

UNIVERSAL CRANE REPLACEMENT LOGIC BOARD

TWOBITS.com

4418 Pack Saddle Pass Austin, TX 78745 512-447-8888

Sales@Twobits.com <http://www.Twobits.com>

10/05

BE SURE TO READ THIS INSTRUCTION MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL THE KIT.
NOTE: IF YOU ARE INSTALLING THIS KIT INTO A MULTIPLE STATION CABINET (DOUBLE OR TRIPLE CRANE), IT IS HIGHLY RECOMMENDED THAT YOU REPLACE ALL THE STATIONS AT THE SAME TIME!
CALL ABOUT QUANTITY DISCOUNTS!

PARTS YOU WILL NEED

Standard video game power supply
#16 fork terminals
wire ties
electrical tape
heat-shrink tubing
small wire nuts
six fuse holders
Replacement Switches (see text)
Replacement Claw Coil (see text)
5 or 6 volt DC Coin Meter (optional)

PARTS SUPPLIED WITH KIT

Main Control Board
Carriage Wiring Harness
Power Wiring Harness
Control Wiring Harness
Bridge Rectifier
2) 10uF Capacitors
47mfd 160 volt capacitor
This manual

Familiarize yourself with your crane before you begin!

TERMINOLOGY:

Carriage	The entire mechanism located at the top of the crane. It contains all of the motors and switches.
Car Assembly	The part of the carriage where the claw is.
Truck Assembly	The part of the carriage which moves from front to back. The car assembly mounts on the truck.
Payout Chute	The hole where the prize falls into.

SPECIAL NOTES FOR HOLLYWOOD CRANES:

This manual has been written to accommodate most of the cranes out in the field today. There are subtle differences in the Hollywood crane not found in other brands of cranes. When applicable, this manual points out these differences.

Also, some Hollywood cranes have an unusual carriage mechanism which may make the 10-foot wiring harness included in this kit too short. This manual includes special installation instructions to handle this problem. We recommend that you follow the SPECIAL NOTES FOR HOLLYWOOD CRANES carefully to avoid difficulties.

In addition, Hollywood cranes are "dual voltage" cranes. This means that the crane operates on two different voltages -- one voltage operates the motors and a different voltage is used for the claw coil. **This kit is designed to operate on a single voltage.** Therefore, to use this kit in a Hollywood crane, the claw coil must be replaced with a new coil which is the SAME VOLTAGE AS THE MOTORS. Although it is possible to modify this kit to operate on dual-voltage, it is strongly recommended that the claw coil be replaced and the kit installed without modifications. Special 12 volt replacement claw coils for Hollywood cranes are available directly from Twobits.com.

SPECIAL NOTES FOR BONARI CRANES:

The BONARI (European made) crane requires special attention when considering control panel options. Due to the limited amount of space available on the front of the machine, it may be difficult to squeeze in a standard 4 way joystick. We recommend that you use either a small footprint joystick (available from Twobits.com) or use 4 pushbuttons in a tight diamond pattern. We do offer a TWO BUTTON OPTION chip, but it does not earn as well as the standard 4 way program which allows the player unlimited motion: left and right, back and forth. The TWO BUTTON OPTION only allows motion in 2 directions; to the right and away. If the carriage travels too far, there's no going back.

Contact Twobits.com for more details on the TWO BUTTON OPTION *only* if you are unable to provide a 4 way joystick or 4 buttons.

Step 1. -- Crane Description

The Twobits.com Universal Crane Replacement Logic Board is designed to replace the control system on cranes *with DC motors only*. Given below is a list of cranes known to have DC motors. If you are not sure if your crane is DC or not, inspect the motors on the carriage assembly. The motors on DC cranes have two wires, usually RED and BLACK, and the motor is encased in a smooth steel housing. AC motors usually are "open frame", that is, the coils of the motors are open and visible, and the motor has no apparent case.

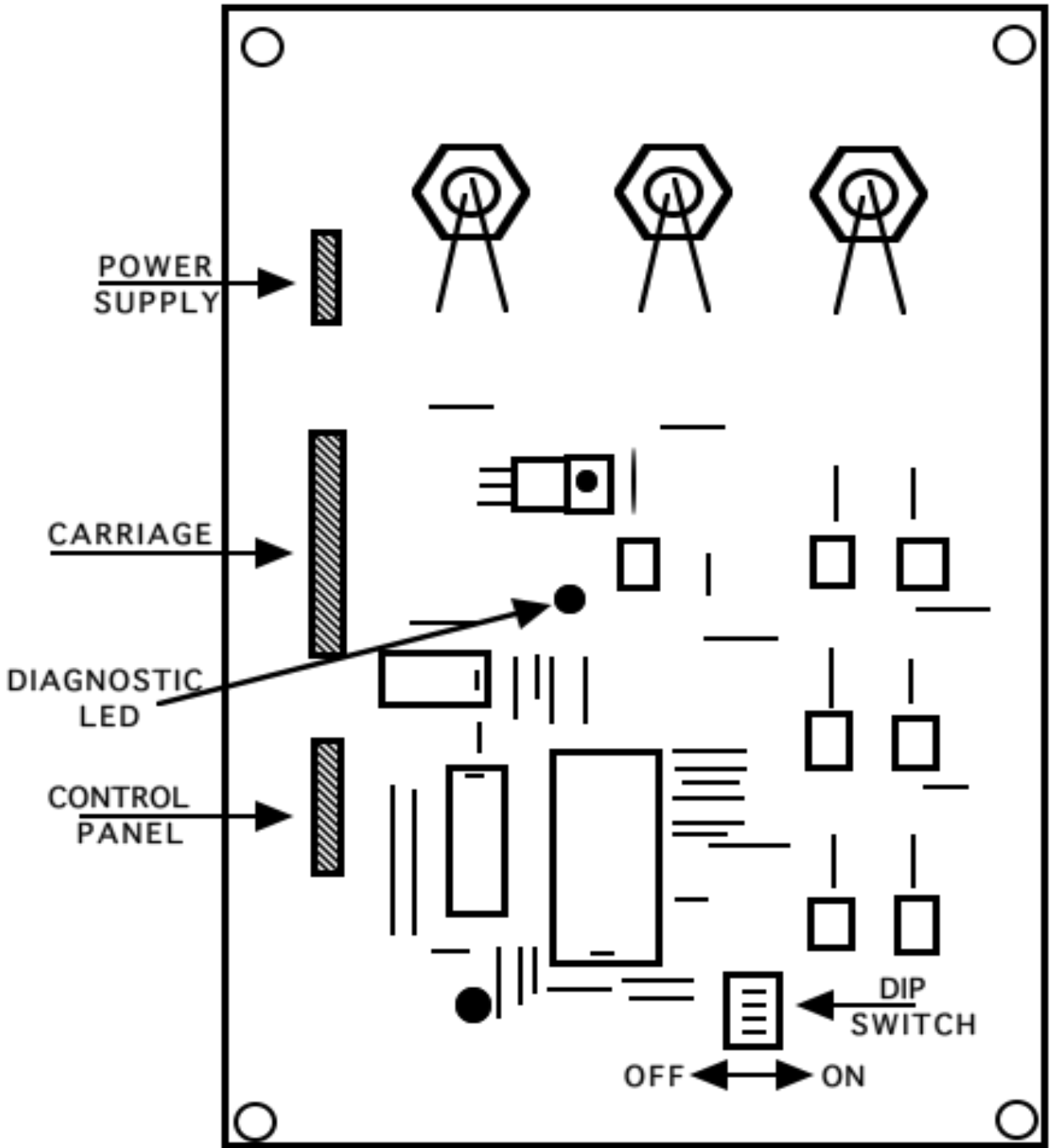
SONIC	16 volts	BETSON	48 volts
BEAR CLAW	48 volts	BONARI	60 volts
CLEAN SWEEP	48 volts	SMS	24 volts
SKILL MASTER	60 volts	SEGASA	16 volts
HOLLYWOOD	12 volts	TITAN	28 volts
SKILL EUROPE	48 volts	SKILL AMERICA	32 volts
BIG CHOICE	48 volts	EARLY GREYHOUND	32 volts

NOTE: "SKILL" is a word used on many cranes. If the word "SKILL" appears in the brand name of the crane, refer to the above chart. *Early "SKILL CLAW" cranes use AC motors and therefore will not work with this board.*

It will be necessary to re-use the original power transformer that came in your crane. If your power transformer is burned out or damaged, use the chart above or refer to your crane's manual for proper voltage. Before you start, it is a good idea to get out your AC volt meter and test and identify each secondary winding. Some crane transformers have several secondary taps. Typically they are in colored pairs. Read the AC voltage across each pair and write down your results. If you know the DC voltage required by your motors, look for an AC winding which puts out slightly more. That is: if you have 12 volt DC motors, then the unloaded AC winding you want should read 14 to 16 volts AC. Usually, the motors are the highest voltage tap. If there is any doubt when installing this kit, use the LOWEST voltage first, and then move up if the motors appear to run sluggish.

