Check the 'Percentage Wear' windows. A percentage will appear on 0.25% (14%) increments. If the chain has elongated by 2% or more, the warning window will be filled with red and necessary action must be taken.	

4.4.5.2 Lubricating the Servo Arm Roller Chain

After changing roller chain, before a test load is lifted and before the hoist is put into operation as well as during normal operation when no load is attached, the chain link contact areas must be lubricated with Demag gear grease, part no. 665 009 44.

The chain link contact areas must be re-lubricated appropriately – after being cleaned – at intervals depending on the service and load conditions. Knight recommends to lubricate roller chain every six weeks under normal service conditions.

Cut off the tip of the grease tube and insert the grease tube at the lubrication point. Insert grease into the chain guide by pressing the tube while you run the chain to its end positions to ensure complete and even lubrication of the chain.

B. PREVENTATIVE MAINTENANCE FOR KNIGHT SERVO HOIST

4.5 Servo Hoists Inspections

4.5.1 Recommendations for Frequent Inspections for Servo Hoists (Visual)

This is a visual examination by the operator or other designated personnel, without requiring records to be made. Inspection should be carried out at the following intervals recommended in section 4.4.1 pg. 4-4.

Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring.

4.5.1.1 Servo Hoist:

- Visually inspect the Servo Hoist, and ensure that it is in good general working order. Repair or replace any broken or missing parts.
- Cycle the Servo Hoist and listen for any abnormal noises (grinding etc.). If any abnormal noises are evident, an inspection of the Servo Hoist must be performed.
- Inspect how the chain feeds through the Servo Hoist. If any binding is evident clean and lubricate the chain (see Chain Periodic Inspection 4.4.2). If the problem persists replace the chain.
- Cycle Run/Stop.

4.5.1.2 Load Shackle:

- Check shackle for signs of wear.
- Ensure load shackle is not cracked, nicked or gouged. Replace the shackle as necessary.
- Confirm all cotter pins and / or keepers are in place.

If any of the conditions listed above are evident, the Servo Hoist should be placed out of service and a detailed inspection and corrective action should be taken.

4.5.2 Periodic Inspection (Documented)

Perform the items listed in the Frequent Inspection section in addition to the items listed below. All findings from this inspection should be recorded.

4.5.2.1 Supporting Structure:

- Check for distortion, wear and continued ability to support the load. Refer to manufacturers' instructions for overhead rail systems.

4.5.2.2 Rail Trolley (if applicable):

- Ensure wheels and side rollers run smoothly and are not excessively worn. Replace the wheels and side rollers as necessary.
- Visually check the nylon at the bearing and along the face of the wheel for cracks.

4.5.2.3 Fasteners:

- Check all fasteners and ensure they are not loose, missing or damaged.

4.5.2.4 Load Hook (if applicable):

- Inspect for cracks, wear or damage.
- Inspect hook throat for spreading and proper safety latch engagement.
- Measure hook throat at wear points: greater than ten percent wear in any throat zone requires replacement. See manufacturer's instructions for wear zone information.
- Inspect hook eye or chain nest and sleeve for security.
- Inspect hook eye or chain nest and sleeve for free rotation without binding.

4.5.2.5 Valves, Timers, and Switches:

- Check during an operation cycle to ensure the sequence is operating at optimum efficiency. Repair or replace if needed.

4.5.2.6 Wiring:

- Check for broken, loose, missing, and worn wires. Check all electrical cables for signs of age and make sure all connections are tight and secure. Repair or replace if needed.

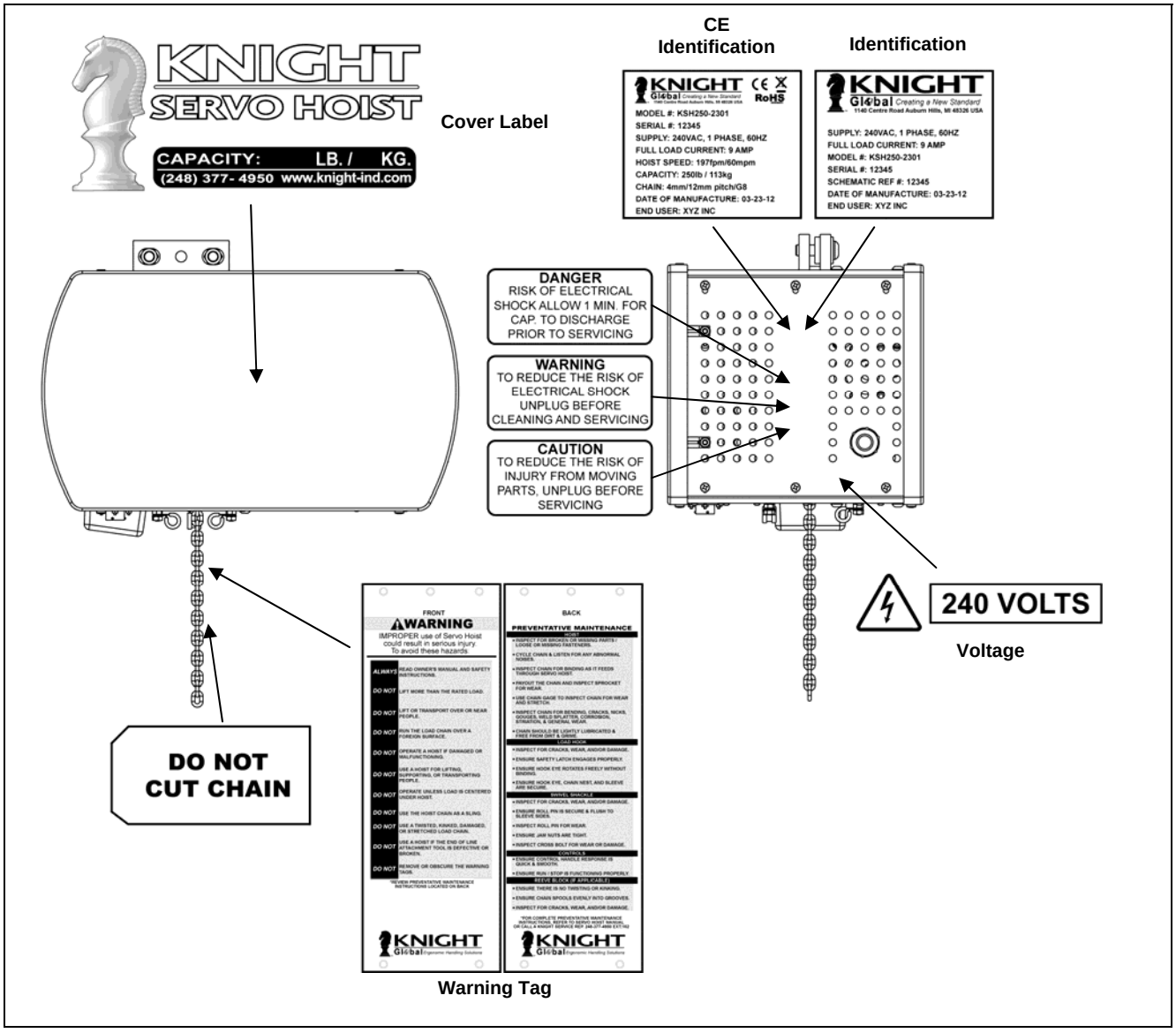
4.5.2.7 Electrical Enclosures, Disconnect Boxes, and Circuit Breakers:

- Check for obvious signs of damage and repair or replace if needed.
- Verify disconnect is operational. Check for loose, bent, or broken components. Repair or replace if needed.
- Inspect for loose or broken terminals. Check for the presence of contaminants like dirt, dust, grease, or rust. Repair or replace if needed.

If any of the conditions listed above are evident, the Servo Hoist should be placed out of service and a detailed inspection and corrective action should be taken.

4.5.2.8 Labels and Tags:

- Ensure that all labels are intact and legible. Replace as necessary. (See below)



If any of the labels or warning tags listed above are missing, contact Knight Global, 248-377-4950, to order.

4.6 Load Chain Replacement

4.6.1 Removing Old Chain

Step 1. Ensure the tooling attached to the load module is on the floor or secured on a table.

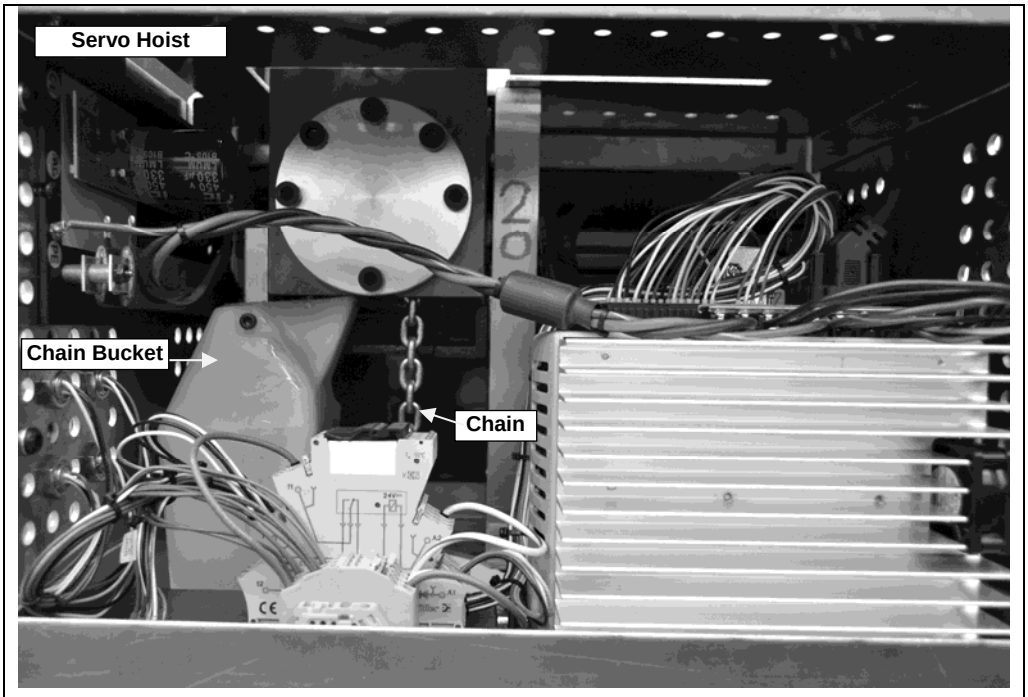
Step 2. Push RUN/STOP button, RED light will illuminate, and disconnect the power from the Servo Hoist.

> **⚠WARNING!**
> Wait for capacitors to discharge. It will typically take about (1) one minute for the capacitors to fully discharge.

Step 3. Remove the side covers from Servo Hoist.

a. Remove the (2) two M6 screws on the bottom of each of the covers.

b. Lift cover upwards off the pins.



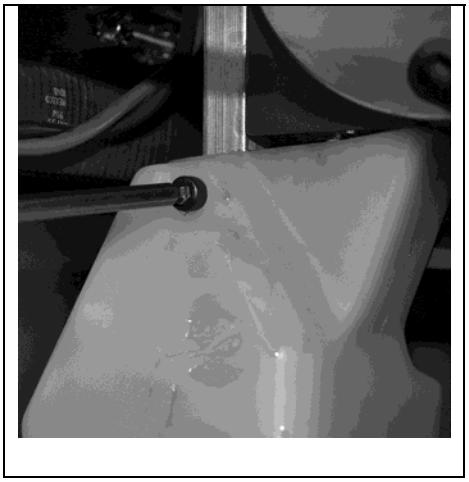
Step 4. Disconnect the coil cable under the Servo Hoist.

a. Remove the (3) three M6 nuts that hold the coil cable underneath the Servo Hoist.(Refer to page 2-5: Coil Cable Installation)

b. Remove the 19-pin connector.

c. Let coil cable slide down to the load monitoring module (LMM).

Step 5. Remove (1) one M5 screw from the chain bucket inside of the Servo Hoist. (See Figure below)



Step 6. Turn the chain bucket approximately 90° and remove through the bottom or side of the Servo Hoist.

Step 7. Pull chain out from the chain bucket.

Step 8. Remove end-stop assembly from the end of the old chain.

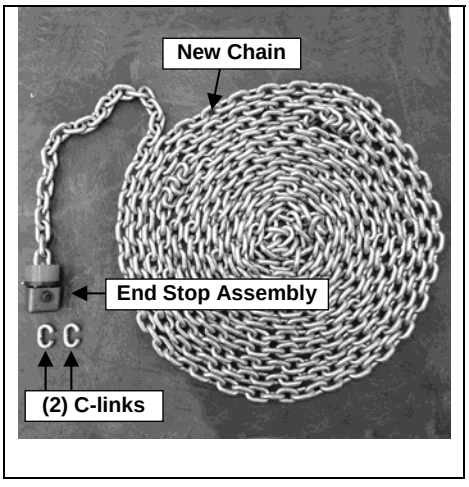
Step 9. Remove the old chain from the chain keeper on the load module. (Refer to page 2-6 for 4mm chain and page 2-7 for 5mm chain)

Step 10. Reinstall the coil cable underneath the Servo Hoist. (Refer to page 2-5: Coil Cable Installation)

4.6.2 Installing New Chain

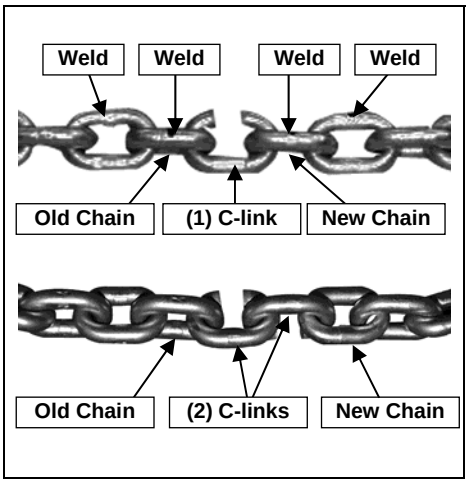
Step 1. Inspect Load Chain Replacement Kit for damage and/or missing parts. (See Figure below)

- 4mm Chain or 5mm Chain
- End Stop Assembly
- (2) Two C-links (Used to position the weld marks on the old chain and new chain feed into the hoist in the exact same pattern)



Step 2. Ensure that the replacement chain has the end stop assembly attached to it or install the end stop assembly from the old chain.

