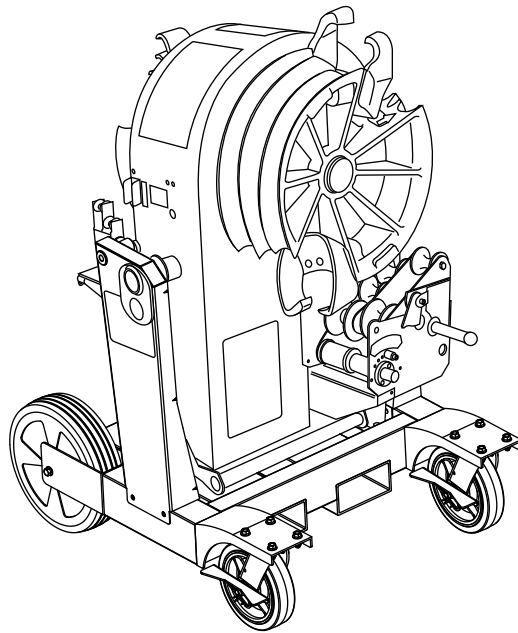


SERVICE MANUAL



855[®] **Smart Bender**[®] and **01711 Optional Deluxe Pendant**

Serial Code AKN



Read and understand all of the instructions and safety information in this manual before operating or servicing this tool.

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Safety

Safety is essential in the use and maintenance of Greenlee tools and equipment. This service manual and any markings on the tool provide information for avoiding hazards and unsafe practices related to the use of this tool. Observe all of the safety information provided.

Purpose of this Manual

This manual is intended to familiarize authorized Greenlee service center personnel with the safe operation and maintenance procedures for the Greenlee 855 Smart Bender, Serial Code AKN.

Keep this manual available to all personnel.

Replacement manuals are available upon request at no charge at www.greenlee.com.

Other Publications

Instruction Manual: 52033651

All specifications are nominal and may change as design improvements occur. Greenlee Textron Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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Loctite is a registered trademark of Loctite Corporation.

Molex is a registered trademark of Molex Inc.

KEEP THIS MANUAL

IMPORTANT SAFETY INFORMATION



SAFETY ALERT SYMBOL

This symbol is used to call your attention to hazards or unsafe practices which could result in an injury or property damage. The signal word, defined below, indicates the severity of the hazard. The message after the signal word provides information for preventing or avoiding the hazard.

⚠ DANGER

Immediate hazards which, if not avoided, **WILL** result in severe injury or death.

⚠ WARNING

Hazards which, if not avoided, **COULD** result in severe injury or death.

⚠ CAUTION

Hazards or unsafe practices which, if not avoided, **MAY** result in injury or property damage.



⚠ WARNING

Electric shock hazard:

- Connect the power cord to a 120 V, 20 A receptacle on a ground fault-protected circuit only. Refer to “Grounding Instructions.”
- Do not modify the power cord or plug.
- Inspect the power cord before use. Repair or replace the cord if damaged.
- Disconnect the unit from power before servicing.

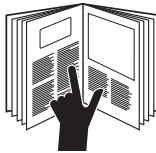
Failure to observe these warnings could result in severe injury or death.



⚠ WARNING

- Do not expose to rain.
- Do not use in wet or damp locations.
- Do not immerse the pendant switch in water or any other liquid.

Failure to observe these warnings could result in severe injury or death.



⚠ DANGER

Read and understand all of the instructions and safety information in this manual before operating or servicing this tool.

Failure to observe this warning could result in severe injury or death.



⚠ WARNING

Wear eye protection when operating or servicing this tool.

Failure to wear eye protection could result in serious eye injury from flying debris.



⚠ DANGER

Do not use this tool in a hazardous environment. Hazards include flammable liquids, gases, or other materials. Using this tool in a hazardous environment can result in a fire or explosion.

Failure to observe this warning will result in severe injury or death.





⚠ WARNING

Do not remove guards.

Failure to observe this warning could result in severe injury or death.

IMPORTANT SAFETY INFORMATION

| | |
|---|--|
|  | ⚠ WARNING |
| | <p>Extension cords:</p> <ul style="list-style-type: none"> • Use only three-wire, 12 AWG extension cords that have three-prong, grounding-type plugs and three-hole receptacles that accept the tool's plug. • Do not use extension cords that are longer than 30 m (100'). • Repair or replace damaged extension cords. <p>Failure to observe these warnings could result in severe injury or death.</p> |

| | |
|--|---|
|  | ⚠ WARNING |
| | <p>Pinch points:</p> <p>Keep hands away from bending shoe, rollers, and conduit when bender is in use.</p> <p>Failure to observe this warning could result in severe injury or death.</p> |

| |
|--|
| ⚠ WARNING |
| <p>Unplug the bender before changing accessories. Accidental startup could result in serious injury.</p> |

| |
|--|
| ⚠ WARNING |
| <p>Adjust fork spacing to match fork tubes on bender. Ensure caster brakes are locked and casters are straight before inserting forks into fork tubes. Forks must extend beyond ends of fork tubes a minimum of 8".</p> <p>Failure to observe this warning could result in severe injury or death.</p> |