Some crane manufacturers chose to mount the power transformer on the control board (which you are disposing of). If you cannot locate a power transformer in your crane, it is probably part of the old circuit board. If this is the case, you will need to provide a suitable replacement.

FIGURE 1 CONTROL BOARD



Step 2. -- Begin disassembly of old crane.

Remove the entire carriage assembly from the main body of the crane and place it on a workbench for easy access. Begin disassembly of the carriage by removing the protective covers over the claw string mechanism and placing them to the side.

Step 3. -- Locate all critical parts and remove all excess.

Identify each of the three motors and each of the four switches used by the new circuit board. Some cranes have more than four limit switches; refer to Fig. 2 and Fig. 3 for identification of each switch and motor.

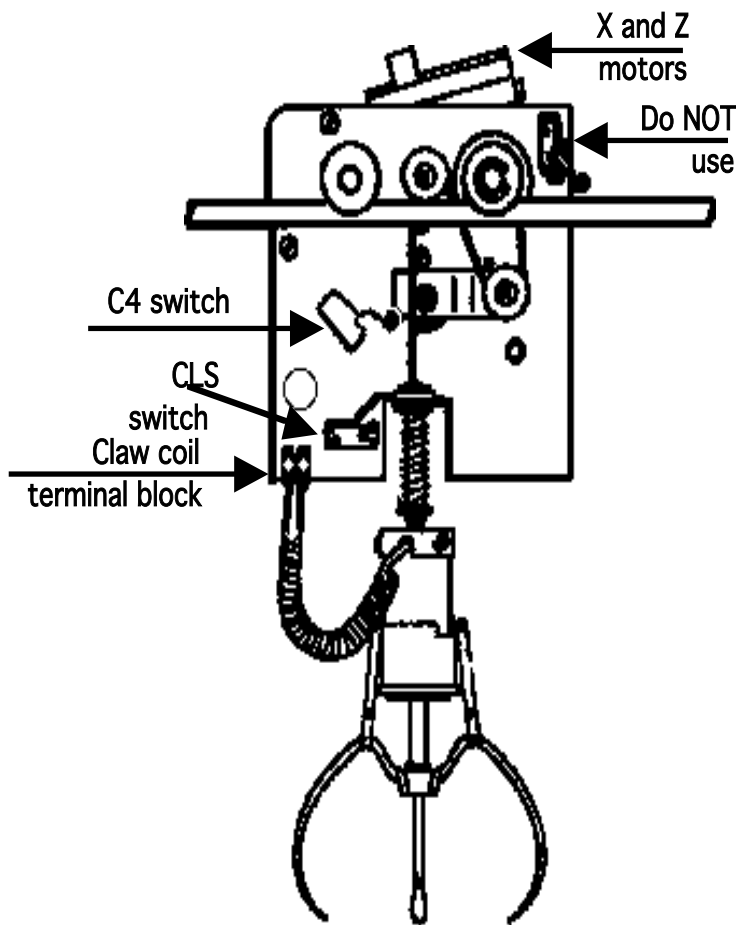
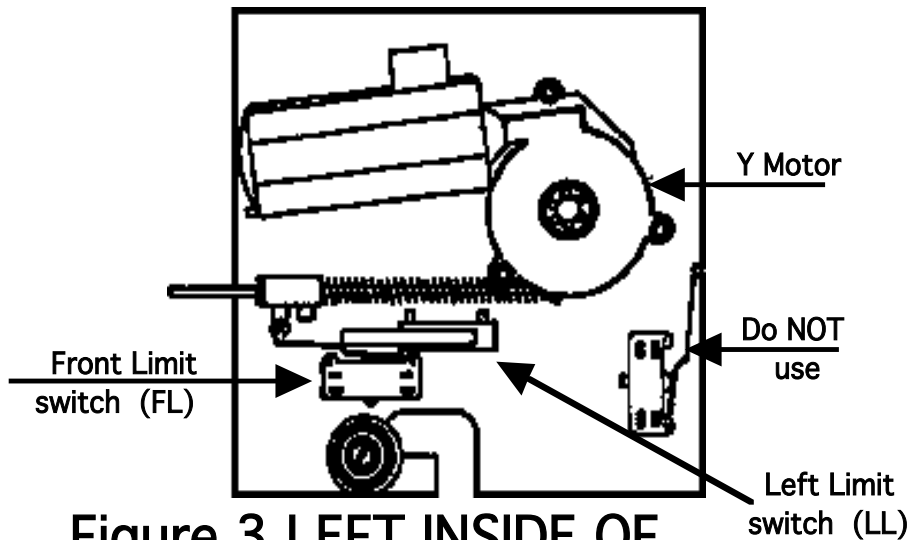


Figure 2 CAR ASSEMBLY



**Figure 3 LEFT INSIDE OF
TYPICAL TRUCK ASSEMBLY**

Carefully desolder ALL wires from ALL switches and motors. If your crane has motors with lead wires instead of terminals, be sure to leave enough lead wire to make a clean splice later. Remove all diodes, capacitors, or other parts which may be attached to the switch terminals. If any switch is physically broken or known to be bad, now is the time to replace it with a new one.

* Hollywood Cranes -- The location of the LEFT LIMIT (LL) switch is moved from the TRUCK assembly (Fig. 3) to the CAR assembly (Fig. 2). Be sure to note this change when wiring the new harness in Step 5.

* Sonic Cranes -- The Sonic crane is equipped with RIGHT LIMIT and REAR LIMIT switches. These are unused & should be removed from the car & truck assemblies.

* Kramer Cranes ONLY. -- Some models of Kramer cranes have NO limit switches on the left or front. If you are installing this kit in one of these cranes, these switches MUST be installed. Use Figs. 2 and 3 to aid in the installation of these two switches.

NOW is the time to install these switches before continuing.

Step 4. -- Salvaging old wiring harness spring tubing.

 Notice the protective flex spring tubing used to enclose the wiring harness. There are two sections -- one connects the car assembly to the truck assembly, and the other connects the entire carriage to the control board. Follow these steps to remove the wiring harness from each section of this spring tubing, being careful

not to damage the tubing. It may be necessary in some cases to remove the tubing from the carriage before removing the old wiring harness.

After all wires are unhooked, cut the old wiring harness off close to the edge of the protective flex tubing and pull the old wires out of the tubing. Some wiring harnesses have a wire tie and a black plastic sheath surrounding the wiring harness at the ends of the tube. If your crane has this tubing or tie, it must be removed before you jerk the wires through the tube, or else the tube may be damaged.

Step 5. -- Install new wiring harness to carriage.

Unroll the new carriage wiring harness. Stretch it out straight and get all the kinks out of it. Remove any wire ties from the loose end of the harness. If you didn't remove the spring tubing from the carriage in Step 4, do so now.

Carefully wrap the loose wire ends of the harness together with electrical tape. Wrap the wire very tightly and neatly one layer thick and about three inches down. Do not allow the tape to build up heavy on the end. Slowly feed the taped end of the harness through the protective spring tube you salvaged in Step 4. It may be necessary to "play" with it for a while in order to make it go through the tube all the way. Once the harness is all the way through the tube, pull it about three feet past the end of the tube and put a wire tie at the point where the wires stick out of the tube. Put another wire tie on the other end of the tube in the same place.

Notice that the wiring harness is comprised of mainly solid color wires (some have colored stripes on them) and white wires with color stripes. Separate the solid color wires from those which are white with stripes (Refer to the chart on page 9). Pull the two separated bundles apart all the way down to about 2 1/2 inches from where the harness exits the large spring tubing. Place wire ties on each bundle. (See figure 4).