Step 3. Place C-link(s) on end of new chain and the end of the old chain. Position the weld sections of the links of the new chain with the weld sections of the links of the old chain. Ensure that the links of both chains are in-line. The use of both C-links may be necessary. This will ensure that the new chain is not twisted when feeding into the hoist. (See Figure below)



Step 4. Mark the C-links to see when the chain feeds through the backside of the gear tower into the chain bucket.

Step 5. Reconnect power to Servo Hoist.

Step 6. Reset Run/Stop by twisting clockwise.

Step 7. Press the GREEN button on Operator Control Interface (OCI). GREEN button illuminates.

Step 8. Connect one side of a 9-Pin D-Sub Null Modem cable to the load monitoring module.

Step 9. Power-up computer that has Ultraware installed and connect the other side of the 9-Pin D-Sub Null Modem cable into the computer.

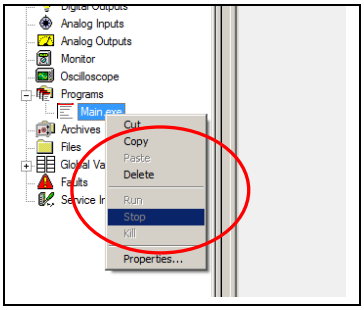
Step 10. Start Ultraware software. (Refer to

Step 11. Click the (+) sign next to the On-Line Drives file.

Step 12. Click the (+) sign next to the Section 5 Software “Connecting to a Servo Hoist”) Z Axis icon.

Step 13. Click the (+) sign next to Programs to get either a Main.exe or Vertical.exe program.
(See Figure below)

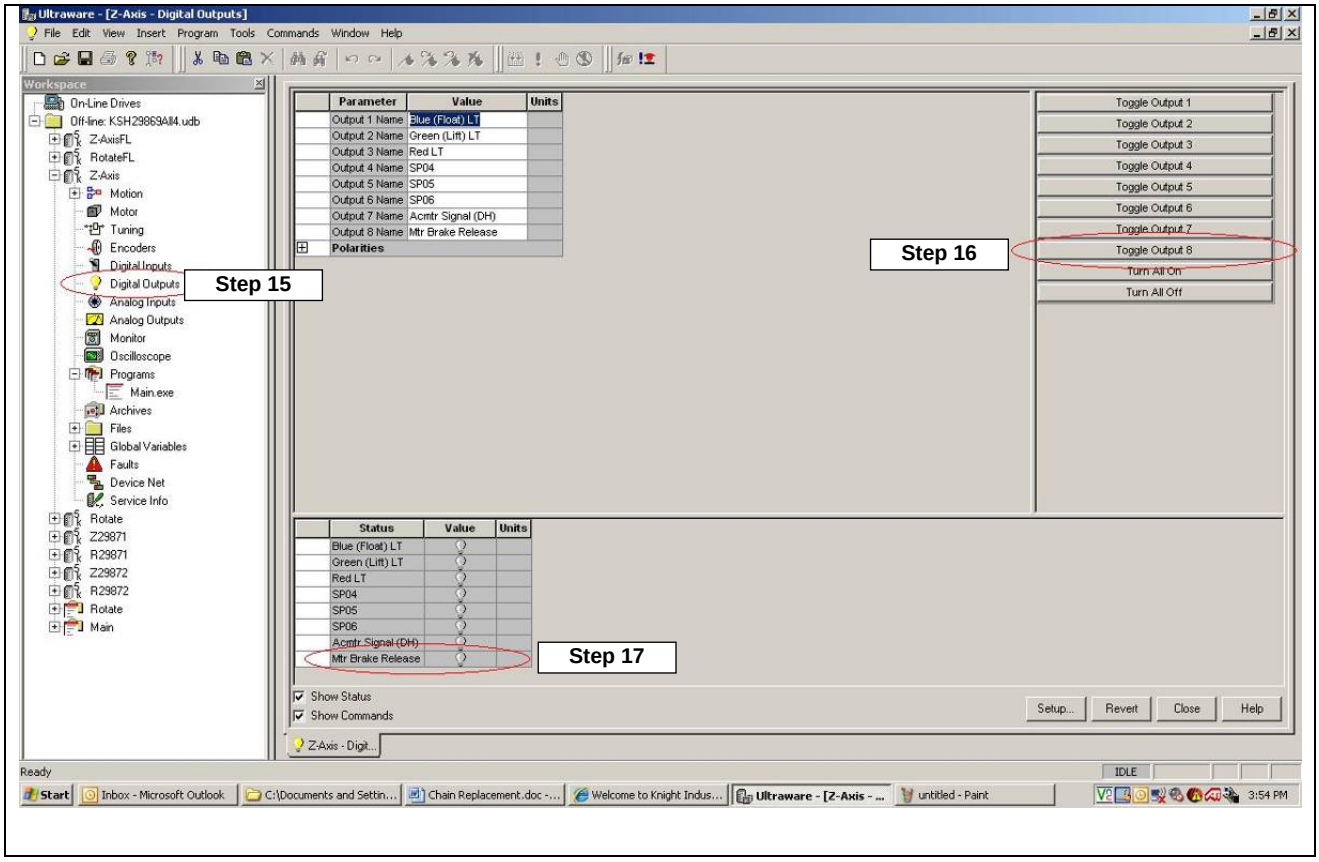
Step 14. Right click on either the Main.exe or Vertical.exe and select STOP from the pop-up menu. (See Figure below)



Step 15. Select Digital Outputs from the project branch and open by double clicking on the icon. (See Figure below)

Step 16. Select Toggle Output 8 button. (See Figure below)

Step 17. Mtr. Brake Release Value illuminates amber. (See Figure below)



Step 18. Select Motion from the project branch and select Jog. Set the following parameters in the Jog window: (See Figure below)

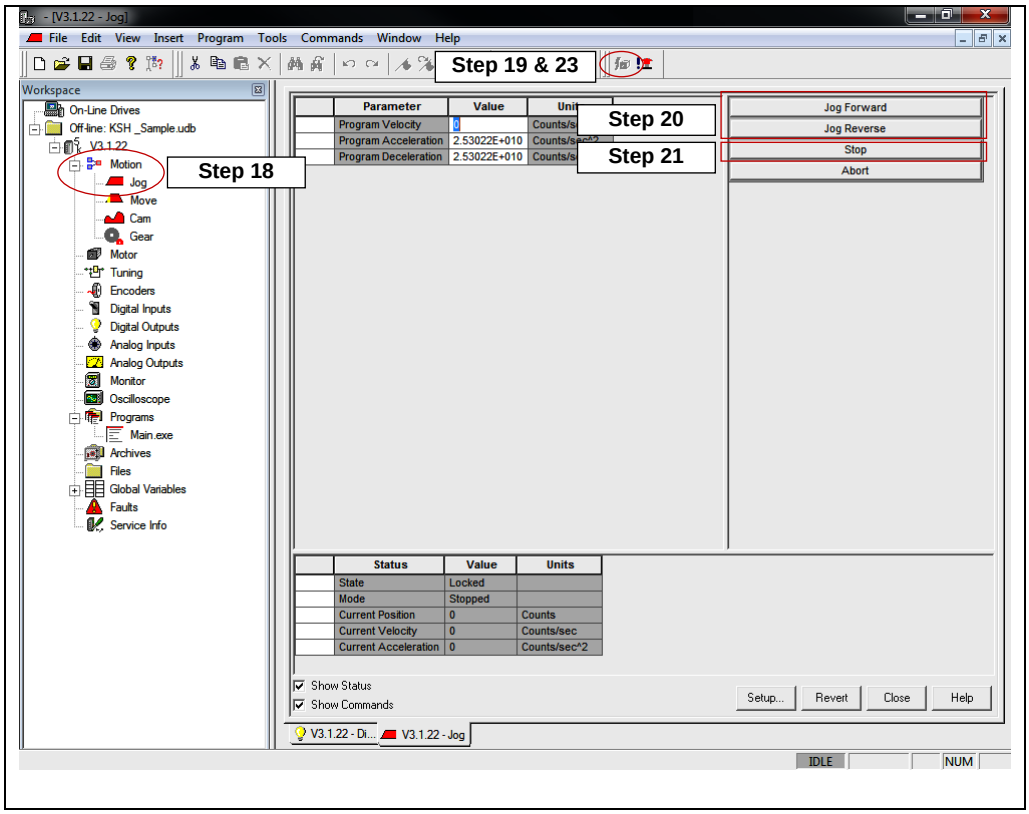
- Program Velocity = 3000000
- Program Acceleration = 5000000
- Program Deceleration = 5000000

Step 19. Enable the drive by selecting the Lightning Bolt button. (See Figure below)

Step 20. Go to the right of the screen and press Jog Forward. The chain should go up to the Servo Hoist. If chain does not, press the Stop button at the right of the screen and then press the Jog Reverse button, so the chain goes into the gear tower of the Servo Hoist.
(See Figure below)

NOTE

- KSH250 and KSH500 units use the Jog Forward button
- KSH350, KSH750, KSH1000, and KSH2000 units use the JOG Reverse button.



Step 21. After the new chain feeds through the gear tower and down to the proper length, press the Stop button to keep the chain from movement. (See **Error! Reference source not found.**)

Step 22. Disconnect the old chain and C-links from the new chain.

Step 23. Disable the drive by selecting the Lightning Bolt button at the top of the screen. (See Figure above)

Step 24. Select Digital Outputs and open by double clicking on icon or selecting the tab. (Refer to step 15)

Step 25. Select Toggle Output 8 (Refer to step 16)

Step 26. Ensure that the Mtr. Brake Release is not illuminated amber. (Refer to step 17)

Step 27. Once the Mtr. Brake Release is off, press the Close button in the lower right corner.

Step 28. Push RUN/STOP button, RED light will illuminate, and disconnect the power from the Servo Hoist.

⚠WARNING!

Wait for capacitors to discharge. It will typically take about (1) one minute for the capacitors to fully discharge.

Step 29. Feed end of chain with the stop assembly into the chain bucket.

Step 30. Turn the chain bucket approximately 90° and install it through the bottom of the Servo Hoist. Ensure all the chain is inside of the chain bucket.

Step 31. Install chain bucket inside of Servo Hoist by securing (1) one M5 screw. (Refer to step 5)

Step 32. Install the side covers from Servo Hoist.

a. Lift cover over the pins on top of Servo Hoist.

b. Secure the (2) two M6 screws on the bottom of each of the covers.

Step 33. Connect new chain to the load module and run coil cable around new chain up to Servo Hoist and reinstall coil cable and nuts.

Step 34. Restore power to the Servo Hoist.

Step 35. Reset Run/Stop by twisting clockwise.

Step 36. Press the GREEN button on Operator Control Interface (OCI). GREEN button illuminates.

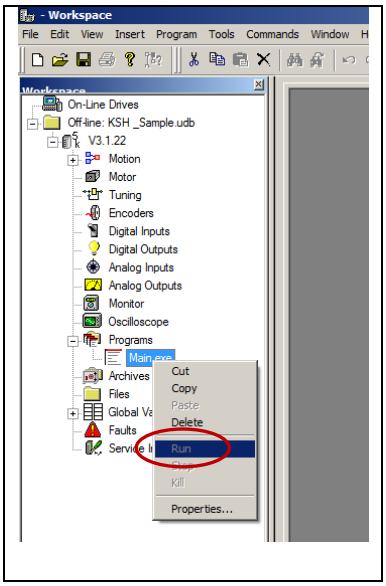
4.6.3 Set New Home Position

Step 1. If necessary, connect one side of a 9-Pin D-Sub Null modem cable to the Load Monitoring Module.

Step 2. If necessary, power-up computer that has Ultraware installed and connect the other side of the 9-Pin D-Sub Null modem cable into the computer.

Step 3. If necessary, start Ultraware software. (Refer to Section 5 Software "Connecting to a Servo Hoist")

Step 4. Restart the Main.EXE by right clicking on the Main.EXE icon and selecting RUN from the Pop-Up Menu. (See Figure below)



Step 5. Refer to Section 5 Software "Encoder Offset Setup Procedure (Zero Position Adjustment)" on page 5-14 to finish installing the chain.

5. SOFTWARE

A. Getting Started

Listed below are the hardware and software items needed to connect to a Knight Servo Hoist (KSH):

- Microsoft Windows based PC
- Serial Port or USB to Serial Adaptor
- Serial Cable: 9-pin Dsub female to 9-pin Dsub male Null Modem cable or straight cable w/Null Modem adapter.
- Allen Bradley UltraWare Software P/N 2098-UWCPRG

Figure 5-1

B. Connecting to a Servo Hoist

The Servo Hoist is controlled by an Allen Bradley Ultra5000 servo drive. Allen Bradley Ultraware software is used to configure and troubleshoot the servo drive. The following steps are required to initiate a connection between a computer running Ultraware and the Ultra5000 servo drive:

Ultraware Software Package Setup:

Step 1. Double click on the Ultraware software icon on the desktop to open Ultraware.