| |
|--|
| ⚠ WARNING |
| <p>Do not operate the bender while wearing loose clothing. Loose clothing can get caught in moving parts.</p> <p>Failure to observe this warning could result in severe injury or death.</p> |

| | |
|---|---|
|  | ⚠ WARNING |
| | <p>Do not use tool as a step or ladder.</p> |

| |
|--|
| ⚠ CAUTION |
| <ul style="list-style-type: none"> • Conduit moves rapidly as it is bent. The path of the conduit must be clear of obstructions. Be sure clearance is adequate before starting the bend. • Inspect the bender before use. Replace worn, damaged, or missing parts with Greenlee replacement parts. A damaged or improperly assembled component could break and strike nearby personnel. • Set the switches to the appropriate conduit size and type before bending. • Select the appropriate shoe groove and support roller for the type and size of conduit before bending. • Do not bend conduit over 93 degrees. Overbending could result in the other shoe hook colliding with the conduit. • Some bender parts and accessories are heavy and may require more than one person to lift and assemble. • Ensure that all bystanders are away from the work area when operating the bender. • Ensure that the work area is clean, dry, uncluttered, and well-lit. • Use this tool for the manufacturer's intended purpose only. Use other than that which is instructed in this manual can result in injury or property damage. <p>Failure to observe these precautions may result in injury or property damage.</p> |

Note: Keep all decals clean and legible, and replace when necessary.

Grounding Instructions

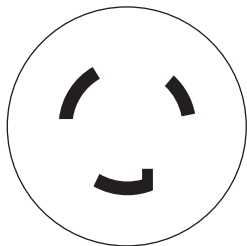
| | |
|---|---|
|  | ⚠ WARNING |
| | <p>Electric shock hazard:</p> <ul style="list-style-type: none"> Do not modify the plug provided with the tool. Connect this tool to a grounded receptacle on a 20 A GFCI-protected circuit. <p>Failure to observe these warnings could result in severe injury or death.</p> |

This tool must be grounded. In the event of a malfunction or breakdown, an electrical ground provides a path of least resistance for the electric current. This path of least resistance is intended to reduce the risk of electric shock.

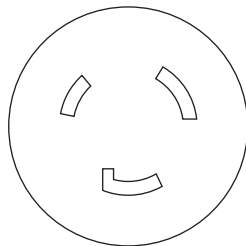
This tool's electric cord has a grounding conductor and a grounding plug as shown. Do not modify the plug. Connect the plug to a corresponding GFCI-protected receptacle that is properly installed and grounded in accordance with all national and local codes and ordinances.

Do not use an adapter.

NEMA L5-20

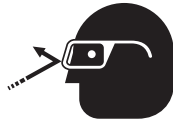


Plug



Receptacle

Setup

| | |
|--|--|
|  | ⚠ WARNING |
| | <p>Wear eye protection when operating or servicing this tool.</p> <p>Failure to wear eye protection could result in serious eye injury from flying debris.</p> |

Follow these steps, which are described in greater detail in this section, to set up the bender.

1. Transport the bender to the job site.
2. Lock both swivel casters.
3. Pivot the bending head to the desired position.
4. Connect the pendant to the bending head.
5. Plug the power cord into a 120 VAC, 20 A GFCI-protected receptacle. For best performance, use a dedicated circuit for this unit and do not use extension cords.
6. Turn on the power switch.

Transporting the Bender

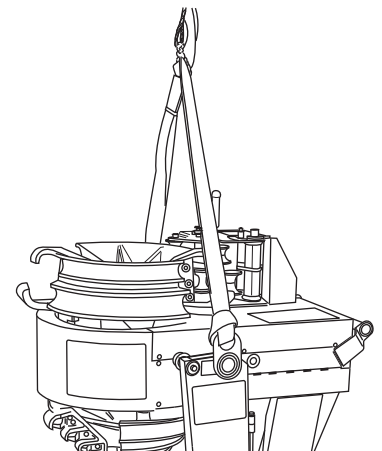
Make sure that all components used to lift the bender are properly rated for the 231 kg (510 lb) weight. Use a ramp to load and unload the bender from a truck or other vehicle that is not equipped with a lift gate.

To roll the bender:

1. Unlock swivel casters.
2. Pivot the bending head to the horizontal position with the 1-1/2" to 2" shoe facing up.
3. Use the transport handle to push and steer the bender.

To lift the bender:

1. Pivot the bending head to the horizontal position with the 1-1/2" to 2" shoe facing up.
2. Rotate the lifting eyes so that they are accessible.
3. Loop the sling (or attach the hooks) to the lifting eyes. Make sure that each side of the sling or chain is 1 m (3') long to prevent it from rubbing against the bender.
4. Securely attach the sling or chain to the lifting device.



Setup (cont'd)

Pivoting the Bending Head

WARNING

- Do not rotate the bending head if one or more of the bending shoes is removed.
- The bender head pivot lock must be fully engaged in the frame hole and fully turned in the counter-clockwise direction.

Failure to observe these warnings could cause the bending head to move rapidly in an unexpected direction, resulting in severe injury or death.