Next, use electrical tape to wrap the ends of the solid colored wire bundle together. Feed the taped end through the short spring tubing until the wire is completely through. Pull all of the wire through up to the point where the spring tubing meets a wire tie. Put another wire tie on the harness at the open end of the short spring tubing. Fig. 4 on the next page is a pictorial detail of this procedure.

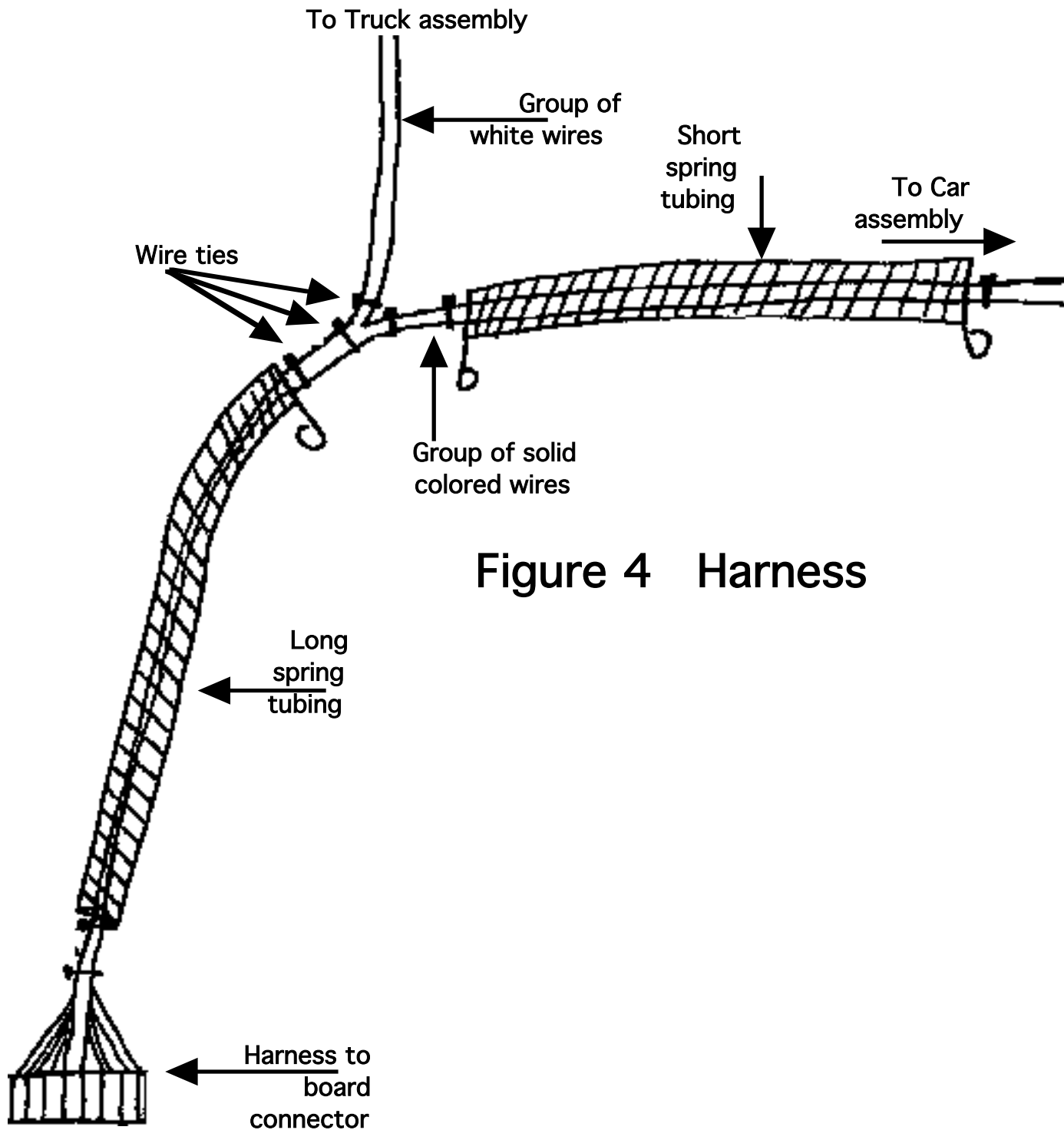


Figure 4 Harness

MAINLY SOLID COLOR WIRES

WHITE WIRES WITH COLOR STRIPE

-----YELLOW

WHITE-

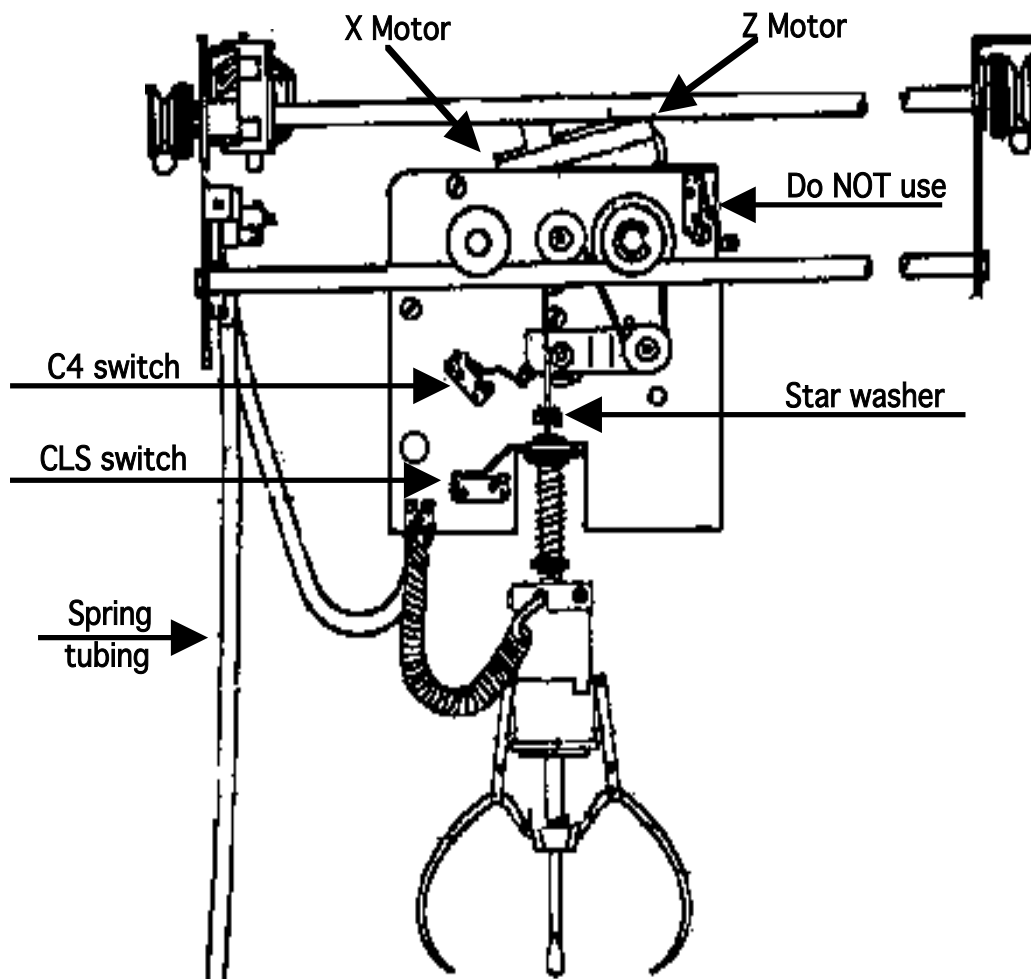
YELLOW
ORANGE
BROWN-WHITE
GREEN-WHITE
RED
BLACK
BLUE-YELLOW
BLUE-WHITE

WHITE-ORANGE
WHITE-BROWN
WHITE-GRAY
SOLID WHITE

* Hollywood Cranes MOVE the WHITE-GRAY wire FROM the "white with a stripe" group to the "solid colors" group.

Re-mount the harness-tubing assembly onto the carriage as it was before disassembly.

Figure 5 Carriage Mechanism



Step 6. -- Connecting wiring harness to carriage and motors.