Step 2. Setup serial communication settings.

a. Select **Tools** and then **Serial Port.** (See Figure 5-2)

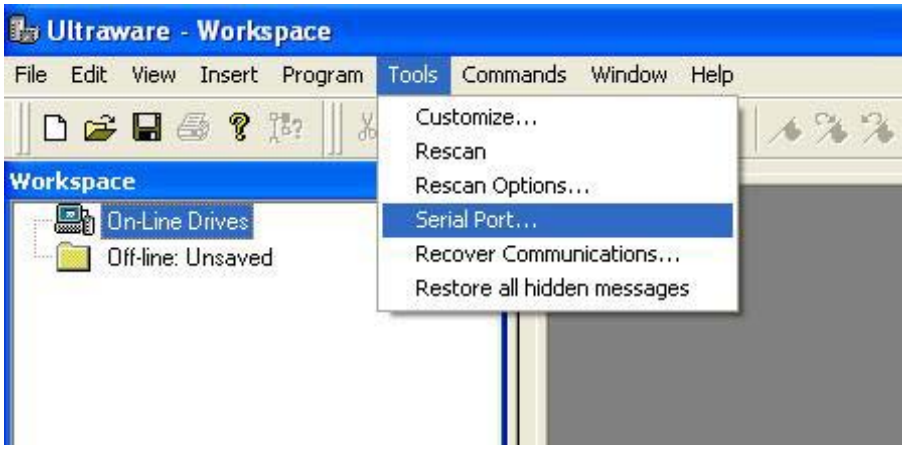


Figure 5-2

b. Confirm the Communication Parameters (Figure 5-3).

- Serial Port should be the com port where the serial cable is connected.
- Baud Rate is always 38400.
- Format is always 8 Data Bits, No Parity.

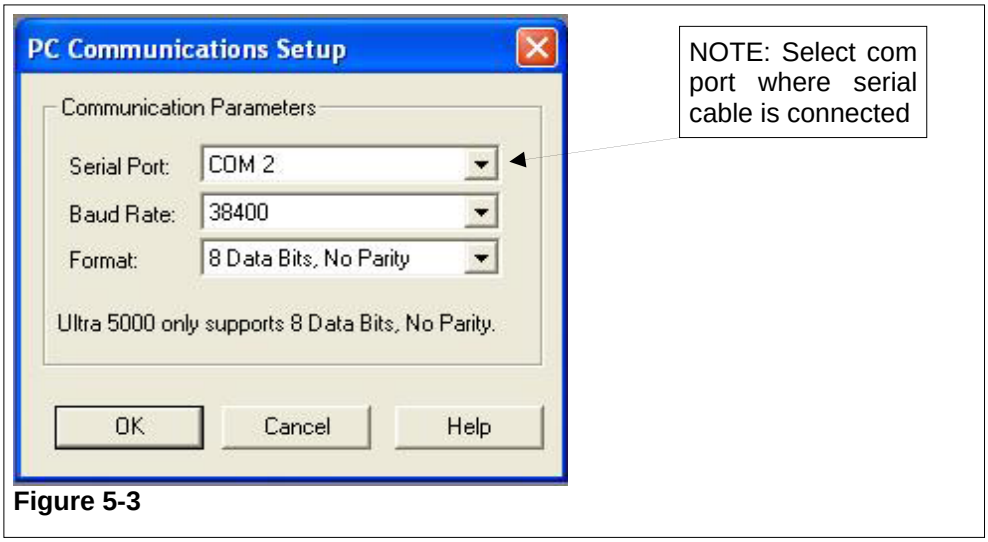


Figure 5-3

c. Click OK to accept the settings.

Step 3. Setup rescan options

a. Select Tools and then Rescan Options. (Figure 5-4)

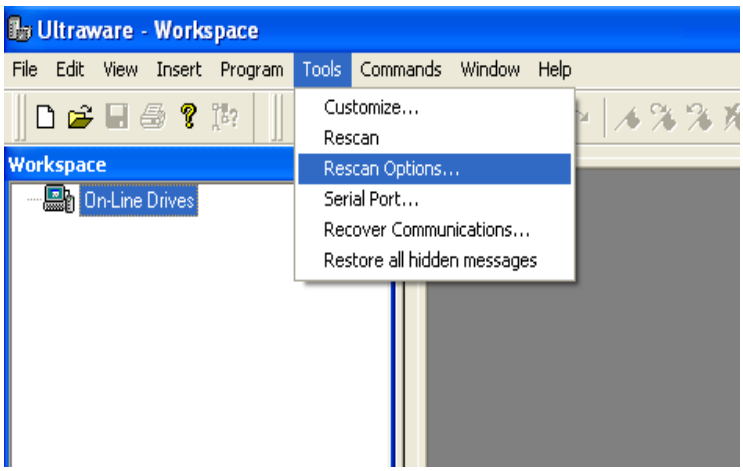


Figure 5-4

b. Set node values in Rescan Options Window.

- Verify the Ultra5000 box is checked.
- Set “From Node: To Node:” values.
- From Node: = 0
- To Node: = 100
- Knight standard hoist systems are all node 1.
- Multi-axis systems may be nodes 1-4.

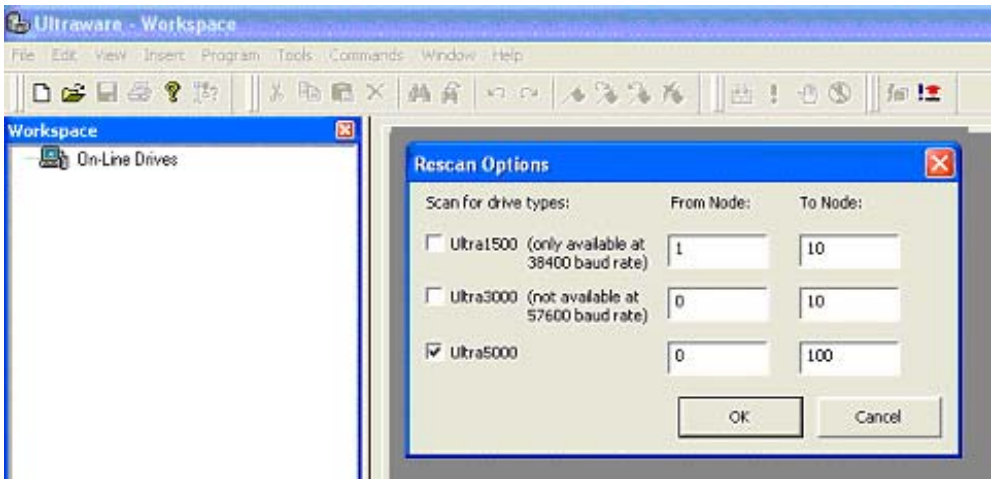


Figure 5-5

Establishing Connection to Servo Hoist:

Step 1. Connect a female-to-male 9-pin null modem serial cable from serial port on the laptop to the 9-pin connector on the Servo Hoist handle. Some servo systems will need a female to female 9-pin null modem serial cable.

Step 2. Provide power to the Servo Hoist and release the run stop push button. This will supply power to the Ultra5000 drive to allow communication with Ultraware.

Step 3. Double click on the Ultraware software icon on the desktop to open Ultraware. Select "Create New File" when prompted. Ultraware will automatically scan for connected drives.

OR

Step 4. Select Tools and then Rescan inside of the Ultraware. (Figure 5-6)

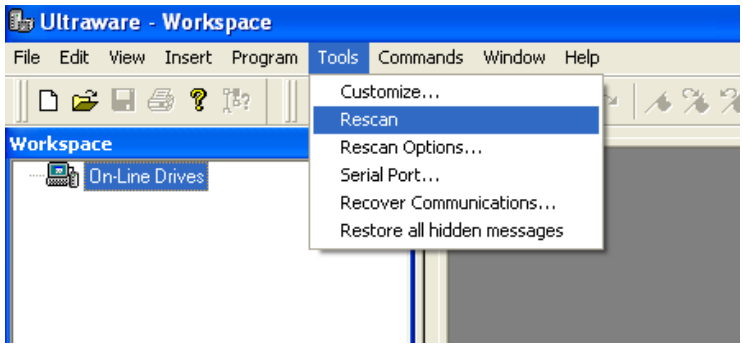


Figure 5-6

Step 5. Ultraware program will scan nodes and attach to the drive. (Figure 5-7)

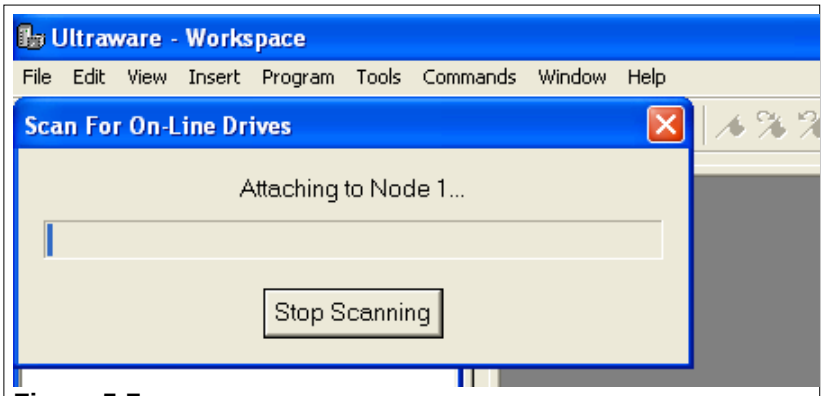


Figure 5-7

Step 6. Software is uploaded and listed under On-Line Drives. (Figure 5-8)

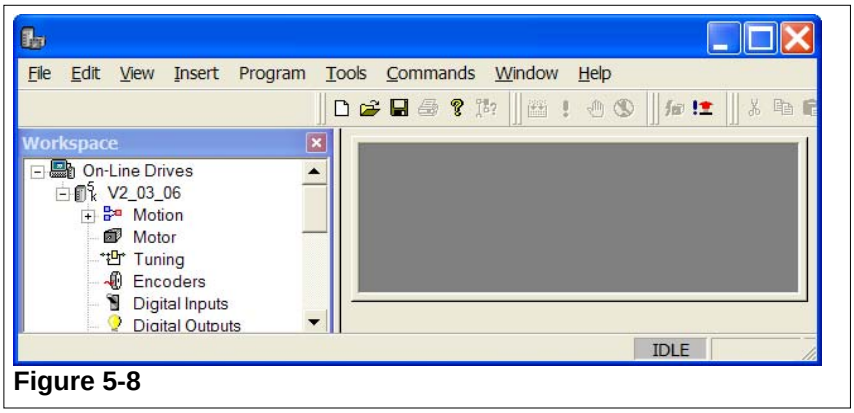


Figure 5-8

C. Save Uploaded File

Uploading and saving the drive parameters from an online drive.

Step 1. Lower hoist or support fixture and load so that no load is present on the hoist.
Step 2. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 3. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 4. Select the + next to Programs. This will expand to show program Main.exe or VertAxis.exe. (A red horizontal line will sweep from the top of the graphic to the bottom of the graphic when the program is running.)
Step 5. Right click on program and select Stop from the menu to stop the program from running.
Step 6. Once the program is stopped, click **File** and then **Save**.

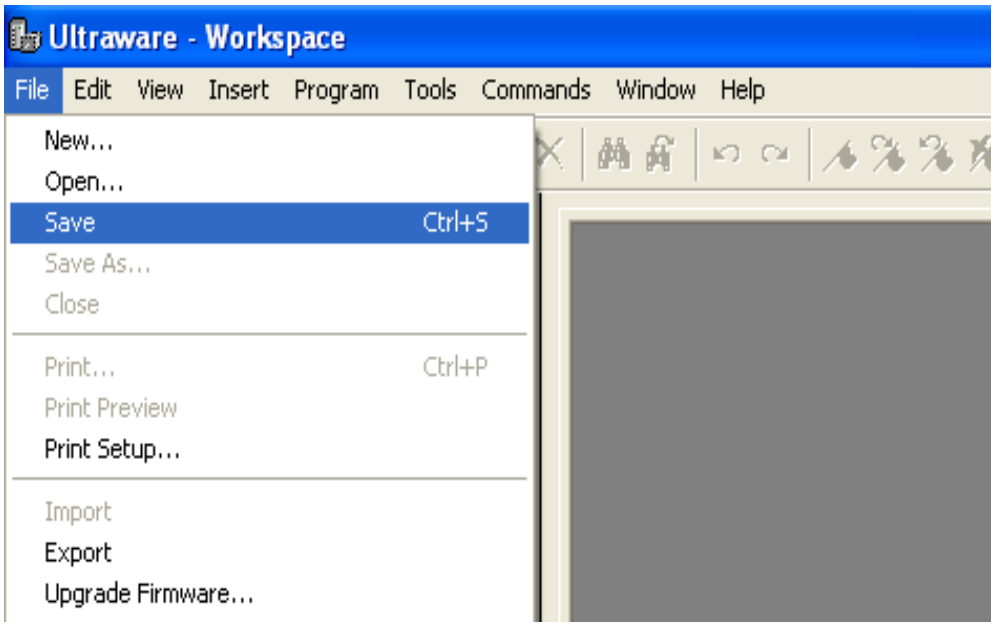


Figure 5-9

Step 7. A confirmation window will pop up. (Figure 5-10)
Step 8. Click YES to upload information from the drive to the computer (process takes approximately 2 minutes).
Step 9. A “Save As” dialog box will appear and prompt for a file name and folder location to save the .udb file. Select folder on hard drive and enter desired file name. Press “Save” button to save to hard drive.
Step 10. The saved drive is now visible in the “Off-line” folder of the Workspace Window. (Figure 5-11)

⚠WARNING!
Lower hoist or support fixture and load so that no load is on the hoist prior to uploading file.