The bending head can be rotated into three positions:

- Vertical
- Horizontal, 1/2" to 1-1/4" shoe facing up
- Horizontal, 1-1/2" to 2" shoe facing up

To change the bending head position:

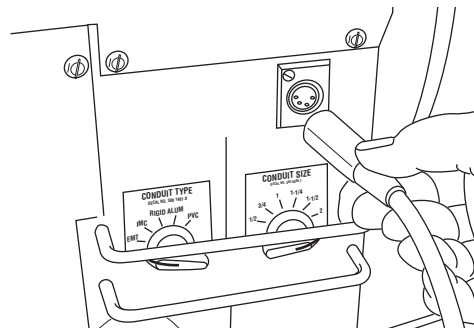
1. Rotate the bender head pivot lock knob clockwise until it contacts the bending head.
2. Pull out the bender head pivot lock knob.
3. Pivot the bending head to the desired position.
4. Release the bender head pivot lock knob so that the pin is fully engaged in the frame hole.
5. Turn the pivot lock knob counterclockwise until there is resistance. Do not overtighten.

Connecting the Standard or Deluxe Pendant


IMPORTANT

Do not connect or disconnect the pendant while the power is on, or permanent damage to the pendant or bender circuitry may result.

Remove the pendant control from its storage area, and plug it into the four-pin receptacle on the side of the bending head.



Adjustments

| | |
|---|---|
|  | ⚠ WARNING |
| | <p>Disconnect power supply before servicing bender. Servicing to be done only by trained service technician.</p> <p>Failure to observe this warning could result in severe injury or death.</p> |

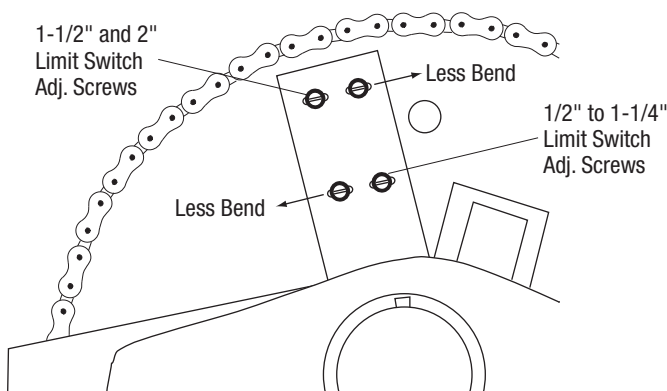
Squeeze

Proper squeeze adjustment for most 1-1/2" and 2" EMT and IMC conduit is when the squeeze adjustment arm is vertical (at middle hole). But variation in conduit can result in wrinkling or side marking of conduit. If wrinkling or excessive ovalness occurs, increase squeeze one position (hole) counterclockwise. If loading conduit is difficult or if excessive side marking occurs, decrease squeeze one position (hole) clockwise.

Accuracy

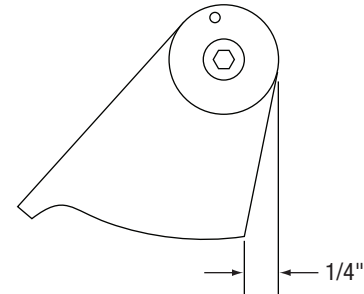
If the accuracy of all sizes of conduit on one shoe is off **in the same direction**, the limit switch needs to be adjusted. Individual adjustments specific to one size and type of conduit should be made using the Accuracy Adjust mode. Refer to the "Troubleshooting" section.

To adjust the limit switches, first unplug the bender. Remove the four screws that secure the top round guard and remove the guard to expose the two limit switches. The top switch controls the 1-1/2" to 2" shoe. Loosen the two screws and move it to the right side of the bender as shown in the diagram below to prevent overbending. The bottom switch controls the 1/2" to 1-1/4" shoe. Loosen the two screws and move it to the left side of the bender as shown below to prevent overbending. Move either switch the opposite direction if the bender is underbending. Every 1/8" of switch movement approximates 1 degree of change. Tighten the screws and replace the guard.

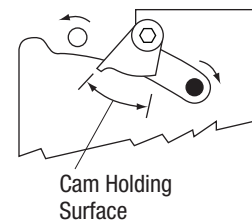


Retention Cam


Loosen the screws securing the retention cam. With the bender oriented in the vertical position, rotate the round plate until the right side edge of the cam is pointed straight down or within 1/4" left of being straight down. Make sure both ends of the spring are engaged in the holes of the cam and round plate. Tighten the screws while holding the round plate in position with pliers to prevent it from rotating.

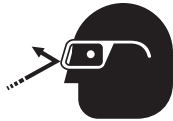


Check to make sure the roller support handle will fully engage and retract without catching on the cam holding surface. This should be done in both the vertical and horizontal bending positions. It should also be done with the cam positioned as far left and as far right as friction will allow it to stay.