* SPECIAL NOTE FOR ALL MODELS -- For the sake of reliability, it is strongly recommended that you replace ALL of the switches located on both CAR and TRUCK, *especially* if your crane used to have an old "relay style" controller board.

Part A: Car Assembly

Refer to Fig. 2. Locate and identify both motors mounted on the car assembly. The motor which operates the car is referred to as the X-axis motor and the motor which operates the claw string is referred to as the Z-axis motor.

Most cranes have two limit switches mounted on the face side of the car mechanism. The top switch is referred to as the C4 switch and the bottom switch is referred to as the CLS switch. If your crane has more than two switches, refer to Fig. 2 for identification of which two switches to use.

WIRING COLOR CHART -- CAR ASSEMBLY

X-AXIS MOTOR	ORANGE
Z-AXIS MOTOR	BROWN-WHITE
MOTOR COMMON	YELLOW
C4 SWITCH	BLUE-YELLOW
CLS SWITCH	BLUE-WHITE
SWITCH COMMON	BLACK
CLAW COIL	GREEN-WHITE
CLAW COIL	RED

A NOTE ABOUT CRANE SWITCHES: Some of the European-made cranes use an unusual switch which has four terminals. These switches are laid out as shown below:

TOP OF SWITCH

(A) * * (B)

(C) * * (D)

In the following instructions, you will be asked to identify and solder to either the normally open or the normally closed side of the switch. If your crane uses switches as shown above, use the following chart to identify and wire your crane:

Normally Open -- Terminals A and B

Normally Closed -- Terminals C and D

Use terminal B for COM if it is a Normally Open switch, and terminal D for COM if it is a normally closed switch.

C4 Switch. Some cranes were designed to operate the C4 limit switch as a normally closed switch while others operated as a normally open switch. Determine which method of operation your crane uses by properly stringing the crane and observe the position of the C4 limit switch when the claw is at its home (top) position. If the switch is in the activated position, it is a normally closed crane. If the switch is in its rest position, it is a normally open crane. Route the blue-yellow wire around the motors and through the wiring hole. Solder the blue-yellow wire to the appropriate terminal on the C4 switch (If your crane is a normally open, use the normally open terminal; if your crane is a normally closed, use the normally closed terminal).

CLS Switch. Route the blue-white wire around the motors and through the wiring hole. Solder the blue-white wire to the normally closed terminal of the CLS switch.

Switch Return. Route the black wire around the motors and through the wiring hole. Connect the black wire to the COM terminal of the CLS switch. Using a piece of leftover wire, connect the COM terminal of the CLS switch to the COM terminal of the C4 switch. Mount a 10uF electrolytic capacitor (supplied) across each switch, making sure the negative side of the capacitor is soldered to the switch terminal with the black wire (COM).

IT IS ABSOLUTELY CRITICAL THAT THE C4 AND CLS SWITCHES ARE WIRED PROPERLY. REVIEW INSTALLATION PROCEDURE NOW BEFORE CONTINUING WITH THIS KIT.

Helpful Notes on Switches.....

All of the switches used by this kit are CLOSED (making contact) when in the ACTIVE position. This means when the crane does something to move a switch from its rest or HOME position, the switch closes. It does NOT mean use the NORMALLY CLOSED contacts. Some switches remain CLOSED (making contact) while in the HOME position. Typically (but not always), these are the FL, LL, and CLS switches.

* Hollywood Cranes ONLY -- Connect the WHITE-GRAY wire to the normally open terminal of the LL switch. Using a piece of scrap wire, connect the COM terminal of the LL switch to the COM terminal of the C4 switch.

ALL MODELS: MOTORS. Using miniature wire nuts, connect the ORANGE wire to the positive lead of the X-axis motor. Connect the BROWN/WHITE wire to the positive lead of the Z-axis motor. Connect both negative motor leads together, along with the yellow wire.

Note: *Do not solder the motor wires at this time.* It may be necessary to reverse the polarity of the motors (swap positive and negative leads) later.

This is a good time to be certain that the star washer is properly installed on the string. It should be above the claw spring and below the C4 switch arm. There should be a knot in the string larger than the hole in the star washer. The knot should be about an inch above the washer when the claw is resting on the bottom of the crane. If it is not correctly installed, the string will be able to run out completely and wind up backwards! Refer back to FIGURE 5 for details.

Claw Coil.

(1). Locate and remove the dual terminal connector used to connect the coiled cord to the car assembly. Next, mount the square bridge rectifier supplied in the kit where the terminal block used to be. Identify each terminal on the bridge rectifier and connect the green-white and the red wires to the AC terminals. Connect the coiled cord to the "+" and "-" terminals. Use a wire tie to relieve stress from the cord and solder joints at the bridge rectifier.

(2). Solder the 47uF electrolytic capacitor across the (+) and (-) terminals of the bridge rectifier. Pay close attention to polarity markings on the bridge and on the capacitor. See FIGURE 6 for details.

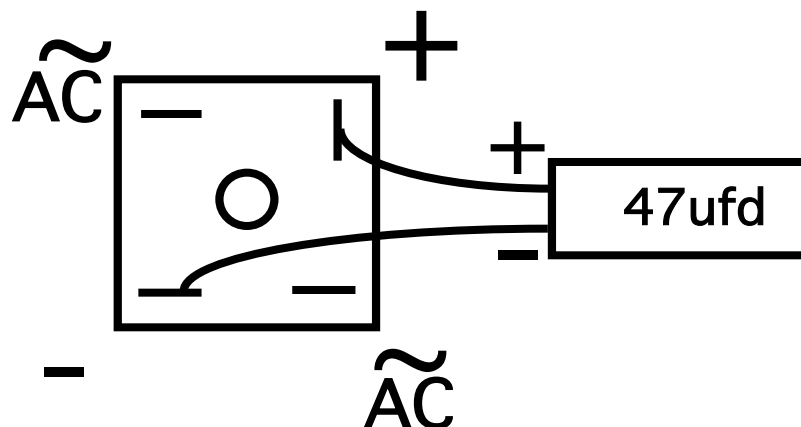


FIGURE 6
CAPACITOR INSTALLATION

*Hollywood Cranes Only. Replace the original claw coil with the Twobits.com 12 volt Replacement Claw Coil for Hollywood Cranes.

Part B. Truck Assembly.

Refer to Fig. 3. Locate and identify the Y-axis motor. Also locate and identify the two limit switches used by this kit. The front limit switch is referred to as the FL switch and the left limit switch is referred to as LL. Some cranes have more than two switches on the truck assembly. If your crane has more than two switches, refer to Fig. 3 to locate and identify which two switches to use.

WIRING COLOR CHART -- TRUCK ASSEMBLY

Y-AXIS MOTOR	WHITE-ORANGE
MOTOR COMMON	WHITE-YELLOW
FL SWITCH	WHITE-BROWN
LL SWITCH	WHITE-GRAY
SWITCH COMMON	SOLID WHITE

Some cranes use a normally closed front limit switch (FL) and some use a normally open switch. It is important to determine which type your crane uses. Observe the operation of the switch and see if it is relaxed when the carriage is out of the game or if the switch is pressed in while it is out of the game. If the switch is relaxed, the switch is normally open. If it is pressed in, it is normally closed.

Refer to the chart above and connect the white-brown wire to the appropriate terminal of the FL switch. Connect the white-gray wire to the normally open side of the LL switch. Connect the solid white wire to the COM terminal of the FL switch. Using a piece of scrap wire, connect the COM terminal of the FL switch to the COM terminal of the LL switch.

Use two miniature wire nuts to connect the white-yellow and the white-orange wires to the motor leads. Connect the white-yellow wire to the positive lead and the white-orange wire to the negative lead.

Step 7. Recheck your work.

Before continuing, recheck all wiring and inspect places where wires may get pinched or tangled. Correct any mistakes **NOW** before continuing.

Step 8. Mount carriage assembly and control board.

NOTE: Due to the extreme length of the carriage harness required to install control boards in the bottom of a Hollywood crane, an alternate procedure for installing the control board at the top of the crane is outlined in the section, "Special Step 8 for Hollywood Cranes".

Extending the carriage harness to reach the bottom of the crane is NOT recommended and may void the warranty.