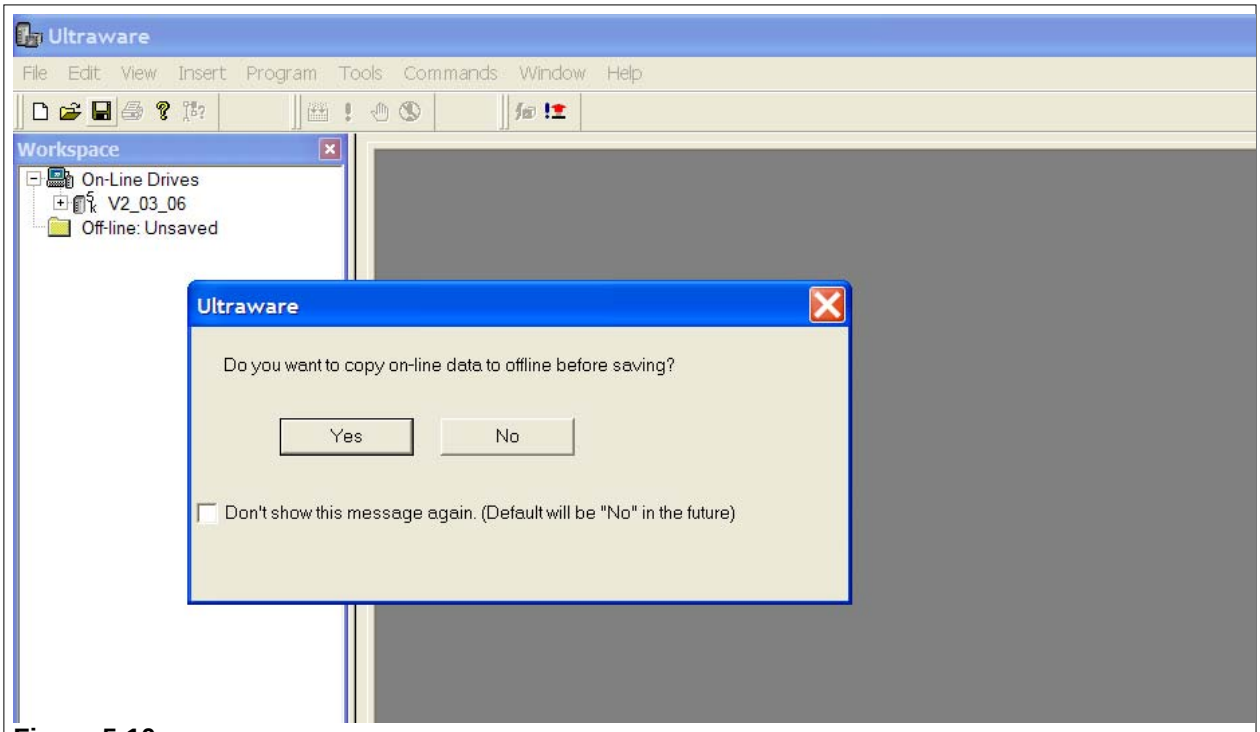


Figure 5-10

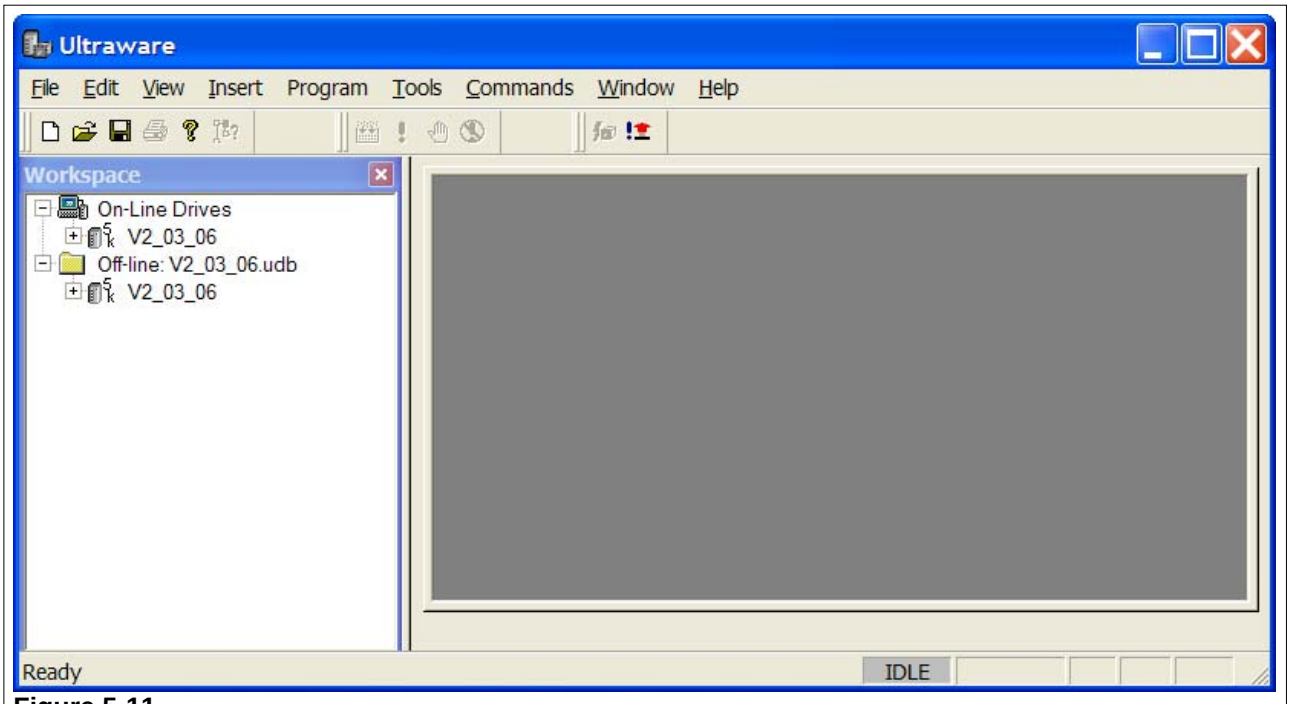


Figure 5-11

Step 11. Select the + next to Programs. This will expand to show program Main.exe or VertAxis.exe
Step 12. Right click on program and select Run from the menu to start the program.
Step 13. Verify operation of hoist.

D. Reload New Drive with Existing Software

This section of the manual will discuss downloading the drive parameters from an offline file to an online drive.

Step 1. Lower hoist or support fixture and load so that no load is present on the hoist.
Step 2. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 3. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 4. Select the + next to Programs. This will expand to show program Main.exe or VertAxis.exe. (A red horizontal line will sweep from the top of the graphic to the bottom of the graphic when the program is running.)
Step 5. Right click on program and select Stop from the menu to stop the program from running.
Step 6. Drag offline drive file to the online drive file. (Figure 5-12)
Step 7. When prompt asks if you want to replace the drive, click “Yes”.

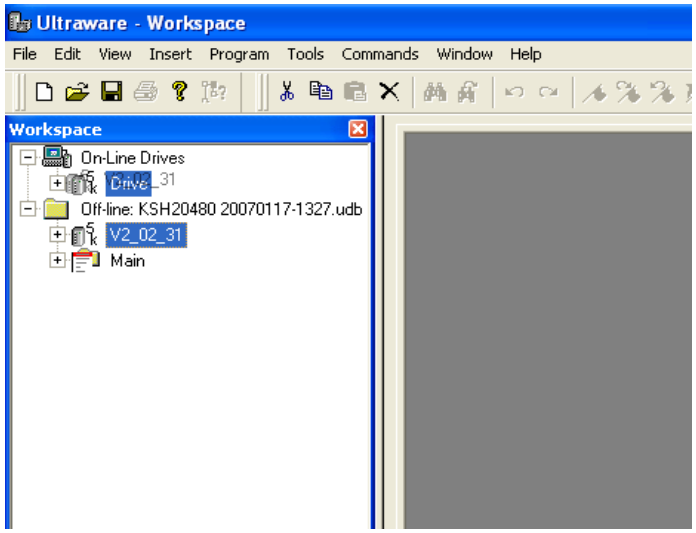


Figure 5-12

Step 8. Drive will be copied. (Process will take approximately 2 minutes).
Step 9. When download is complete the program will not be running.
Step 10. Expand Programs folder (located under Workspace On-Line Drives).
Step 11. Select the + next to Programs. This will expand to show program Main.exe or VertAxis.exe
Step 12. Right click on program and select Run from the menu to start the program.
Step 13. Verify operation of hoist.

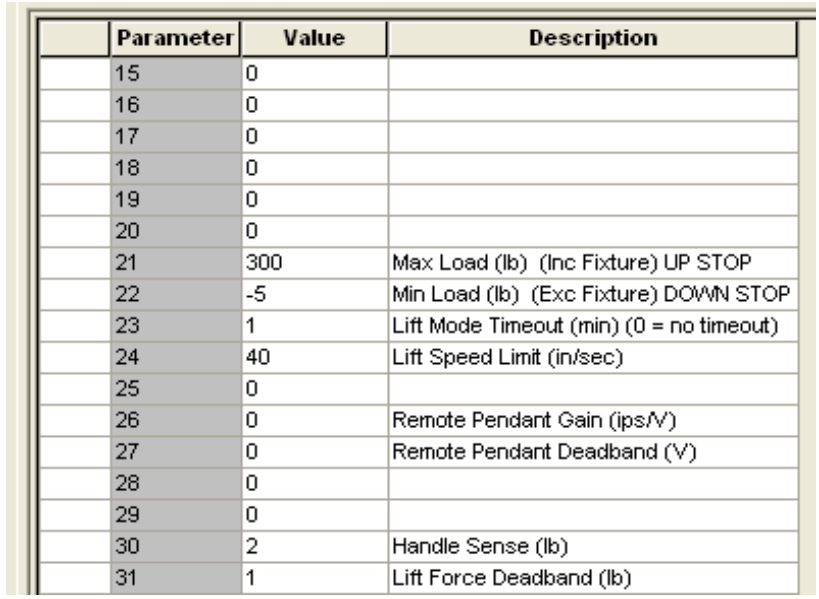
⚠WARNING!
Lower hoist or support fixture and load so that no load is on the hoist prior to reloading drive.

E. Change Max Load Limit (Up Stop)

If maximum load limit is reached, the hoist will no longer move in an upward direction. The system will however, allow the operator to set the load down.

To Modify Settings:

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable table F8L1 and scroll down to parameter F8L1:21 - Max Load (this value is the maximum weight that the hoist will pick up).



	Parameter	Value	Description
	15	0	
	16	0	
	17	0	
	18	0	
	19	0	
	20	0	
	21	300	Max Load (lb) (Inc Fixture) UP STOP
	22	-5	Min Load (lb) (Exc Fixture) DOWN STOP
	23	1	Lift Mode Timeout (min) (0 = no timeout)
	24	40	Lift Speed Limit (in/sec)
	25	0	
	26	0	Remote Pendant Gain (ips/V)
	27	0	Remote Pendant Deadband (V)
	28	0	
	29	0	
	30	2	Handle Sense (lb)
	31	1	Lift Force Deadband (lb)

Figure 5-13

NOTE

Physics and Force = Mass x Acceleration. If limits are set at 250lbs and operator attempts to pick up 240lbs, the 250lb threshold will be crossed when accelerating upward. Refer to load capacity ratings (listed on Servo Unit) when setting limits. For optimal, safe performance, **DO NOT** exceed rated capacity.

F. Modify Chain Payout (Set-Down Weight, Down Stop)

To prevent chain payout or chain slacking, a minimum load weight is programmed into the software. For example if the fixture weight is 40lbs and the minimum load weight is set to -10lbs, then the servo system will allow the hoist to lower until 10lbs of the fixture is placed on the floor. The remaining 30lbs will be supported by the hoist. This allows the operator to set down the fixture without paying out chain. If the minimum load weight is set to -50lbs, then the servo system will allow the hoist to lower until the entire weight of the 40lb fixture is placed on the floor. If the down command is maintained then the chain will payout onto the fixture until it reaches the lower limit.

To Modify Settings:

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable table F8L1 and scroll to F8L1:22 (Parameter-Min Load) (Figure 5-14)
Step 4. Change value to allow or stop chain payout.

	Parameter	Value	Description
	15	0	
	16	0	
	17	0	
	18	0	
	19	0	
	20	0	
	21	300	Max Load (lb) (Inc Fixture) UP STOP
	22	-5	Min Load (lb) (Exc Fixture) DOWN STOP
	23	1	Lift Mode Timeout (min) (0 = no timeout)
	24	40	Lift Speed Limit (in/sec)
	25	0	
	26	0	Remote Pendant Gain (ips/V)
	27	0	Remote Pendant Deadband (V)
	28	0	
	29	0	
	30	2	Handle Sense (lb)
	31	1	Lift Force Deadband (lb)

Figure 5-14

NOTE

Larger values stop chain payout; smaller values allow chain payout.

G. Balance Analog Handle

The analog handle is controlled from a load cell that senses any additional force to the handle. A force-up creates a command up; a force-down creates a command down. If the static weight of the handle changes, the analog signal needs to be balanced.

To Balance Analog Handle:

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable tables F8L1 and fSTS and scroll to fSTS:3. This is the current command on the analog handle in pounds. Add this number to the number in F8L1:8. This is the Handle Weight used to offset the lift load cell. (See Figure 5-15)

NOTE

Move curser off value cell to update new value and save setting.
When looking at values online the update rate is fairly slow, so you should wait 10-15 seconds to make sure the values that you are looking at are correct.
An easy way to verify that you are working in a parameter table that is in the online drive is to see if the tab at the bottom of the window is highlighted green. The green highlighted tab means online and gray means offline.