Maintenance

| | |
|---|---|
|  | ⚠ WARNING |
| | <p>Electric shock hazard: Disconnect the unit from power before servicing.</p> <p>Failure to observe this warning could result in severe injury or death.</p> |

| | |
|---|--|
|  | ⚠ WARNING |
| | <p>Wear eye protection when operating or servicing this tool.</p> <p>Failure to wear eye protection could result in serious eye injury from flying debris.</p> |

Schedule

| Component | Maintenance Activity | Maintenance Interval |
|--------------------|------------------------------------|---|
| Chain | Lubrication and Tension Adjustment | Every 6 months* |
| Roller Supports | Cleaning and Lubrication | Every 6 months* |
| Commutator Brushes | Replacement | When drive unit performance diminishes noticeably |

* More often if the bender is used in dusty or corrosive environments

Chain Lubrication and Tension Adjustment

1. Disconnect the bender from the power source.
2. Refer to the "1-1/2" to 2" Side Exploded View." Remove the 1-1/2" to 2" shoe (refer to "Changing Shoes" in this section of the manual).
3. Refer to the "Main Exploded View." Remove the screws (23) and front chain guard assembly (4).
4. Spray a motorcycle chain lubricant on the inside of the chain between the sprockets while pressing **UNLOAD**. Lubricate the entire length of the chain.
5. Check the amount of slack halfway between the sprockets. If the chain slack is :
 - More than 25 mm (1"), proceed to step 6.
 - Less than 25 mm (1"), proceed to step 10.
6. Remove 11 screws (23) and the motor guard (5).
7. Loosen the two motor mounting screws (25) on the front, the two on the back, and the nut (22).
8. Torque the eccentric locator (21) to 81 Nm (60 ft-lb). Maintain this amount of torque while tightening the nut (22) and two front screws (25).
9. Tighten the two rear screws (25).
10. Assemble in reverse order.

1/2" to 1-1/4" Roller Support


1. Disconnect the bender from the power source.
2. Remove the support pivot pin (19). Remove the roller support (7).
3. Spray a motorcycle chain lubricant through the 3 mm (1/8") diameter hole in each roller. Rotate each roller to distribute the lubricant.
4. Spray the pivot pin.
5. Wipe away any excess lubricant.
6. Replace the roller support and pivot pin.

Maintenance (cont'd)

1-1/2" to 2" Roller Support

1. Disconnect the bender from the power source.
2. Remove the 1-1/2" to 2" shoe (refer to "Changing Shoes" in this section of the manual).
3. Refer to the "1-1/2" to 2" Roller Support Unit Exploded View." Use a pair of needle-nose pliers to disconnect the springs (104) from the holes in the side of the bender frame beneath the roller support unit.
4. Refer to the "Main Exploded View." Remove the squeeze adjustment arm screw (97) and arm (74).
5. Remove the three button head cap screws (96) and adapter sleeve (92).
6. Place one hand under the support arms (71) to support the weight of the roller support unit. Remove the eccentric shaft (91).

Note: You may need to rotate the eccentric shaft to remove it.

| | |
|--|--|
|  | ⚠ WARNING |
| | <p>Pinch points: Keep hands away from bending shoe, rollers, and conduit when bender is in use.</p> <p>Failure to observe this warning could result in severe injury or death.</p> |

7. Lift the roller support subassembly to the left and upward.
8. On the 1-1/2" roller group:
 - Loosen the sleeve set screw (98) and remove the 1-1/2" pivot roller shaft (86) with grip (90). Remove the sleeve (87).
 - Remove two hex head screws (93). Remove the outer roller plate (75).
 - Remove the tail roller (84).
 - Remove all components of the split roller assembly.
9. On the 2" roller group:
 - Loosen the sleeve set screw (98) and press out the 2" pivot shaft (88). Remove the sleeve (89).
 - Remove the hex head screw (93). Remove one retaining ring (95) from the tail roller shaft (83). Remove the outer roller plate (76).
 - Remove the tail roller (82) and center roller (85).
 - Remove all components of the split roller assembly.

10. Clean off all of the grease and dirt.
11. Inspect each item. Replace any worn, damaged, or missing items.
12. Lubricate all working surfaces with a high-quality grease.
13. Replace all components in reverse order, noting the following:
 - On both roller groups: To ease the assembly of the split roller subassemblies, begin by slipping the O-rings onto the side plates. Assemble the split roller subassemblies as shown, and then slip the O-rings into their correct positions.
 - On the 2" roller group only: After replacing any split roller components, add or remove shim washers (99, 119, or 150) as needed.
 - On the 1-1/2" roller group: Install the two Belleville washers (100) so that the inside diameters contact each other.
 - Use Loctite® 271 on the two hex head screws (93). Torque to 55 Nm to 61 Nm (40 ft-lb to 45 ft-lb).
14. Position the roller support arms (71) as shown. Assemble the roller groups to the support arms.
15. Reinstall the roller support unit to the bender. Keep one hand under the support arms so they do not drop completely below the set screw (107).
16. Insert the eccentric shaft (91).