Carefully remount carriage assembly onto the tracks in the top of the crane. Feed the wiring harness through the hole in the playfield and route the cable to a convenient place where the control board can be mounted. Be sure that there is enough slack in the harness to allow the carriage free movement about the entire playfield without putting stress on the harness. Plug the carriage harness into connector J2 on the control board. Mount the control board with wood screws and spacers. Use a cable strap if necessary to relieve any stress on the carriage harness. Be sure to leave access to the other two connectors on the board as well as access to the DIP switches and LED.

* Hollywood Cranes ONLY -- Special Installation Procedure -- Due to the unusual nature of the wiring of this crane, it is recommended that a "service chassis" be built to allow easier access to the control mechanism. This procedure is explained in detail in *the following step*.

* ALTERNATE STEP #8 FOR HOLLYWOOD CRANES ONLY: Refer to figure 7

- 8a. Remove the grille above the mounting brackets for the carriage mechanism.
- 8b. Remove the two fluorescent lamp fixtures and put them to the side.
- 8c. Remove any old wiring present in the left side wiring trough (next to the hinge). If decorative lighting is installed on the crane, be sure to identify this wiring from all other wiring, including the wires going to the fluorescent lamps.
- 8d. Carefully measure the inside dimensions of the top of the crane. Subtract 1 inch from each dimension and cut a piece of plywood to fit the inside top of the crane. This piece will be referred to as the 'service chassis'.
- 8e. Mount the fluorescent light fixtures removed in Step 8b onto the newly cut service chassis.
- 8f. Drill 4 (four) 3/8" holes near the corners of the service chassis, and 2 (two) 3/8" holes near the center. These holes are the pilot holes for mounting the chassis to the top of the crane.
- 8g. Mount the logic board, power supply, power transformer salvaged in Step 1 and fuse holders to the service chassis. Note the location of the carriage harness relative to where it leaves the carriage and allow for the mounting of the harness so that movement is not impaired.
- 8h. Wire the power supply to the board at this time. Connect the power supply, power transformer, and fluorescent lamps to the AC line using separate fuses for each. Next, connect the power supply harness supplied with this kit (See Step 11 for color chart) to J3 of the control board and route the wires around to the fuse holders, power supply, and transformer.
- 8i. Connect the RED wire from the power supply harness via fuse to the 5v terminal on the switching power supply. Connect the BLACK wire to GROUND (NOT FG!) If you have not already measured the voltages on your power transformer, do so now and identify the 12v winding and the 24v winding. Connect the BLUE-YELLOW wire to one of the two 12v leads and the BLUE-WHITE wire to the other 12v lead via fuse. NOTE: If more than one kit is to be installed in the same cabinet (i.e. dual crane) both BLUE-YELLOW wires MUST connect to the same transformer wire. The same applies for the BLUE-WHITE wires.
- 8j. Connect (3) 18-gauge wires, one white, one black, and one green to the AC line commons and FG terminal on the service chassis. These wires need to be long enough to be fed around the top, down the wiring trough, and into the bottom of the machine.
- 8k. Mount the entire service chassis into the top of the crane. Route the AC supply wires around and down the wiring trough into the bottom of the machine.

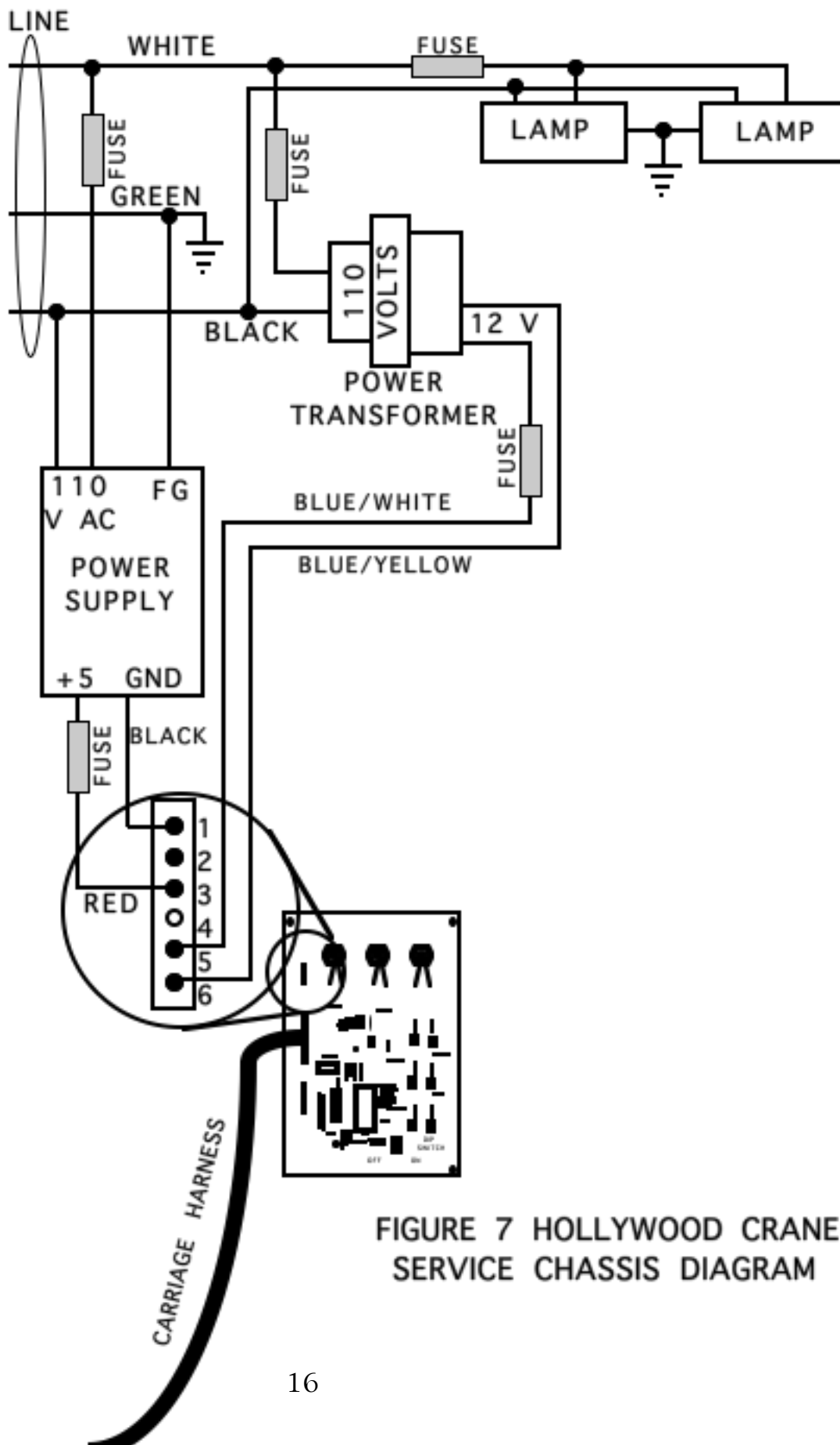


FIGURE 7 HOLLYWOOD CRANE SERVICE CHASSIS DIAGRAM

Step 9. Control Panel

If your crane is already equipped with a joystick and a claw drop button, you can omit this step.

Most cranes utilize a hinged front panel to hold the forward and backward direction buttons. Remove the old buttons and discard them.

This kit recommends the use of a joystick with a Fire button. You can use any joystick, or array of buttons which fits your individual needs, as long as the player can move the crane around in all four directions plus a claw drop button.

Mount the joystick onto the control panel where the old direction buttons were previously. It may be necessary to cut the crane frame slightly in order to close hinged front panels (this is typical on Sonic cranes).

* Bonari Cranes ONLY-- The control panel width is quite narrow and may not allow room to install a joystick. 4 separate push buttons may be used instead

Step 10. Control Panel and Coin door.

Locate the control and coin door harness supplied with the kit. Refer to the chart on the next page and wire the joystick and coin door just like you would in a regular video game kit.

Connecting Two Coin Switches. Connect both coin switches in parallel with each other. Connect the BLACK wire to the COM (common) terminal of each switch and the ORANGE wire to the NO (normally open) terminal of each switch.