Step 4. Return to fSTS and look to make sure that fSTS:3 is close to zero. This variable is an actual filtered value that represents the pounds of force on the lift load cell. (See Figure 5-16)

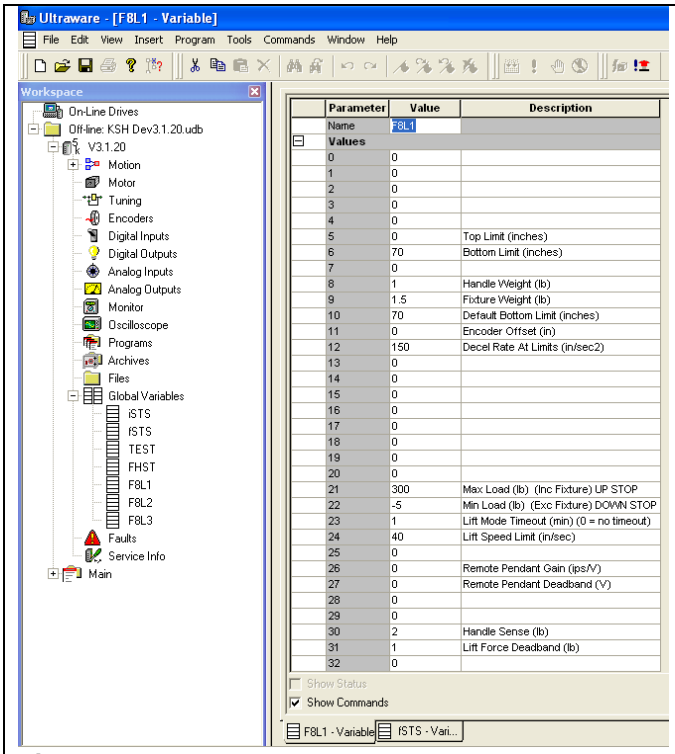


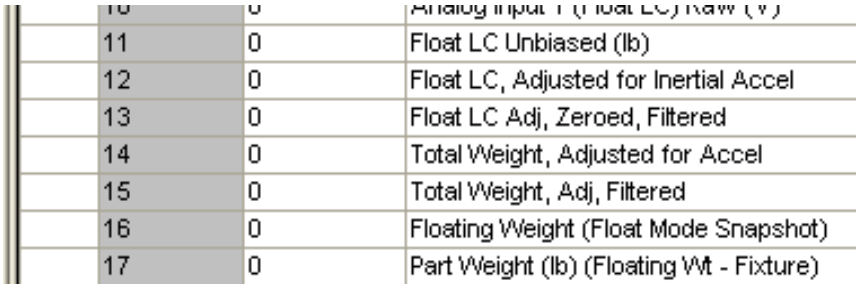
Figure 5-15

	Parameter	Value	Description
	Name	fSTS	
⊟	Values		
	0	0	Analog Input 2 (Lift LC) Raw (V)
	1	0	Lift LC Unbiased (lb)
	2	0	Lift LC, Adjusted for Inertial Accel
	3	0	Lift LC Adj, Zeroed, Filtered
	4	0	

Figure 5-16

H. Adjust Fixture Weight

Allow the fixture to hang freely without a part. Monitor variable fSTS:17. This variable is the current part weight. This value should read approximately zero. (See Figure 5-17)



	11	0	Float LC Unbiased (lb)
	12	0	Float LC, Adjusted for Inertial Accel
	13	0	Float LC Adj, Zeroed, Filtered
	14	0	Total Weight, Adjusted for Accel
	15	0	Total Weight, Adj, Filtered
	16	0	Floating Weight (Float Mode Snapshot)
	17	0	Part Weight (lb) (Floating Wt - Fixture)

Figure 5-17

To reset variable fSTS:17 (Part Weight) to zero:

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable tables F8L1 and fSTS and scroll to fSTS:17. This is the current part weight on the float load cell in pounds. Add this number to the number in F8L1:9. This is the fixture weight, used to offset the float load cell.
Step 4. After the change, return to fSTS:17 to make sure it is close to zero with no part on the fixture. This variable is an actual filtered value that represents the weight hanging from the fixture.

NOTE

Fixture must be hanging freely without a load present to set correct fixture weight.

I. Enabling Float, Lift, Digital, or Analog Mode

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable table F8L2. (Figure 5-18).
Step 4. To enable the functionality, input (1) in the value columns.
Step 5. To disable the functionality, input (0) in the value columns.
Step 6. F8L2:20 Enable Lift Mode.
Step 7. F8L2:40 Enable Float Mode.
Step 8. F8L2:30 Enable Analog Handle. (Control with analog fixture handle or inline handle)
Step 9. F8L2:38 Enable Digital Handle. (Control with discrete up/down pendant)

NOTE

The above enable bits should only be set with the aid of a Knight Representative.

	Parameter	Value	Description
	20	0	Enable Lift Mode
	21	300	Max Load (lb) (Inc Fixture) UP STOP
	22	2	Up Stop Resume Bandwidth (lb)
	23	10	Down Stop Resume Bandwidth (lb)
	24	1	Up/Down Stop Resume Time (sec)
	25	1	Lift Max Speed "Fudge Factor"
	26	0	
	27	1	Enable Impulse Limiting (Lift Mode)
	28	12	Impulse Limit Max Speed After Impulse
	29	0.1	Impulse Limit Time To Limit Max Speed
	30	1	Enable Analog Handle
	31	8	Handle Filter Bandwidth
	32	0	
	33	100	Lift Mode Prop Accel (in/sec2)
	34	150	Lift Mode Prop Decel (in/sec2)
	35	100	Lift Command Limit (lb)
	36	0.9	Lift Force Cancellation Gain
	37	0	
	38	0	Enable Digital Handle
	39	0	
	40	0	Enable Float Mode

Figure 5-18

J. Adjust Speeds of an UP/DOWN Pendant Handle

To change the speed of the Up/Down pendant handle:

Step 1. Connect to Servo Hoist by following the “Connecting to a Servo Hoist” procedure.
Step 2. Select the + next to the drive name under the On-Line Drives folder. This will expand and give more choices inside the drive.
Step 3. Open Global Variable table F8L1 and scroll down to F8L1:36 (high speed digital value in in/sec.) and F8L1:37 (low speed digital value in in/sec.) (Figure 5-19)

To adjust the rate of acceleration and deceleration of the Up/Down pendant handle:

Step 1. Open Global Variable table F8L1 and scroll down to F8L1:38 (digital acceleration value in in/sec2) and F8L1:39 (digital deceleration value in in/sec2). (Figure 5-19)

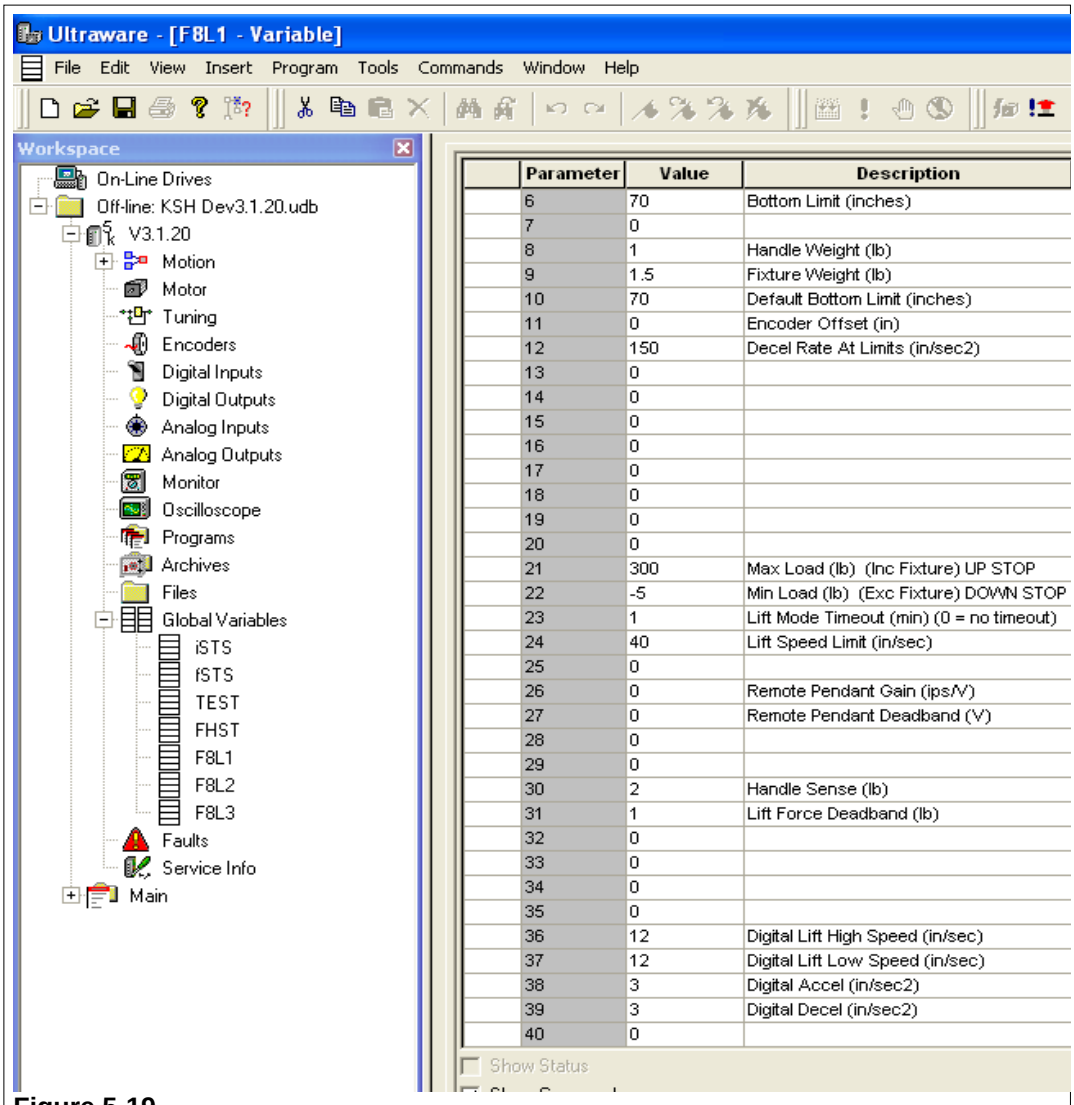


Figure 5-19

K. Encoder Offset Setup Procedure (Zero Position Adjustment)

This procedure is to be performed after the servo motor, gearbox or chain have been modified or replaced. It will "teach" the system the encoder position that equates to the zero or fully raised position of the hoist. Zero position is when the hoist is fully raised. The bottom limit is when the hoist is fully lowered. To setup the encoder offset, the encoder position that equates to the hoist zero position must be determined. This is the encoder offset.

Step 1. Connect to Servo Hoist by following the "Connecting to a Servo Hoist" procedure.

Step 2. Record original values of encoder related variables from the On-Line drive.
- a. Variable F8L1:5 _____ "Top Limit Inches"
- b. Variable F8L1:6 _____ "Bottom Limit Inches"
- c. Variable F8L1:11 _____ "Encoder offset Inches"

Step 3. The current position of the hoist is displayed in variable fSTS:30 "Real World Position". This is the position that the hoist thinks that it is at. This may be incorrect due to the due to the replaced motor, gearbox or chain. It may be a positive or negative value.
- a. Record current value of fSTS:30 _____ "Real World Position".

Step 4. Now that we know where the servo thinks that it is at, we can temporarily adjust the top limit to allow the hoist to move up to the physical top limit position (zero position).
- a. Adjust F8L1:5 "Top Limit Inches" a few inches less than fSTS:30 "Real World Position"
- b. Use lift control to raise hoist a few inches.
- c. fSTS:30 "Real World Position" will now display the new position.
- d. Re-adjust F8L1:5 "Top Limit Inches" a few inches less than fSTS:30 until it allows you to completely raise the hoist to home position. Raise hoist to the point that the coil cable is almost fully compressed, but not to the point that the hoist is forcing the cable into the hoist enclosure. This is the proper zero position.

Step 5. Now that the hoist is at zero position we can determine the encoder position that equates to this zero position.
- a. Record current value of fSTS:29 "Encoder Position" _____.
- b. Copy value of fSTS:29 "Encoder Position" to F8L1:11 "Encoder Offset inches".
- c. Return values of variables F8L1:5 "Top Limit Inches" and F8L1:6 "Bottom Limit Inches" to the original values recorded in step 1.
- d. Verify that fSTS:30 "Real World Position" now displays a number close to zero.

Step 6. Verify that encoder offset is correct by raising the host and checking that it stops automatically at the top limit before the coil cable is fully compressed.

Step 7. Lower the hoist and verify that it stops automatically at the bottom limit before the hoist physically runs out of travel.

6. VARIABLE DESCRIPTIONS

A. iSTS Global Variable Array

This complete array is reserved for internal use.