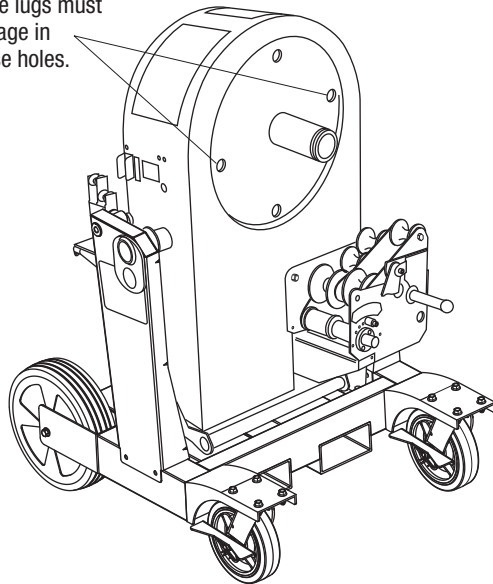
Note: You may need to rotate the eccentric shaft to get it to seat completely.
17. Install the adapter sleeve (92) and three button head cap screws (96).
18. Install the adjustment arm (74) and adjustment arm screw (97).
19. Attach the springs (104) to the holes in the side of the bender frame beneath the roller support unit.
20. Put the bender in the horizontal bending position. Adjust the set screw (107), if necessary, so that the support arms (71) are centered between the front and back plates. Engage and disengage the roller support unit to be sure that it moves freely.

Maintenance (cont'd)

Changing Shoes

1. Disconnect the bender from the power source.
2. Lock the bender head in the vertical bending position (refer to "Pivoting the Bending Head" in the "Setup" section of this manual).
3. Refer to the "1/2" to 1-1/4" Side Exploded View" or the "1-1/2" to 2" Side Exploded View." Use heavy-duty retaining ring pliers to remove the retaining ring (26) that secures the shoe.
4. Remove the shoe from the spindle.

Drive lugs must engage in these holes.



5. Mount the replacement shoe onto the spindle. Align the slot in the shoe bore with the screw head on the spindle. Push the shoe onto the spindle until the drive lugs are fully engaged in the drive lug holes. Replace the retaining ring.

Motor

The motor commutator brushes should last for about 1000 hours of normal use but will eventually need to be replaced.

1. Disconnect power to the unit.
2. Remove the motor cover.
3. Remove the power cord strain relief.
4. Remove the two nuts securing the shroud to the tail of the motor and remove the shroud.
5. Push in the commutator brush retainer and move it toward the brush to release it. Unplug the brush and remove it. Replace it if the length is less than 1/4".
6. Reassemble in reverse order.

Setting Roller Support Limit Switch

The switch is activated by the main outer roller support arm, in the retracted position. Retract the switch from the maximum switch travel by pivoting the switch in its mounting holes and rotating it clockwise in its mounting slot.


Set the squeeze adjustment at the maximum clockwise position. Move the switch in a counterclockwise direction (with a 0.030" feeler gage between the roller arm and the body). When the roller, arm, gage, and switch body are in contact, tighten the mounting screws.

The switch lockout circuit is normally closed. Attach alligator clips to the common and normally closed switch terminals to check switch trip operation.

Do not insert meter probes into the Molex® plug.


Brake

Under normal circumstances the brake should not require adjustment. However, if the brake can be heard dragging while bending or if the braking performance deteriorates, brake adjustment may be necessary.

| | |
|--|---|
|  | ⚠ WARNING |
| | <p>Do not touch the brake if the bender has been recently used. It will be hot. Wait an hour for it to cool off before adjusting.</p> |

1. Disconnect power to the unit.
2. Remove the motor cover.
3. Loosen the two set screws on the brake rotor hub (the part that turns).
4. Slide it to a position 0.002" to 0.015" away from the mating face (about 1 to 3 page thicknesses of this manual).
5. Tighten the set screws to 4 Nm (35 in-lb).
6. Replace the motor cover.

Bender Head Disassembly

| | |
|---|---|
|  | ⚠ WARNING |
| | Disconnect power supply before servicing bender. The bender head should be serviced/disassembled while on the trunnion base. Failure to observe this warning could result in severe injury or death. |

Electronics

Note: Refer to the “Electrical Control System Layout and Parts List” for the location of key numbers.

Power Generation Board (PGU)

1. Remove the four screws securing the top round cover, and remove the cover.
2. Disconnect the ground jump wire (28) and the white and black leads of the Power AC Wire Unit (21).
3. Disconnect the power cord neutral (white) wire (3).
4. Disconnect the power lead (black) from the switch (1).
5. Disconnect the PGU-I/O cable (13).
6. Disconnect the motor leads (2).
7. Remove the four screws securing the PGU subplate and remove the assembly.
8. Assemble in reverse order, noting the proper polarity of all wires as shown.

Rectifier

1. Remove the PGU subplate by following steps 1 to 7 under “Power Generation Board” disassembly above.
2. Disconnect the red, black, and two yellow wires to the rectifier (18, 19, 20).
3. Remove the screw, lock washer, and nut securing the rectifier.
4. Assemble in reverse order, using heat transfer grease between the rectifier and subplate.

Relay

1. Remove the PGU subplate by following steps 1 to 7 under “Power Generation Board” disassembly above.
2. Disconnect the red and black PGU-relay wires (11, 12).
3. Disconnect the relay wire unit (8).
4. Remove the red and black relay wires (9, 10).
5. Remove the two screws, lock washers, and nuts, and then remove the relay.
6. Assemble in reverse order.

Input/Output Board (I/O)

1. Remove the four screws securing the top cover and remove the cover.
2. Disconnect the receptacle unit (4).
3. Disconnect the selector switch (22).
4. Disconnect the unload lockout switch (7).
5. Disconnect the limit switch (5).
6. Disconnect the optical encoder (23).
7. Disconnect the brake wire (6).
8. Disconnect the PGU-I/O cable (13).
9. Disconnect the Power AC Wire Unit (21).
10. Remove the four screws securing the I/O subplate and remove the assembly.
11. Assemble in reverse order, noting the proper polarity of all wires as shown.