Bill Acceptor Installation (optional). Connect the bill acceptor just as if it were a coin switch. Connect one bill acceptor output wire (typically YELLOW) to the BLACK wire and the other bill acceptor output wire (typically YELLOW) to the ORANGE wire. If your bill acceptor has (+) and (-) markings on the output wires, connect the (+) to the ORANGE wire and the (-) to the BLACK wire. Connect power to the bill acceptor at the switching power supply (to be installed in next step). Most bill acceptors are either 110VAC or 12VDC. This Crane kit does not use the +12V portion of a switching power supply, therefore the 12V terminals are a convenient source of power for 12V bill acceptors.

* Hollywood Cranes. It may be necessary to lengthen the coin door and control panel harnesses. THE CARRIAGE HARNESS CANNOT BE EXTENDED.

CONTROL PANEL WIRING CHART

UP	WHITE-ORANGE
DOWN	WHITE-YELLOW
LEFT	WHITE-GRAY
RIGHT	YELLOW
CLAW DROP	RED
CONTROL RETURN	BLACK
COIN SWITCH	ORANGE
COIN RETURN	BLACK

Route the control harness through the cabinet and plug the connector into J1 of the control board. Secure the wiring harness to the cabinet with wire ties.

*** TWO BUTTON Cranes ONLY--** If you are installing in a two-button crane, use the UP wire (WHITE-ORANGE) for the FORWARD button, and the RIGHT (YELLOW) wire for the SIDEWAYS button. Remove all other unused wires from the harness. ***Remember, THIS IS A 4-WAY JOYSTICK KIT: two-button operation requires special software.***

*** NOTE FOR TWO-BUTTON CRANES:** This kit **DOES NOT** provide drivers for FORWARD or SIDEWAYS lights. This kit is only designed for joystick operation and does not require lights. The two-button option is provided only as a convenience to operators who have cranes which physically cannot be converted to joystick operation. There is no connection available on the board for these signals. Any attempt to rig these lights to the board will void the warranty.

Step 11. Power Supply

* Hollywood Crane ONLY -- OMIT THIS STEP! It was completed in Step 8.

THIS STEP REQUIRES THE USE OF THE ORIGINAL AC TRANSFORMER PROVIDED IN YOUR CRANE CABINET. If the original transformer is missing or burned out, you must provide a suitable replacement.

WARNING!! DO NOT CONNECT THE BLUE/WHITE AND BLUE/YELLOW WIRES TO THE 110 VOLT AC LINE!!

Locate the power supply harness supplied with the kit.

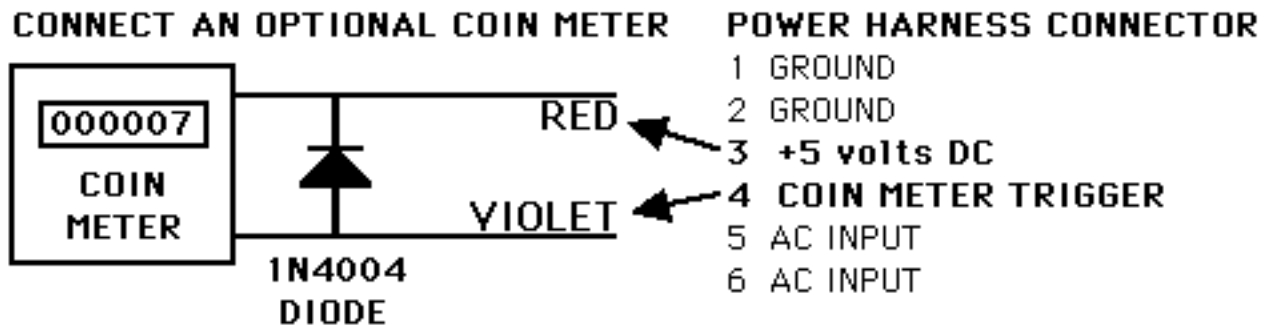
WIRING COLOR CHART -- POWER SUPPLY HARNESS

Switching power supply	+5v	RED
Switching power supply	GROUND	BLACK
Coin Meter	METER	VIOLET
Transformer secondary	AC	BLUE-WHITE
Transformer secondary	AC	BLUE-YELLOW

Mount a standard switching power supply inside the cabinet near the power transformer. Connect the AC terminals to the primary side of the power transformer. Mount a dual fuse holder near the power chassis. Connect the +5v terminal of the power supply to Fuse #1. Connect the red wire of the power supply harness to the other terminal of Fuse #1. Use a piece of scrap wire and connect one of the two leads from the power transformer secondary side (refer to Step 1) to Fuse #2. Connect the blue-white wire from the power supply harness to the other terminal of Fuse #2. Connect the black wire from the power supply harness to the GND terminal of the switching power supply. Connect the blue-yellow wire to the remaining terminal of the power transformer. Install a 1 amp AGC fuse in the place of Fuse #1 and a 7 amp MDL for less than 28 volts and 5 amp MDL for more than 28 volts in place of Fuse #2. Insert the power supply connector into connector J3 of the control board.

NOTE FOR DOUBLE OR TRIPLE CRANES: IF YOU ARE INSTALLING MORE THAN ONE KIT IN THE SAME CABINET, ALL BLUE-WHITE WIRES MUST GO TO ONE TRANSFORMER LUG AND ALL BLUE-YELLOW WIRES TO THE OTHER.

Install Cash Meter (optional). Mount a 6V mechanical coin counter inside the coin door in an easy to read spot. Connect one of the meter leads to the Power supply harness violet wire and connect the other meter lead to the +5v terminal of the switching power supply. Next, install a 1N4004 diode across the meter leads with the banded end on the 5-volt power supply wire. **FAILURE TO INSTALL THIS DIODE MAY RESULT IN SERIOUS DAMAGE TO THE CONTROL BOARD.**



NOTE: The Cash Meter function will only work on boards manufactured after January, 1998. These boards are easily identifiable by the addition of an 8 pin chip labeled U4.

Step 12. Recheck your work.

Be sure that all power supply connections are insulated and proper before continuing with the power-up test.

Step 13. Motor calibration. **THIS STEP IS VERY IMPORTANT. DO NOT SKIP**

PLEASE REFER TO THE DIAGNOSTIC PROCEDURES FOUND AT THE END OF THIS MANUAL. ALLOW 15 SECONDS AFTER POWER UP FOR THE DIAGNOSTIC LED TO RESPOND.

a) Manually push the carriage out into the middle of the playfield.

b) Turn on the power. **THE CLAW STRING WILL NOT WIND UP.**

c) The carriage should move into the Home position by itself. It will first move to the left until the LL switch senses it, and then to the front until the FL switch is triggered. If the car moves to the right instead of moving to the left, reverse the polarity of the X-axis motor. If the truck moves backwards instead of forwards, reverse the polarity of the Y-axis motor. Make sure that the X- and Y-axis motors are correct before continuing.

d) The **CAR** assembly should now be at its furthest **LEFT** position and the **TRUCK** assembly should be at its furthest **FRONT** position. Unplug the crane and set DIP switches 1 and 2 **OFF** (1 coin 1 credit). Reconnect power and operate the coin switch.

NOTE: If the claw is "free hanging" or not all the way up at the top, this is normal at this stage. It is recommended that the threading of the string around the rollers is double-checked for proper stringing and that the claw is hanging 6 to 10 inches below the bottom of the car assembly before continuing with the next test. It is **not** recommended for the claw to be loosely lying on the playfield.

e) Use the joystick to move the carriage around the playfield. Play with doing this only for a few seconds and then press the claw drop button. The claw should fall. If it doesn't, and the claw "goes up" or appears to be "lodged" at the top and being held in place by the motor's pull, reverse the polarity of the Z-axis motor and repeat Step 13-d. Be sure the Z-axis motor is correct before continuing.

When properly operating, the claw will lower when the **CLAW DROP** button is pressed. When the claw reaches the playfield, the Z-motor will continue to run just long enough to relax the tension on the string. At this time the **C4** switch will be activated. At the time **C4** is activated, the claw coil should engage and the Z-motor will reverse, bringing the claw back up to the top. When the claw reaches the top, the **CLS** switch is activated and begins the "return home" sequence. The **CAR** will then move to its furthest **LEFT** position, then the **TRUCK** will move to the furthest **FRONT** position. When the carriage makes it back "home", the claw coil will release and the claw should open.

If the above sequence of events does not **EXACTLY** occur....