B. fSTS Global Variable Array

This Global Array is used as a status file to see what is going on inside the program. The values are updated from the drive over the serial communication. This means that they may not update very fast. The less parameters on the screen, the faster it will update. You can use the Windows restore down button in the upper right hand corner of the window and shrink the window to reduce the number of parameters showing. Also, if you click on the workspace the update rate will increase.

fSTS: 00 – Analog Input 2 (Lift Load Cell) Raw
Variable Units: Volts
Description: This parameter displays the current reading of the lift load cell input in volts.

fSTS: 01 – Lift Load Cell Unbiased
Variable Units: Pounds
Description: Intermediate calculation of force on lift load cell. *Reserved for internal use only.*

fSTS: 02 – Lift Load Cell, Adjusted for Inertial Acceleration
Variable Units: Pounds
Description: Intermediate calculation of force on lift load cell. *Reserved for internal use only.*

fSTS: 03 – Lift Load Cell, Adjusted for Inertial Acceleration, Zeroed, Filtered
Variable Units: Pounds
Description: This parameter displays the current reading of the lift load cell input in pounds. This is the zeroed and filtered value meaning that the load cell bias F8L2:9 has been applied to the raw input, converted to pounds with F8L2:7 and zeroed with the handle weight of F8L1:8.

fSTS: 06 – Fault # (1-99 Drive, 100+ Software)
Variable Units: Fault #
Description: This parameter displays the current drive fault if one exists. If the number is between 1 and 99 then it is a drive fault and can be looked at on the Ultraware fault screen or in the Ultra5000 manual. If the fault number is 100 or greater then it is a software servo fault and can be looked up in troubleshooting section of this manual or the application specific addendum.

fSTS: 07 – Analog Input 2 Source
Variable Units: Reserved for Internal Use Only
Description: Reserved for Internal Use Only

fSTS: 08 – Operating Mode
Variable Units: Choice (0 = No Mode / Sleep, 1=Lift, 2=Float, 3=Test)
Description: This parameter displays the current mode of the hoist.

fSTS: 10 – Analog Input 1 (Float Load Cell) Raw
Variable Units: Volts
Description: This parameter displays the current reading of the float load cell input in volts.

fSTS: 11 – Float Load Cell Unbiased (lb)
Variable Units: Pounds
Description: Intermediate calculation of force on float load cell. *Reserved for internal use only.*

fSTS: 12 – Float Load Cell, Adjusted for Inertial Acceleration
Variable Units: Pounds
Description: Intermediate calculation of force on float load cell. *Reserved for internal use only.*

fSTS: 13 – Float Load Cell, Adjusted for Inertial Accleration, Zeroed, Filtered
Variable Units: Pounds
Description: Intermediate calculation of force on float load cell. *Reserved for internal use only.*

fSTS: 14 – Total Weight, Adjusted for Acceleration
Variable Units: Pounds
Description: Intermediate calculation of force on float load cell. *Reserved for internal use only.*

fSTS: 15 – Total Weight, Adjusted for Acceleration, Filtered
Variable Units: Pounds
Description: Displays the current reading of the float load cell input in pounds. This is the zeroed and filtered value meaning that the load cell bias F8L2:10 has been applied to the raw input and converted to pounds with F8L2:8. This includes the fixture weight and the fixture weight.

fSTS: 16 – Floating Weight (Float Mode Snapshot)
Variable Units: Pounds
Description: Displays the value of the fSTS:15 “Total Weight” when float mode was selected. This is the amount of weight that the system will balance in float mode.

fSTS: 17 – Part Weight (lb) (Floating Weight – Fixture Weight)
Variable Units: Pounds
Description: Displays the current part weight which is the value of fSTS:15 “Total Weight” with the fixture weight F8L1:9 subtracted from it.

fSTS: 20 – Motion Timer (sec)
Variable Units: Seconds
Description: *Reserved for internal use only*

fSTS: 21 – Main Loop Core Time (ms)
Variable Units: ms
Description: *Reserved for internal use only*

fSTS: 22 – Main Loop Total Time (ms)
Variable Units: ms
Description: *Reserved for internal use only*

fSTS: 23 – Main Loop Core Time, 100 scan avg (ms)
Variable Units: ms
Description: *Reserved for internal use only*

fSTS: 24 – Main Loop Total Time, 100 scan avg (ms)
Variable Units: ms
Description: *Reserved for internal use only*

fSTS: 25 – Logic Run Timer (days)
Variable Units: Days
Description: Displays the number of days that the controller has been running.

fSTS: 26 – Total Distance Counter (inches)
Variable Units: Inches
Description: Displays the total distance in inches that the hoist has lifted and lowered. This includes travel in lift mode, float mode and test mode.

fSTS: 27 – Lift Mode Distance Counter (in)
Variable Units: Inches
Description: Displays the total distance in inches that the hoist has lifted and lowered in lift mode.

fSTS: 28 – Float Mode Distance Counter (in)
Variable Units: Inches
Description: Displays the total distance in inches that the hoist has lifted and lowered in float mode.

fSTS: 29 – Encoder Position (in)
Variable Units: Inches
Description: Displays the actual encoder counts converted to inches.

fSTS: 30 – Real World Position (in)
Variable Units: Inches
Description: Displays the actual encoder counts converted to inches with the absolute encoder offset F8L1:11 applied to convert it to a real world position. Position is referenced to the fully raised position of the hoist. Fully raised position is 0". Position increases as hoist is lowered.

fSTS: 32 – Feedback Velocity (in/s)
Variable Units: Inches per second
Description: This parameter displays the actual velocity of the Servo Hoist.

fSTS: 33 – Feedback Acceleration (in/s2)
Variable Units: Inches per second^2
Description: This parameter displays the actual rate of acceleration of the Servo Hoist.

fSTS: 35 – PGain (Vel Loop Tuning)
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 36 – IGain (Vel Loop Tuning)
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 37 – FGain (Vel Loop Tuning)
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 38 – Kp (Pos Loop Tuning)
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 39 – Kff (Pos Loop Tuning)
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 40 – Stress Relief Mode
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 41 – Stress Relief Active
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 42 – Jog Vel Squared Filter
Variable Units: N/A
Description: *Reserved for internal use only*

fSTS: 43 – Command Current (Amps)
Variable Units: Amps
Description: Displays the amount of current output from the servo drive to the servo motor.

fSTS: 44 – Equivalent Force (lbs) (Up = negative)
Variable Units: Pounds
Description: Displays the force generated by the commanded current in fSTS:43.

C. TEST Global Variable Array

This Global Array is used to configure and initiate the test mode auto cycle. The mode is used to cycle the hoist during the break-in period and for performance verification prior to shipping each system. This mode is for use by Knight Representatives only and is disabled prior to shipping.

TEST: 00 – START TEST MODE
Variable Units: Boolean 1 = ON, 0 = OFF
Description: This parameter is used as a switch to turn on test mode. The controller will not respond to inputs and follows a set path based on the parameters set below.

TEST: 01 – Position 1
Variable Units: Inches
Description: This parameter sets the upper position limit for the controller while in test mode.

TEST: 02 – Position 2
Variable Units: Inches
Description: This parameter sets the lower position limit for the controller while in test mode.

TEST: 03 – Velocity
Variable Units: Inches per second
Description: This parameter sets the velocity for test mode.

TEST: 04 – Acceleration
Variable Units: Inches per second^2
Description: This parameter sets the acceleration while in test mode.

TEST: 05 – Deceleration
Variable Units: Inches per second^2
Description: This parameter sets the deceleration while in test mode.

TEST: 06 – Delay
Variable Units: Seconds
Description: This parameter sets the time delay between cycles in test mode.

TEST: 07 – Max Moves
Variable Units: Number of moves
Description: This parameter sets the number of test cycle moves. When the test cycle counter reaches this number, the test cycle will stop. If set to zero it will never stop on its own.

TEST: 10 – Move Count
Variable Units: Cycle Count
Description: This parameter displays the number of cycles completed by the hoist in test mode.

TEST: 13 – Estimated Weight (lb) - Based On Motor Current
Variable Units: Pounds
Description: This parameter displays the estimated weight that the hoist is moving in test mode. This weight value is calculated from the motor current sampled during the motion.

TEST: 14 – Estimated Efficiency - Based On Motor Current
Variable Units: Percent
Description: This parameter displays the estimated efficiency of the drive system. This is based on data collected during motion in test mode.

TEST: 15 – Motor Amperage Average 2nd Last Move
Variable Units: Amp
Description: Displays the average current draw of the servo motor during the 2nd to last motion in test mode.

TEST: 16 – Motor Amperage Average Last Move
Variable Units: Amp
Description: Displays the average current draw of the servo motor during the last motion in test mode.

D. FHST Global Variable Array

This variable array stores the history of system faults. It is used for system diagnostic and troubleshooting.

FHST: 00 – Fault History Index
Variable Units: Integer
Description: This variable displays the current index number of the revolving fault history array. If the fault history index is 1 then the number of the last fault is located in FHST:1 and the time of the last fault is located in FHST:2. If the fault history index is 10, then the number of the last fault is located in FHST:20 and the time of the last fault is located in FHST:21.
-- Location of last fault number = (Fault History Index x 2)
-- Location of last fault time = (Fault History Index x 2) + 1

FHST: 01, 03, 05 … – Fault Number
Variable Units: Integer
Description: This variable displays the fault number for each fault number / fault time pair. If the number is between 1 and 99 then it is a drive fault and can be looked at on the UltraWare fault screen or in the Ultra5000 manual. If the fault number is 100 or greater then it is a software servo fault and can be looked up in the troubleshooting section of this manual.
Note: Parameter fSTS:06 “Fault #” displays the current active fault.

FHST: 02, 04, 06 … – Fault Time (Sec)
Variable Units: Seconds
Description: This variable displays the fault time for each fault number / fault time pair. The time is displayed in seconds from the global run timer.

E. F8L1 Global Variable Array

This variable array stores parameters that are most frequently adjusted by the end user. This list contains parameters used to fine tune the system performance. It also contains configuration parameters that must be adjusted after maintenance to the servo, motor or gearbox or after adjustment of the fixture or lift handle.

F8L1: 05 – Top Limit
Variable Units: Inches
Description: This sets the upper travel limit for the hoist. This may also be set through program mode on the handle. This value should be set to a number greater than or equal to zero. The home position or absolute top limit is set at zero. When setting the limits through program mode on the handle the limits must be 12 inches apart to prevent setting limits at the same point, which would prevent any movement.
Reference: Section 3 “Setting Upper Travel Limits”

F8L1: 06 – Bottom Limit
Variable Units: Inches
Description: This sets the lower travel limit for the hoist. This may also be set through program mode on the handle. This value should be set to a number greater than the Top Limit. The home position is set at zero. When setting the limits through program mode on the handle the limits must be 12 inches apart to prevent setting limits at the same point, which would prevent any movement.
Additional: Section 3 “Setting Lower Travel Limits”

F8L1: 08 – Handle Weight
Variable Units: Pounds
Description: This configuration parameter is for the entry of the static weight of everything on the operator’s side of the lift load cell. This must be adjusted if the lift handle is modified or replaced.
Reference: Section 5 “Balance the Analog Handle”

F8L1: 09 – Fixture Weight
Variable Units: Pounds
Description: This configuration parameter is for the entry of the static weight of the fixture, hook or shackle hanging below the float load cell. This must be adjusted if the fixture is modified or replaced.
Reference: Section 5 “Adjust the Fixture Weight”

F8L1: 10 – Default Bottom Limit
Variable Units: Inches
Description: This sets the default value for the bottom position limit. This value is used when the operator programmed limits are reset by holding the green button for more than six seconds.
Reference: Section 3 “Clearing Travel Limits” instructions.

F8L1: 11 –Encoder Offset
Variable Units: Inches
Description: This sets the offset that the hoist uses to compute the home position. It offsets the absolute encoders zero position so the hoists zero position becomes the position at the physical upper limit of travel. A setting of zero indicates a non-absolute incremental motor and is for compatibility with legacy systems. This parameter must be adjusted when the motor, gearbox or chain are replaced.
Reference: Section 6 “Encoder Offset Procedure”

F8L1: 12 – Deceleration Rate at Limits
Variable Units: Inches per second^2
Description: This sets the rate of deceleration at the top and bottom limits.

F8L1: 21 - Max Load (lb) (Including Fixture)
Variable Units: Pounds
Description: This sets the maximum load that the Servo Hoist will lift, including the weight of the fixture.
Note: Parameter "F8L2:21 – Max Load (lb)" also restricts the maximum load. F8L1:21 must be set to a value less than or equal to the value of F8L2:21.
Reference: Section 6 "Change Max Load Limit" procedure.

F8L1: 22 - Min Load (lb) (Excluding Fixture)
Variable Units: Pounds
Description: This sets the minimum load that the Servo Hoist will release. This means that once it gets below this amount of weight the Servo Hoist will not pay out any more chain. This is typically set to a value that allows the hoist to lower most of the fixture weight on to the floor without paying out additional chain once the fixture is on the floor.
Reference: Section 6 "Modify Chain Payout" procedure.

F8L1: 23 - Lift Mode Timeout (min) (0 = no timeout)
Variable Units: Minutes
Description: This sets the length of time that the controller will stay in lift mode unattended. When idle for longer than the specified time the controller will disable and revert to off mode. If this variable is set to zero, the hoist will never go into off mode.

F8L1: 24 - Lift Speed Limit
Variable Units: Inches per second
Description: This sets the maximum lift velocity for the Servo Hoist. The parameter is limited to the absolute maximum velocity of the system.

****F8L1: 26 – Remote Pendant Gain**
Variable Units: N/A
Description: *Reserved for internal use only.*

****F8L1: 27 – Remote Pendant Deadband**
Variable Units: N/A
Description: *Reserved for internal use only.*

F8L1: 30 – Handle Sense
Variable Units: Pounds
Description: This sets the amount of force that is required on the lift handle before it changes from off mode to lift mode or from float mode to lift mode.
Note: Applies to systems with in-line or fixture style handles only.

F8L1: 31 – Lift Force Deadband
Variable Units: Pounds
Description: This sets the amount of input force that is required on the lift handle to start motion.
Note: Applies to systems with in-line or fixture style handles only.