Chain

If the chain breaks, replace it with new chain (90542509)—not another master link. Because of the high stress on the chain, the addition of a second master link will only weaken the chain further. If the master link breaks, replace it with a new master link (90542517).

1. Remove the four screws securing the top cover and remove the top cover.
2. Remove the 1-1/2" to 2" shoe (refer to “Changing Shoes” in the “Maintenance” section of this manual).
3. Remove the seven screws securing the front guard and remove the guard.
4. Remove the nine screws securing the motor cover and remove the motor cover.
5. Rotate the motor until the chain master link is accessible at the top of the bender.
6. With the bender head in the horizontal position, loosen the four bolts and nut securing the motor and turn the eccentric adjusting bolt to allow chain slack.
7. Tap the motor toward the spindle to slack the chain, taking care not to allow the encoder to contact the frame.
8. Remove the cotter pins, master link, and chain.
9. Reassemble in reverse order, noting the following:
 - Torque the eccentric adjusting bolt to 81 Nm (60 ft-lb) while tightening the two front bolts and nut to maintain chain tension.
 - Use a new master link and cotter pins.

See Electrical Control System Layout for location of key numbers.

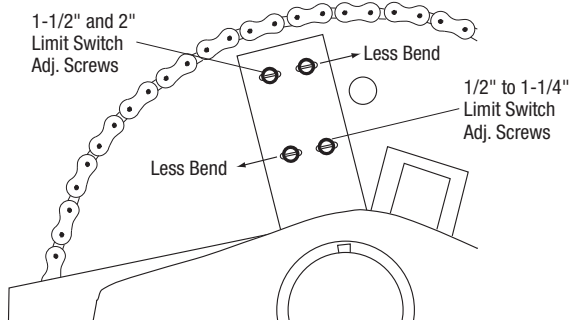
Bender Head Disassembly (cont'd)

Spindle

1. Remove the chain (refer to "Chain" disassembly).
2. Remove the 1/2" to 1-1/4" shoe (refer to "Changing Shoes" in the "Maintenance" section of this manual).
3. Loosen the 1/2" to 1-1/4" drive plate hub set screw.
4. Remove the socket head screw in the 1/2" to 1-1/4" spindle.
5. Remove the drive plate and key.
6. Use a file to remove any raised edges from the spindle to prevent bearing damage.
7. Remove the spindle/sprocket.
8. Reassemble in reverse order.

Limit Switch Bracket

1. Remove the spindle (refer to "Spindle" disassembly).
2. Remove the four screws securing the two limit switches, and remove the switches.
3. Remove the two screws securing the bracket and remove the bracket.
4. Reassemble in reverse order, noting the following:
 - The limit switch with red wires goes on top.
 - Install the top switch so that the trip roller is as far left as possible, as viewed with the switch behind the bracket.
 - Install the bottom switch (black wires) with the trip roller as far right as possible, as viewed with the switch behind the bracket.
 - Temporarily install both shoes before installing the chain.
 - Place 2" IMC in the bender and rotate the shoe until the conduit locks up against tail roller. (**Do not** raise the support rollers as is normal for IMC.)
 - Slide the top limit switch until the contacts trip and tighten in that position.
 - Place 1/2" rigid in the bender and rotate the shoe until the conduit locks up against the support roller.
 - Slide the bottom switch until the contacts trip and tighten in that position.
 - Rotate the spindle, checking that the limit switch trip bolts do not snag the trip rollers. Readjust the bracket mounting, if necessary.



Brake

1. Remove the eleven screws securing the motor cover, and remove the cover.
2. Loosen the two set screws securing the brake rotor, and remove the rotor.
3. Remove the power supply leads.
4. Remove the four screws securing the brake housing, and remove the housing.
5. Reassemble the brake housing and power leads.
6. Use shims to set the brake rotor gap at 0.002" to 0.015" and tighten.
7. Replace the motor cover.

Optical Encoder

1. Remove the four screws securing the top cover, and remove the cover.
2. Remove the seven screws securing the front guard, and remove the guard.
3. Remove the nine screws securing the motor cover, and remove the cover.
4. Rotate the motor until both hub set screws are accessible.
5. Loosen the two set screws in the drive hub.
6. Unplug the encoder from the I/O board.
7. Remove the two mounting screws and round plastic spacers securing the encoder, and pull off the encoder.

Note: Attach a wire or string to the encoder plug at the I/O board to serve as a retrieval line to pull the new wire and plug up through the unit.
8. Reassemble in reverse order, noting the following:
 - Torque the hub set screws to 0.16 Nm (22 in-oz).
 - Jog the motor and check Quad 1 and Quad 2 LEDs for on/off pulsing.