Study the following troubleshooting guide and determine the cause of failure. There may be more than one failure taking place at the same time creating unique failure schemes. Study each symptom and relate it to the activity you see taking place, perform the necessary adjustments, then retest to be sure there are no more failures. Repeat this procedure as often as necessary.

Figs. 1 and 2 as well as the Diagnostic Procedure at the end of this manual will also help in troubleshooting.

Symptom: When the claw drop button is pressed the carriage returns home without

lowering the claw. The **DIAGNOSTICS LED** remains dark.

Cause: **C4** and **CLS** switches are either wired as normally closed when they should be normally open or vice versa.

- Symptom:** The claw drops, but the carriage returns home dragging the claw at the bottom.
- Cause:** CLS switch is bad or wired improperly. Check the CLS switch and move the wire from the (NO to the NC) **OR** from the (NC to the NO) terminals, whichever applies.
- Symptom:** The claw drops but the string winds up backwards and the crane locks up with the claw free hanging. The **DIAGNOSTIC LED** is flashing a **1 error code**.
- Cause:** Bad CLS switch. Replace this switch. Be sure to re-string the crane properly before re-testing.
- Symptom:** The claw drops but the string winds up backwards and the crane locks up with the claw free hanging. The **DIAGNOSTIC LED** is dark.
- Cause:** CLS switch is bad or out of adjustment. Check CLS switch for proper operation. Replace if necessary.
- Symptom:** The claw drops, comes back up and stops before reaching the top. Carriage returns home.
- Cause:** C4 AND the CLS switches are bad or improperly wired. Check for "bouncy operation" of C4 switch. Usually caused by rough rollers. Adjust the "play" in the actuation of the C4 switch rocker arm. Check for proper wiring on the CLS switch.
- Symptom:** The claw drops, comes back up and stops before reaching the top. Crane locks up without returning home.
- Cause:** C4 switch is bad or there is a short in the wiring to the C4 switch. Replace the C4 switch.
NOTE: The **DIAGNOSTIC LED** should be flashing a **6 error code**.
- Symptom:** Claw drops only a short distance, then crane locks up.
- Cause:** CLS switch is bad or wired improperly. Check the CLS switch and move the wire from the (NO to the NC) **OR** from the (NC to the NO) terminals, whichever applies.
NOTE: The **DIAGNOSTIC LED** should be flashing a **5 error code**.
- Symptom:** Claw drops only a short distance, then comes back up and carriage returns home.
- Cause:** Noisy operation of switches. Be sure the 10uF capacitor is properly installed on BOTH C4 and CLS switches. Also check for mechanically smooth operation of each switch.

- Symptom: Crane locks up immediately after pressing the CLAW DROP button.
Cause: C4 switch is bad or wired improperly. Check the C4 switch and move the wire from the (NO to the NC) **OR** from the (NC to the NO) terminals, whichever applies.
- Symptom: Claw drops fine, but is slow in returning to the top.
Cause: AC transformer output voltage too low. If the transformer has more than one voltage tap, move to the HIGHEST tap.
Transformer is bad. Replace power transformer.
Z-motor is weak or bad. Replace motor.
- Symptom: Claw drops fine, but is slow in returning to the top. Crane locks up before reaching the top. **DIAGNOSTIC LED** flashes a **2 error code**.
Cause: AC transformer output voltage too low. If the transformer has more than one voltage tap, move to the HIGHEST tap.
Transformer is bad. Replace power transformer.
Z-motor is weak or bad. Replace motor.
- Symptom: Motors run fine until claw coil pulls in.
Cause: Power transformer is weak. Replace power transformer with heavier current capacity.
Bridge rectifier is wired improperly or is shorted.
- Symptom: All motors run fine but claw coil does not pull in.
Cause: Bridge rectifier wired improperly.
Missing or bad capacitor on bridge.
Capacitor installed backwards on bridge.
Broken wire from control board to bridge.
Claw coil bad.
Bad curly cord from bridge rectifier to claw coil.
Crane originally is dual-voltage with higher voltage claw coil.

Symptom: Claw coil pulls in but is weak or takes a bit of time to fully close.

Cause: On low voltage cranes (28 volts or less) the capacitance across the bridge needs increasing. Replace the 47uF capacitor with a 220uF or 470uF capacitor, 35 volts.

Bridge is improperly wired

Power transformer is weak or bad

On higher voltage cranes:

claw coil is weak. Replace coil.

wrong voltage coil. Check for proper coil.

dual voltage crane with higher voltage claw coil

power transformer is weak or bad. Replace with a heavier transformer.

Symptom: Motors move carriage forward and backwards OK with joystick, but when claw drop button is pressed carriage moves to the right or left and fails to claw.

Cause: Shorted Z-axis motor. Replace motor.

If you encounter a symptom not mentioned in the above guide, call Twobits.com for assistance. Remember, you are welcome to send us your UNIVERSAL CRANE LOGIC BOARD any time for a free check-up!

Step 14. Reassembly.

Use common sense in reassembling the cosmetic attributes of the crane. Be sure that the car assembly covers do not short out against the bridge rectifier or motor connections. Also make sure the claw coil casing lid does not short against the solder lugs on the coil itself and that the grommet on the curly cord is intact and the wires going to the coil are not damaged at the entry point to the claw coil casing.

Be sure that there is a GROUND PRONG on the power cord. The 3-prong grounded plug is essential for safe and reliable operation. Be positive that the GROUND PRONG is actually connected to the FG terminal of the power supply and the metal parts of the crane and not just simply "on the cord".

OPERATION OF THE CRANE

Power Up. The carriage will return to its home position, but **THE CLAW WILL NOT WIND UP.** This is a safety feature built-in to the software to prevent vandals from damaging your crane by flipping the power on and off quickly. On many crane designs, this will cause the string to wind up a little tighter each time until the string breaks. After setting up the crane on location, the operator **MUST** play at least one game to check out the machine. The string will wind up normally during the first of these "test games".

Operation. Set the DIP switches for the proper coinage. From 1 to 4 coins can be set as the price. (If you requested that your crane be equipped with special pricing options, refer to the addendum sheet included in your kit.)

UNITS per CREDIT	DIPSWITCH			
	1	2	3	4
1	OFF	OFF	X	X
2	ON	OFF	X	X
3	OFF	ON	X	X
4	ON	ON	X	X

SWITCHES 3 AND 4 ARE NOT USED.

Optional Cash Meter. The optional cash meter will increment one step per unit of credit inserted. For example, if you have DIP SWITCHES 1 and 2 OFF and you are using a quarter slot (one play per quarter) the meter will represent the number of quarters inserted. If you are using a dollar bill acceptor set for one pulse per dollar and DIP SWITCHES 1 and 2 are OFF (one play per dollar) the meter will represent the number of dollars inserted. If you change the DIP SWITCHES to 1 ON and 2 OFF and operate the crane on a bill acceptor set for 4 pulses per dollar, the meter will represent "quarters" inserted (4 pulses per dollar is the same as 4 quarters) but the player will get only 2 plays (DIP SW 1 ON and 2 OFF sets crane for 2 units for 1 play).

Your new Crane can detect minor errors which occur in the mechanics of the carriage, and can compensate for them. If the crane runs into anything out of the ordinary, it shuts down and indicates the reason by blinking a diagnostics LED located on the Control Board. Be sure not to turn off the power to the crane in the event of a service call. If the power is turned off, the report code on the LED is also lost. A quick view of the LED as soon as a service person arrives on location will tell the service person why the crane went out of order, thus saving time and money.

GAME PLAY

The player must insert coin(s) to begin play. The Control Board has a credit accumulator, allowing credit to be "built up". For example, if the crane is priced at 1 coin for 1 play and the customer inserts 3 coins, he will receive 3 plays, one right after the other. If the crane is priced at 2 coins for 1 play and the customer inserts 3 coins, the customer will receive 1 play and the computer will remember the 1/2 credit remaining. Therefore, a play will be given for the next coin inserted.

Once credit has been established, the crane will wait until ANY joystick or claw drop button is pressed. On the first switch action, a 15-second timer begins. The player has 15-seconds to move the claw around the playfield freely. If he does not push the drop button before time runs out, the claw will drop by itself.