F8L1: 36 – Digital Lift High Speed
Variable Units: Inches per second
Description: This sets the high speed for hoists with discrete up/down controls.
Note: Applies to systems with up/down pendants or wireless transmitters only.
Reference: Section 5 "Adjust the Speeds of an UP/DOWN Pendant Handle"

F8L1: 37 – Digital Lift Low Speed
Variable Units: Inches per second
Description: This sets the low speed for hoists with discrete up/down controls.
Note: Applies to systems with up/down pendants or wireless transmitters only.
Reference: Section 5 "Adjust the Speeds of an UP/DOWN Pendant Handle"

F8L1: 38 – Digital Acceleration
Variable Units: Inches per second^2
Description: This sets the acceleration for hoists with discrete up/down controls.
Note: Applies to systems with up/down pendants or wireless transmitters only.
Reference: Section 5 “Adjust the Speeds of an UP/DOWN Pendant Handle”

F8L1: 39 – Digital Deceleration
Variable Units: Inches per second^2
Description: This sets the deceleration when for hoists with discrete up/down controls.
Note: Applies to systems with up/down pendants or wireless transmitters only.
Reference: Section 5 “Adjust the Speeds of an UP/DOWN Pendant Handle”

F8L1: 41 – Float Top Limit
Variable Units: Inches
Description: This sets the upper travel limit for the hoist when in float mode. This is used to restrict the float mode travel to a position less than the overall upper limit set in F8L1:5 “Top Limit”

F8L1: 42 – Float Bottom Limit
Variable Units: Inches
Description: This sets the lower travel limit for the hoist when in float mode. This is used to restrict the float mode travel to a position less than the overall lower limit set in F8L1:6 “Bottom Limit”

F8L1: 43 - Float Mode Timeout (min) (0 = no timeout)
Variable Units: Minutes
Description: This sets the length of time that the controller will stay in float mode unattended. When idle for longer than the specified time the controller will disable and revert to off mode. If this variable is set to zero, the hoist will never go into off mode.

F8L1: 44 - Float Speed Limit
Variable Units: Inches per second
Description: This sets the maximum velocity of the Servo Hoist in float mode.

F8L1: 45 - Float Force Deadband
Variable Units: Pounds
Description: This sets the amount of input force that is required on the object hanging from the hoist to start motion in float mode.

F8L1: 71 – User Parameter 1
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

F8L1: 72 – User Parameter 2
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

F8L1: 73 – User Parameter 3
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

F8L1: 74 – User Parameter 4
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

F8L1: 75 – User Parameter 5
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

F8L1: 78 - Down Slow
Variable Units: Choice (0=off, 1=dn, 2-up, 3=up/dn)
Description: This configures the mode of the slow down feature. This parameter works with the variables F8L1:79 to F8L1:84 to configure the slow down feature.

0 = Slow down feature is disabled.
1 = Hoist will slow the system when moving down only.
2 = Hoist will slow the system when moving up only.
3 = Hoist will slow the system when moving up and down.

F8L1: 79 - Down Slow Part Loaded Weight
Variable Units: Pounds
Description: This sets the number of pounds that the hoist needs to see to indicate that a part loaded on the fixture. This is specific to the Down Slow feature.

F8L1: 80 - Down Slow Height Loaded
Variable Units: Inches
Description: This sets the height that the hoist will start to run at a reduced speed when the part loaded is turned on. The home position with the hoist completely raised is zero and this parameter is the number of inches down from home position.
Note: Current position is visible in fSTS:30 “Real World Position”

F8L1: 81 - Down Slow Speed Loaded
Variable Units: Inches per second
Description: This sets the slow speed that the hoist runs when the part loaded is turned on and it is below the down slow height loaded parameter.

F8L1: 82 - Down Slow Height Unloaded
Variable Units: Inches
Description: This sets the height that the hoist will start to run at a reduced speed when the part loaded is turned off. The home position with the hoist completely raised is zero and this parameter is the number of inches down from home position.
Note: Current position is visible in fSTS:30 “Real World Position”

F8L1: 83 - Down Slow Speed Unloaded
Variable Units: Inches per second
Description: This sets the slow speed that the hoist runs when the part loaded is turned off and it is below the down slow height unloaded parameter.

F8L1: 84 - Down Slow Max Deceleration
Variable Units: Inches per second^2
Description: This sets the deceleration when transitioning from the current speed to the down slow speed.

F8L1: 91-99 – User Parameters
Variable Units: Application Specific
Description: See manual addendum for application specific parameters.

NOTE
Variables marked with a "**" should NOT be manipulated without the aid of a Knight representative, as it may have unintended consequences.

F. F8L2 Global Variable Array

This variable array stores advanced parameters that affect the performance of the hoist. These parameters should only be adjusted with the aid of a Knight representative.

F8L2: 00 – Nominal Capacity
Variable Units: Pounds
Description: This displays the rated capacity of the hoist. It is purely text and is not used by the controller.

****F8L2: 02 – Payout Mode**
Variable Units: N/A
Description: *Reserved for internal use only.*

****F8L2: 05 – Gear Ratio**
Variable Units: Integer
Description: Gear ratio of the gear reducer. This is a physical property and should not be modified.

****F8L2: 06 - Max Motor RPM**
Variable Units: RPM
Description: Maximum RPM of the servo motor. This is a physical property and should not be modified.

****F8L2: 07 - Lift Load Cell Gain**
Variable Units: Pounds per Volt
Description: Gain of lift load cell. This is a physical property and should not be modified.

****F8L2: 08 – Float Load Cell Gain**
Variable Units: Pounds per Volt
Description: Gain of float load cell. This is a physical property and should not be modified.

****F8L2: 09 – Lift Load Cell Bias**
Variable Units: Volts
Description: This is the value of the lift load cell analog input that corresponds to zero weight on the lift load cell. This is a physical property and should not be modified.

****F8L2: 10 – Float Load Cell Bias**
Variable Units: Volts
Description: This is the value of the float load cell analog input that corresponds to zero weight on the float load cell. This is a physical property and should not be modified.

****F8L2: 11 – Reverse Motor Direction**
Variable Units: Boolean
Description: This parameter sets the forward direction of the servo motor. This is a property of the servo motor and should not be modified.

F8L2: 12 – Absolute Encoder
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used as a switch in the code to determine the encoder type which is either an absolute or incremental. If the system has an absolute encoder then the motor will remember its counts even after losing power. If it is incremental it will power up with a new set of counts thus needing to be re-homed. To re-home with an incremental just raise the hoist until the ball stop triggers the limit switch up inside the hoist enclosure.

****F8L2: 13 – Max Velocity Following Error**
Variable Units: Inches per second
Description: Sets the maximum acceptable amount of following error. This is used by the controller for detecting following error fault E104.

****F8L2: 14 – Chain Pitch**
Variable Units: mm
Description: Pitch or length of each chain link. This is a physical property and should not be modified.

****F8L2: 15 – Sprocket Size**
Variable Units: Number of Chain Links Per Rev
Description: Size of the drive sprocket. This is a physical property and should not be modified.

****F8L2: 16 – Deceleration Rate on Fault**
Variable Units: Inches per second^2
Description: Sets the deceleration rate of the hoist when a fault occurs. The minimum setting for this is 50in/s^2

****F8L2: 17 – Allow Down Full Speed Lift**
Variable Units: Boolean (0=Off, 1=On)
Description: Setting this ON allows the hoist to travel at its maximum speed when lowering in lift mode. The speed is dynamically limited by the load weight when lifting in lift mode. Setting this to OFF dynamically limits the speed when lifting and lowering.

****F8L2: 18 – Allow Down Full Speed Float**
Variable Units: Boolean (0=Off, 1=On)
Description: Option for float mode similar to F8L2:17 for lift mode.

F8L2: 20 – Enable Lift Mode
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to enable or disable lift mode.

F8L2: 21 – Max Load (lb) (Including Fixture)
Variable Units: Pounds
Description: This sets the maximum load that the Servo Hoist will lift, including the weight of the fixture.
Note: Parameter “F8L1:21 – Max Load (lb)” also restricts the maximum load. F8L1:21 must be set to a value less than or equal to the value of F8L2:21.
Additional Reference: Section 5 “Change Max Load Limit” procedure.

****F8L2: 22 – Up Stop Resume Bandwidth**
Variable Units: Reserved for internal use only.
Description: Reserved for internal use only.

****F8L2: 23 – Down Stop Resume Bandwidth**
Variable Units: Reserved for internal use only.
Description: Reserved for internal use only.

****F8L2: 24 – Up/Down Stop Resume Time**
Variable Units: Reserved for internal use only.
Description: Reserved for internal use only.

****F8L2: 25 – Lift Max Speed Fudge Factor**
Variable Units: Factor
Description: This factor is multiplied by the lift max speed limit. A value of one is normal. Any value above one will increase the max speed and any value below one will reduce the max speed.

****F8L2: 27 – Enable Impulse Limiting**
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to enable the impulse limiting code. When this code is enabled the hoist will sense an impulse in the float load cell and slow the hoist to reduce the impact on the system. This prevents the sharp motion that would occur if a load is snagged while the lift is in motion. Instead of jerking the load off the ground, the hoist senses the impulse and slows to a controlled speed.

****F8L2: 28 – Impulse Limit Max Speed after Impulse**
Variable Units: Inches per second
Description: This sets the speed that the hoist will slow to when impulse limiting is enabled and an impulse is detected.

****F8L2: 29 – Impulse Limit Time to Limit Max Speed**
Variable Units: Seconds
Description: This sets the duration that the slow speed will be active when impulse limiting is enabled and an impulse is detected.

F8L2: 30 – Enable Analog Handle
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to enable the analog handle. The parameter is enabled for systems that have an inline or fixture handle.

****F8L2: 31 – Handle Filter Bandwidth**
Variable Units: Reserved for internal use only.
Description: Reserved for internal use only.

****F8L2: 33 – Lift Mode Proportional Acceleration**
Variable Units: Inches per second^2
Description: Reserved for internal use only.

****F8L2: 34 – Lift Mode Proportional Deceleration**
Variable Units: Inches per second^2
Description: Reserved for internal use only.

F8L2: 35 – Lift Command Limit
Variable Units: Pounds
Description: This sets the maximum lift command that can be given to an analog handle without a fault. For example, if this parameter is set to 100lbs and a force of more than 100lbs is applied to the lift handle then the hoist will fault. A force of 100lbs would indicate the handle may be hung-up on fixed structure or damaged.

****F8L2: 36 – Lift Force Cancellation Gain**
Variable Units: Reserved for internal use only.
Description: Reserved for internal use only.

F8L2: 38 – Enable Digital Handle
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to enable the digital handle. This parameter is enabled for systems that have a single speed or two speed pushbutton handle or a wireless transmitter pendant.

****F8L2: 40 – Enable Float Mode**
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to enable or disable float mode.

F8L2: 41 – Float PB Dwell Time
Variable Units: Seconds
Description: This sets that amount of time that the blue button needs to be pressed before the hoist enters float mode.

****F8L2: 45 – Float Max Speed Fudge Factor**
Variable Units: Factor
Description: This factor is multiplied by the float max speed limit. A value of one is normal. Any value above one will increase the max speed and any value below one will reduce the max speed.

****F8L2: 53 – Float Mode Proportional Acceleration**
Variable Units: Inches per second^2
Description: *Reserved for internal use only*

****F8L2: 54 – Float Mode Proportional Deceleration**
Variable Units: Inches per second^2
Description: *Reserved for internal use only*

****F8L2: 55 – Float Command Limit**
Variable Units: Pounds
Description: This sets the maximum float command that can be given to a load without a fault.

****F8L2: 60 – Float Prop Gain Fudge Factor**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 61 – Float Input Filter Fudge Factor**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 62 – Float Output Filter Fudge Factor**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 63 – Float Force Filter Limiting Scale Factor**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 64 – Max Velocity for Jerk Limitation**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 65 – Disable "Gear Unlock" code**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 67 – Acmtr Enable**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 68 – Acmtr g's per Volt**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

F8L2: 70 – Disable Program Limits
Variable Units: Boolean (1 = ON, 0 = OFF)
Description: This configuration parameter is used to disable the programming of the top and bottom limits from the green and blue pushbuttons. This feature may be disabled to prevent accidental programming of limits.

1 = Limit programming is disabled
0 = Limit programming is enabled

****F8L2: 71 – Enable Stress Relief Logic**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 80 – Load Touch Bandwidth**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 81 – True Weight Filter Constant (2-pole)**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 85 – Active Damping Normal Filter Constant**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 86 – Active Damping Gain (Sensitive)**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 87 – High Freq Active Damping Gain**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 90 – Active Damping Min Gain - Lift**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 91 – Active Damping Min Gain - Float**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 92 – Active Damping Always On**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 93 – Active Damping Ramp Down - Start Position (in)**
Variable Units: *Reserved for internal use only*
Description: ***Reserved for internal use only*

****F8L2: 94 – Active Damping Ramp Down - Min Gain Position (in)**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

****F8L2: 95 – Active Damping Ramp Down - Min Gain**
Variable Units: *Reserved for internal use only*
Description: *Reserved for internal use only*

G. F8L3 Global Variable Array

This complete array is reserved for internal use.

NOTE
Variables marked with a "**" should NOT be manipulated without the aid of a Knight Representative, as it may have unintended consequences.

7. TROUBLESHOOTING

A. Troubleshooting Chart

Servo Hoist operation may be affected by various factors. If your hoist is not performing as well as expected, follow the flow chart below to diagnose the problem. If unable to resolve the issue, contact the Knight Service Department at 248-377-4950 ext. 162 or via e-mail at service@knight-ind.com.