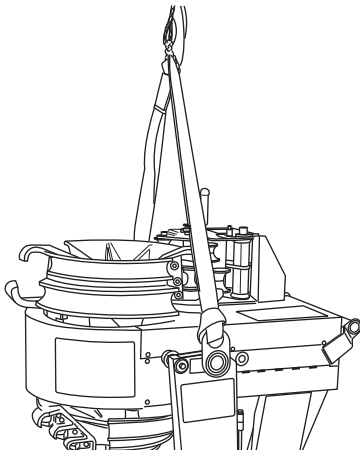
Motor Disassembly

1. Remove the optical encoder (refer to “Optical Encoder” disassembly in the “Bender Head Disassembly” section).
2. Remove the chain (refer to “Chain” disassembly).
3. Remove the brake (refer to “Brake” disassembly).
4. Loosen the motor sprocket set screws, and remove the sprocket and key.
5. Disconnect the motor leads at the relay and the ground wire.
6. Remove the five motor mounting bolts and nut.
7. Remove the motor.

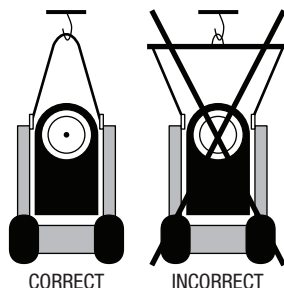
Note: Attach a wire or string to the motor leads at the power generation board to serve as a retrieval line to pull the new wire through the unit.
8. Assemble in reverse order.

Trunnion Disassembly

1. Support the bender’s entire weight, which is approximately 230 kg (500 lb), at the lifting eyes, but do not lift above the floor.



Note: Lifting slings must attach to the lifting mechanism within the width boundaries of the bender to prevent the lifting eyes from sliding off once the retaining rings are removed.



2. Remove the support tower on the rotary selector switch side.
 - Remove the two bolts and two nuts at the side of the tower.
 - Remove the outer retaining ring on each side of the bender.
 - Slide the tower off the pivot spindle.
3. Slide the remainder of the trunnion assembly off the opposite pivot spindle.

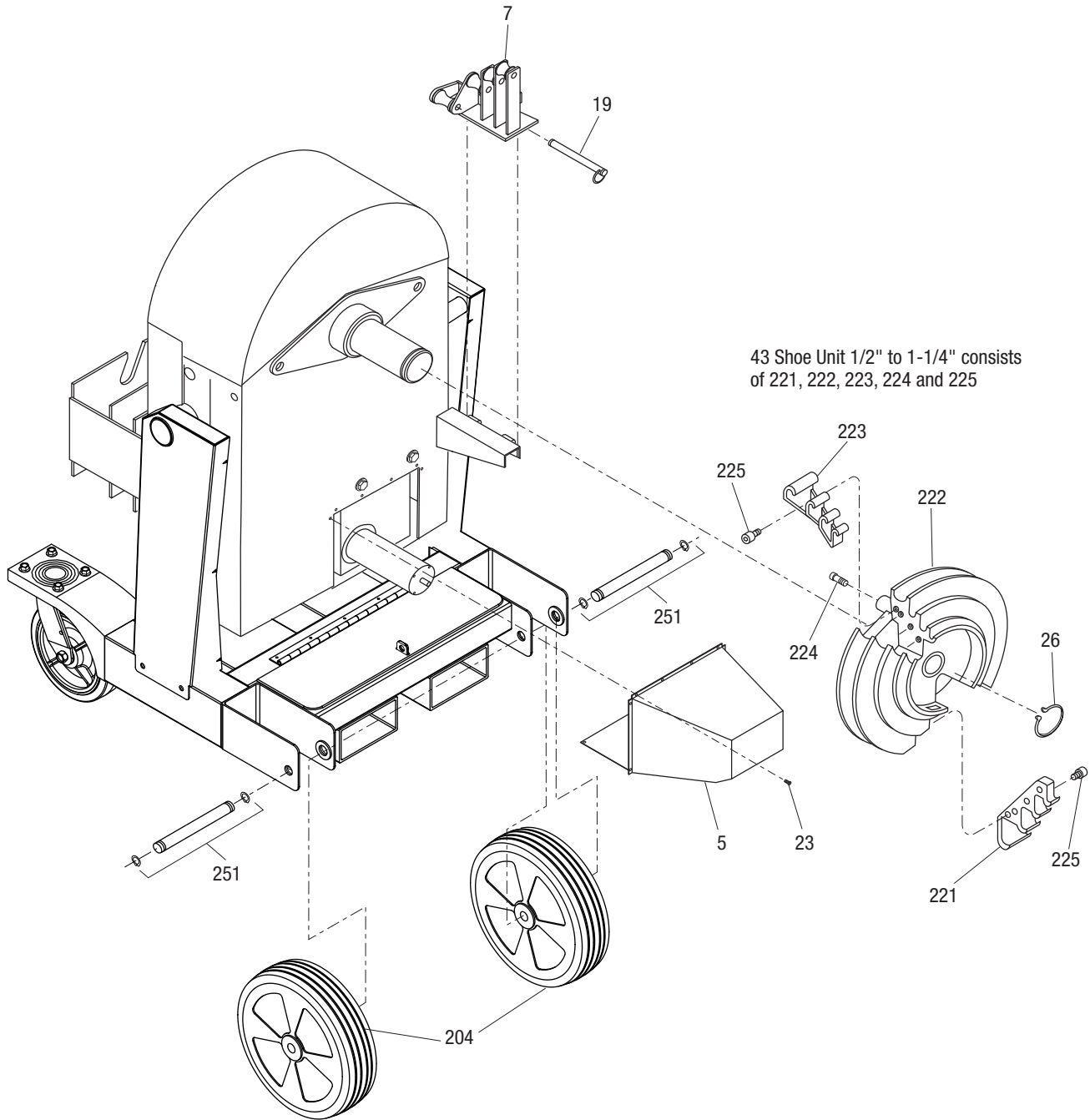
⚠ CAUTION

Bender head may rotate a bit when locking detent pin is disengaged. Keep hands clear.