The claw drops until the string goes slack. At this point the claw energizes. Then the string winds back up, the carriage goes first to the left all the way, then to the front all the way so as to position it above the payout chute where the claw will release the prize. At this time, the player has the option to add more coins. The only time coins can be added is when the crane is in its home position. If anything goes wrong with this sequence of events (such as the crane string breaking), the Control Board will shut down the machine and report an error code on the diagnostics LED.

DIAGNOSTIC PROCEDURES

The Universal Crane Replacement Logic board comes equipped with on-board diagnostics. These continuous tests monitor motor and switch status and report any errors by a series of flashes on the LED. If an error occurs, the crane (or station in the case of a double or triple crane) will shut down and remain shut down until the power is turned off and then back on (reset condition). Try to count the LED blinks before powering down the crane.

of Flashes Cause

- 1 A protect time-out occurred during a claw drop cycle. For some reason, the Z-axis motor remained on too long trying to lower the claw. It is also possible that both limit switches on the car are not being read properly. Check for broken black wire on the CLS switch.

- 2 A protect time-out occurred during a claw rise cycle. For some reason, the Z-axis motor remained on too long trying to raise the claw. It is also possible that both limit switches on the car are not being read properly. Check for broken black wire on the CLS switch.

- 3 A protect time-out occurred during a left home return cycle. This typically is caused by an obstruction in the return path or the car has become crooked on the track. It is also possible that the left limit switch has been damaged or is being misread. Check for a broken white-gray or solid white wire on the truck assembly.

- 4 A protect time-out occurred during a forward home return cycle. This typically is caused by an obstruction in the return path or the truck assembly has become crooked on the track. It is also possible that the front limit switch is damaged or is being misread. Check for a broken white-brown or solid white wire on the truck assembly.

- 5 A CLS switch trigger occurred during a claw drop cycle. This usually is accompanied by the crane string being wound backwards. Check the C4 switch for proper operation. Also check for broken or pinched wires. Is there a STAR WASHER on the string?
- 6 A C4 switch trigger occurred AFTER a CLS switch trigger. This error can only occur while the claw is on its way back up from the playfield to the car. Usually, this error is caused by the crane string breaking. If the string is not broken or wound backwards, check for the proper operation of the C4 switch. Also check for broken or pinched wires.
- 7 A C4 switch trigger occurs while the car is returning to its home position left. This error is due to the crane string breaking or rough treatment by the customers.
- 8 A C4 switch trigger occurs while the car is returning to its home position forward. This error is due to the crane string breaking or by rough treatment by the customers.
- 9 Coin switch remains closed during game play.
- 10 Either the joystick forwards and backwards or left and right switches are closed at the same time.
- 11 Both FL and LL limit switches open within 15 seconds after game play during the idle attract mode. This is usually an indication that the crane has been tipped over.

LED On Continuously: Fault in the CPU or in the RESET circuit. Send the control board to Twobits.com for a free check-up!.

HELPFUL HINTS

Keep the machine clean, especially the carriage mechanism. Do not allow plush dust to build up on the motors and rollers. Clean the metal rails often and check them for rust. Do not apply oil to the rails or the wheels on the carriage. Use steel wool to remove rust or debris from the rails. Keep belts on both sides of the truck assembly at all times. Use the proper belt; if the belt is too long, it will drag and cause the crane to move at an angle. If the belts are too short, they will break prematurely and cause the truck to get stuck somewhere out in the playfield. Check the protective spring tube holding the wiring harness periodically for wear on the harness near the ends of the spring. Repair the spring tube quickly if it breaks off from where it mounts on the carriage assembly. Keep the covers attached to the car assembly. Never over-fuse the machine!

If the crane string breaks, use 200 lb. test NYLON MULTISTRAND fishing line to replace the string. This is the overall best choice because it has high wear qualities and will last a long time. BE CERTAIN that a STAR WASHER is installed PROPERLY on the string above the CLS switch and below the C4 switch (see Fig. 5).

If the claw coil has too much power, you can reduce the power of the claw by installing a rheostat in one of the two wires running from the Control board and the bridge rectifier (RED and GREEN-WHITE; Refer to figure 6.) Use a 50 ohm, 20 watt for 28 volts or less and a 75 ohm 20 watt for over 28 volts. Once installed, rotate the shaft of the rheostat until you reach the desired power. If you can't locate a heavy enough one, a suitable rheostat is available directly from TWO BIT SCORE.

If the claw coil isn't powerful enough, adding pinball machine ball shooter tips to the claw ends will increase the claw grip. A combination of this and adding the rheostat as mentioned above may be necessary to adjust the crane for the proper percentage.

On some lower voltage cranes, like Sonic and Hollywood it may be necessary to replace the 47uF capacitor located on the bridge rectifier on the car assembly with a capacitor of higher value, say 220uF or 470uF, otherwise the strength of the claw coil may be weak. Use at least a 35V capacitor.

QUICK REFERENCE GUIDE

Power Supply	+5v and low voltage AC
Fuses:	
+5v	AGC 1
AC	MDL 5 (for 28v or less) MDL 7 (for over 28v)
Driver TRIAC	2N5445 (Motorola)
Claw Driver	T2800D (TRIAC)
Bridge Rectifier	30 amp 400v

DON'T PANIC!!

If for any reason you feel like you "just don't get it", give us a call. We will be glad to answer any questions you may have regarding the installation or operation of this kit. If you suspect that there is a problem in your control board, we invite you to send it to us anytime for a free check-up!

**Contact us by telephone 512-447-8888
 9:00 to 5:00 M-F Central Time**
Use your fax machine 512-447-8895
The Internet Sales@Twobits.com
Visit our Website for latest info <http://www.Twobits.com>

Shipping: TWOBITS.COM
4418 Pack Saddle Pass
Austin, TX 78745

POWER HARNESS CONNECTOR UNIVERSAL CRANE LOGIC BOARD KIT WIRING CHART

1	GROUND	BLACK
2	GROUND	NOT USED
3	+5v	RED
4	COIN METER TRIGGER	VIOLET
5	AC INPUT #1	BLUE-WHITE
6	AC INPUT #2	BLUE-YELLOW

CARRIAGE HARNESS CONNECTOR

1	CAR ASSY MOTOR RETURN	YELLOW
2	CLAW COIL RETURN	RED
3	TRUCK ASSY MOTOR RETURN	WHITE-YELLOW
4	Z-AXIS MOTOR DRIVE	BROWN-WHITE
5	Y-AXIS MOTOR DRIVE	WHITE-ORANGE
6	X-AXIS MOTOR DRIVE	ORANGE
7	CLAW COIL DRIVE	GREEN-WHITE
8	FL (FRONT LIMIT) SWITCH	WHITE-BROWN
9	LL (LEFT LIMIT) SWITCH	WHITE-GRAY
10	CAR SWITCH RETURN	BLACK
11	TRUCK SWITCH RETURN	WHITE
12	NOT USED	
13	C4 (CRANE DOWN) SWITCH	BLUE-YELLOW
14	CLS (CRANE UP) SWITCH	BLUE-WHITE

CONTROL HARNESS

1	COIN SWITCH RETURN	BLACK
2	PANEL SWITCH RETURN	BLACK
3	COIN SWITCH	ORANGE
4	CLAW DROP SWITCH	RED
5	UP	WHITE-ORANGE
6	DOWN	WHITE-YELLOW
7	LEFT	WHITE-GRAY
8	RIGHT	YELLOW

The CAR has TWO motors: WIRE PAIR from 14 pin connector

X MOTOR moves LEFT – RIGHT	1 YELLOW	6 ORANGE
Z MOTOR winds up the STRING	1 YELLOW	4 BROWN-WHITE

The CAR has TWO SWITCHES:

C4 SLACK STRING; CLAW DOWN	10 BLACK	13 BLUE-YELLOW
CLS CLAW all the way UP	10 BLACK	14 BLUE-WHITE

The TRUCK has ONE MOTOR:

Y MOTOR moves FRONT – REAR	3 WHITE-YELLOW	5 WHITE-ORANGE
----------------------------	----------------	----------------

The TRUCK has TWO SWITCHES

LL LEFT Limit; Car has hit the LEFT wall	9 WHITE-GRAY	11 WHITE
FL FRONT Limit; Car has hit FRONT wall	8 WHITE-BROWN	11 WHITE