Problem	Cause	Solution
Hoist does not lift or lower	Power loss	Check circuit breaker, switches, and connections of all power lines. Check run/ stop, reset if necessary.
	Incorrect voltage	Check supply voltage and frequency of power supply to ensure it is correct for the Servo Hoist.
	Hoist capacity exceeded	Reduce load to within the rated capacity of the servo.
	Electrical fault	Secure power to the hoist; check all wiring and connections on the Servo Hoist.
Servo Hoist lifts but does not lower	"Lower Travel Limit" set incorrectly	Clear Travel Limits. Refer to travel limits in operation section. Check parameter F8L1:6 “Bottom Limit”
	Damaged pendant cord	Check each conductor in the pendant cable for continuity. Replace damaged cable as required.
Servo Hoist lowers but will not lift	"Upper Travel Limit" set too close to the over travel	Clear Travel Limits. Refer to travel limits in operation section. Check parameter F8L1:5 “Upper Limit”
	Damaged pendant cord	Check each conductor in the pendant cable for continuity. Replace damaged cable as required.
	Hoist capacity exceeded	Reduce the weight of the load to within the rated capacity of the Servo Hoist.
	Low voltage in power supply	Determine the cause of low voltage and restore voltage back to within +/-10% of required voltage supply.
Servo Hoist does not lift at proper speed	Hoist capacity exceeded	Reduce the weight of the load to within the rated capacity of the Servo Hoist.
	Low voltage in power supply	Determine the cause of low voltage and restore voltage back to within +/-10% of required voltage supply.
Servo Hoist operates intermittently	Open / Short circuit	Check circuit for loose connections or broken conductors. Repair or replace as necessary.
	Damaged pendant cord	Check each conductor in the pendant cable for continuity. Replace damaged cable as required.
	Damaged handle	Check each conductor in the pendant cable for continuity. Replace damaged conductors as required. Check connections and replace if necessary.

B. Troubleshooting Servo Drive Faults

Problem: Red light on the Run/Stop button is flashing.

Action: Connect to the On-Line UltraWare Drive and open Global Variable fSTS:06. If the fault number is less than 100 then the fault is in the servo drive. Open the Fault screen to see the fault that is present. A yellow indicator (in the value column) will be on next to the fault description. (Figure 7-1)

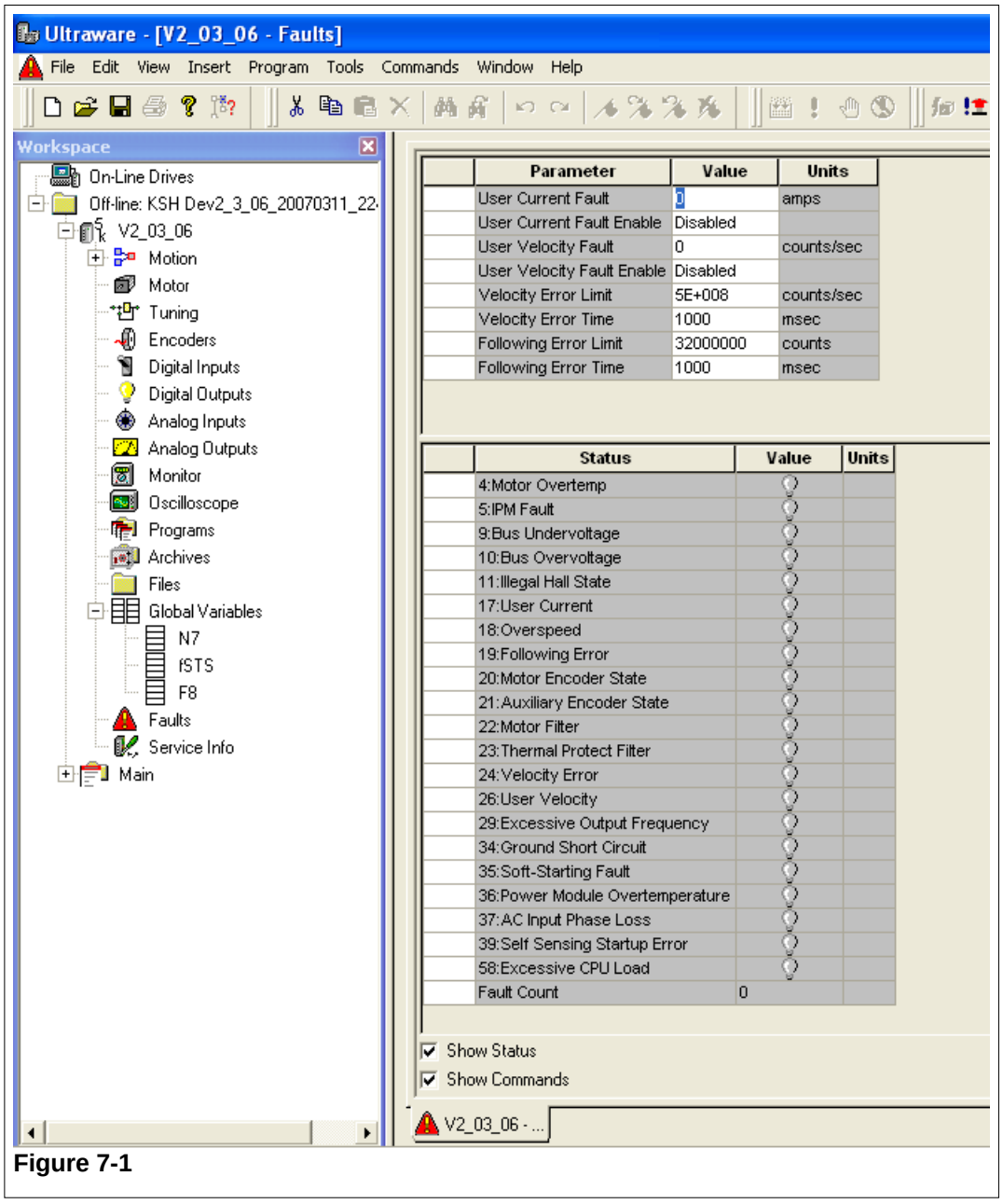


Figure 7-1

Fault Description Table

If the fault number is greater than 99 then the fault is a software generated fault that can be found in the table below.

Fault #	Description	Possible Solution
101	Run/Stop input is not on to the drive.	Check input to determine why the drive is not getting the run/stop input.
102	Failed to allocate memory for Global Variables	Reduce the number of Global Variables used in the code.
103	Frame Failed	Reduce the amount of code in the frame that is overloaded.
104	Velocity Following Error	Possible bad encoder cable. Possible mechanical binding.
105	Home Limit Switch Error	Home Limit switch has been made after the system has already been homed. Check to see why limit switch has moved. This error is for legacy systems without absolute encoder only.
106	Axis Enable Failed	Axis enable did not enable after one second. Possible bad encoder cable.
107	Float Load Cell not connected	The float load cell has been disconnected. Look at the physical connection to see why the input is not on.
108	Lift Load Cell not connected	The lift load cell has been disconnected. Look at the physical connection to see why the input is not on.
150	Heartbeat Fault	The heartbeat from the PLC has been lost. For systems with DeviceNet interface only.
152	Encoder Position Fault	The tractors absolute encoder does not match the motors encoder position. For tractor systems only.
201	Lift Load Cell Faulted	The lift load cell has seen more than the Lift Load Cell Command Limit, F8L2:35.
202	Test Parameter Fault	One of the Test Parameters is outside the top or bottom limits, or max speed limits.
203	Lift Load Cell Not Ok	The cable to the load cell is either damaged or disconnected.
204	Air Pressure Switch Not Ok	The air pressure is below that allowable limit to operate the system.

NOTE

Please see the application specific manual addendum for information on application specific faults.

C. Troubleshooting Inputs and Outputs

Problem: Not sure if an Input or Output is coming on?

Action: Log onto the On-Line Ultraware Drive and open the Digital Input or Digital Output screen. Verify if the specific Input or Output is ON (the lower half of the window has the current status of the Input or Output). The value column will be yellow if it is ON. (Figure 7-2)

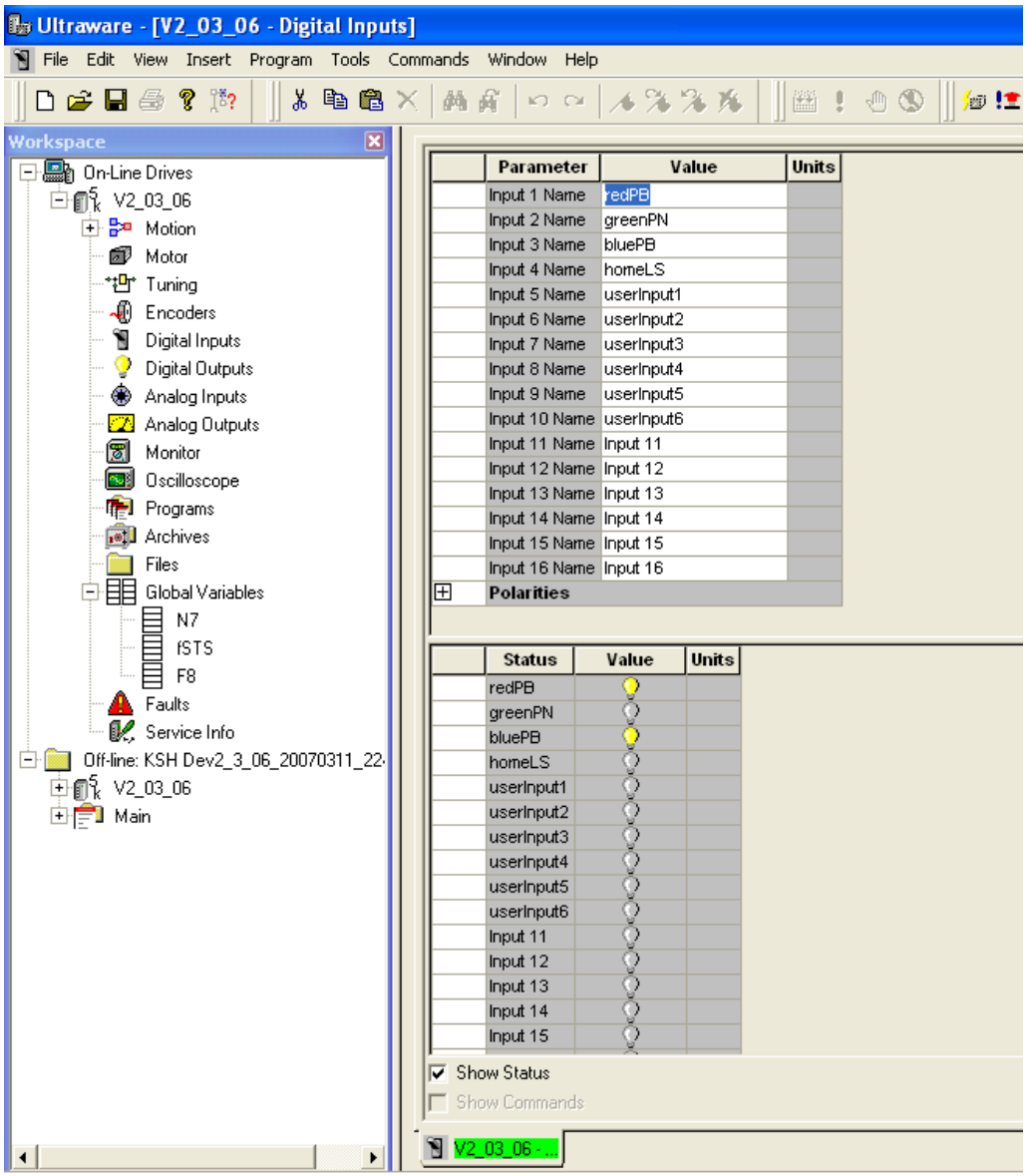


Figure 7-2

NOTE: On-Line Drive windows are indicated with a “Green” highlighted tab.
Off-Line Drive windows are indicated with a “Grey” tab.

***NOTE*:** Refer to the AB Ultraware Manual for additional software information. The AB Ultra5000 Manual will provide detailed information on the Servo Unit. If unable to diagnose the problem, contact a Knight Representative for further assistance.

8. SPARE PARTS LIST

Because Knight is continuously improving and updating its products, all product drawings and spare parts lists for the Servo Hoist are provided with the supporting documentation accompanying this manual.

9. DECOMMISSIONING OF A SERVO HOIST

Knight Servo Hoists contain various materials which, at the end of the service life, must be disposed of or recycled (where appropriate), in accordance with statutory regulations.

Decommissioning:

⚠WARNING!

Knight Servo Hoists must only be decommissioned by qualified personnel.

- Ensure there is not a load on the hoist.
- Remove power from hoist.
- Remove hoist from rail or support structure.
- If desired, Knight Global will properly dispose of hoist. Contact a Knight Global representative to obtain a Return Material Authorization form.

10. KNIGHT'S PERFORMANCE WARRANTY

Knight warrants that its products and parts shall meet all applicable specifications, performance requirements, and be free from defects in material and workmanship for one year, (Servo Systems for two years), from the date of invoice, unless otherwise noted. One exclusion would include any purchased components not manufactured by Knight and their specific individual warranties. Paint defects, scratches and marring from shipping are also excluded.

This warranty shall not cover failure or defective operation caused by inadequate training provided by customer regarding the operation and / or maintenance of the tool, misuse, negligence, misadjustment, or alteration not approved by Knight. Knight's obligation is limited to the replacement or repair of Knight's products at a location designated by Knight. Buyer is responsible for all associated internal removal and reinstallation costs as well as freight charges to and from Knight Industries. Knight's maximum liability shall not in any case exceed the contract price for the products claimed to be defective.

On a design & build job, the customer is the owner of the equipment once they authorize shipment. The equipment cannot be returned for reimbursement or credit.

Knight warranties Servo Hoists, servo balancers, and servo tractors to be free from defects in material or workmanship for a period of two years or 6000 hours use from date of shipment.

Knight distributors/agents are not authorized to circumvent any of the terms and conditions of this warranty unless approved in writing by Knight Management. Statements made by Knight distributors/agents do not constitute warranties.

Unauthorized changes to any of Knight's products voids our performance warranty and any potential liabilities. If changes are necessary, please contact Knight for authorization to continue.

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Printed on March 2012