4. Remove the remaining support tower from the base.
5. Pull out the detent pin, knob, and spring.
6. Remove the four bolts and swivel casters on each side.
7. Remove the stationary wheels.
 - Remove the retaining rings on the axle.
 - Press out the axle.
 - Remove the wheel and washers from each side.
8. Assemble in reverse order, but leave out the detent pin, knob, and spring. After all else is assembled, rotate the bender head so that the top of the bender is pointed toward the kickstand, and insert the detent pin assembly. Hold the detent pin in while rotating the bender head back to one of its normal positions.

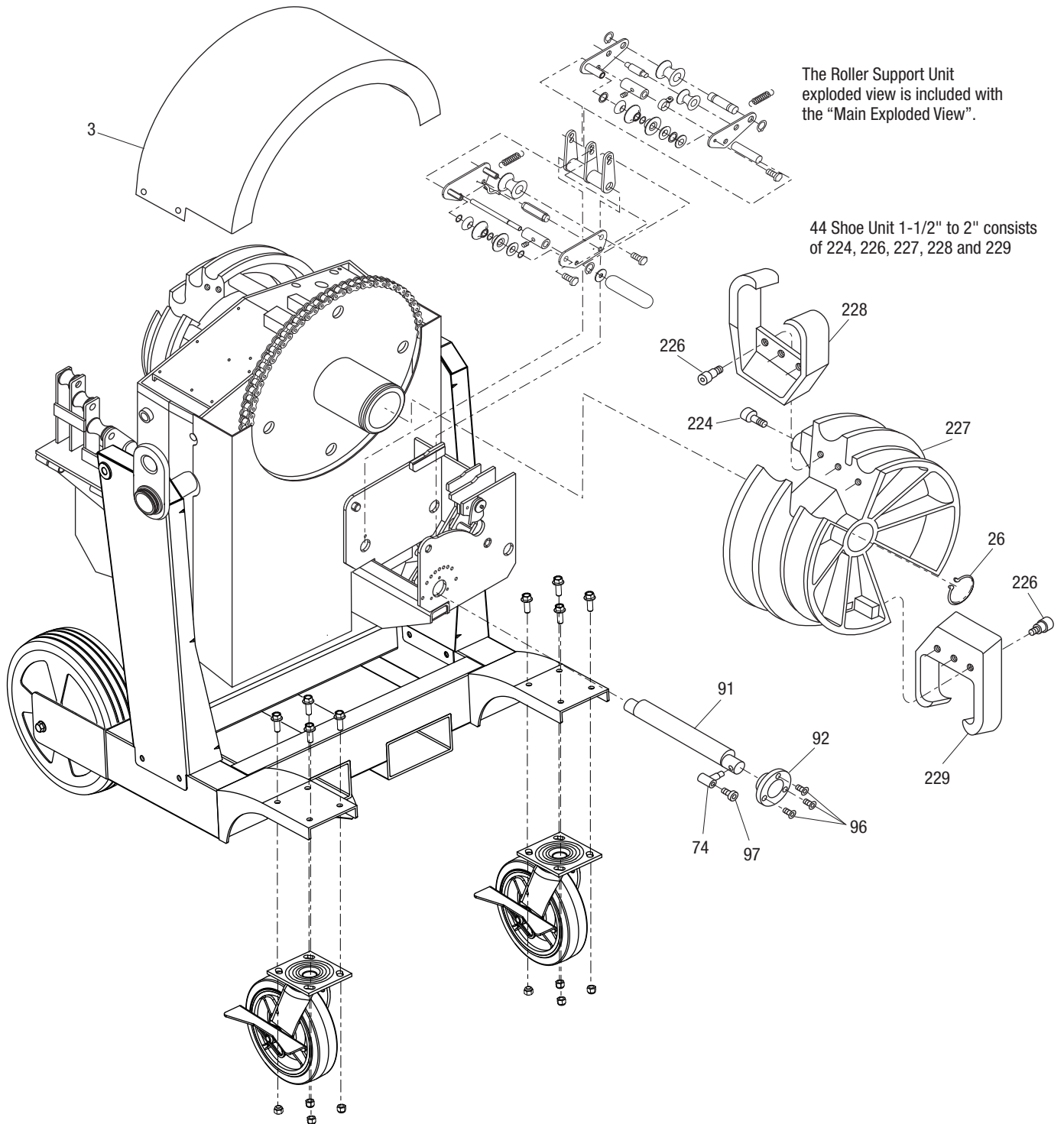
1/2" to 1-1/4" Side Exploded View

Note: Refer to the "Main Parts List" to identify the parts in this illustration.



1-1/2" to 2" Side Exploded View

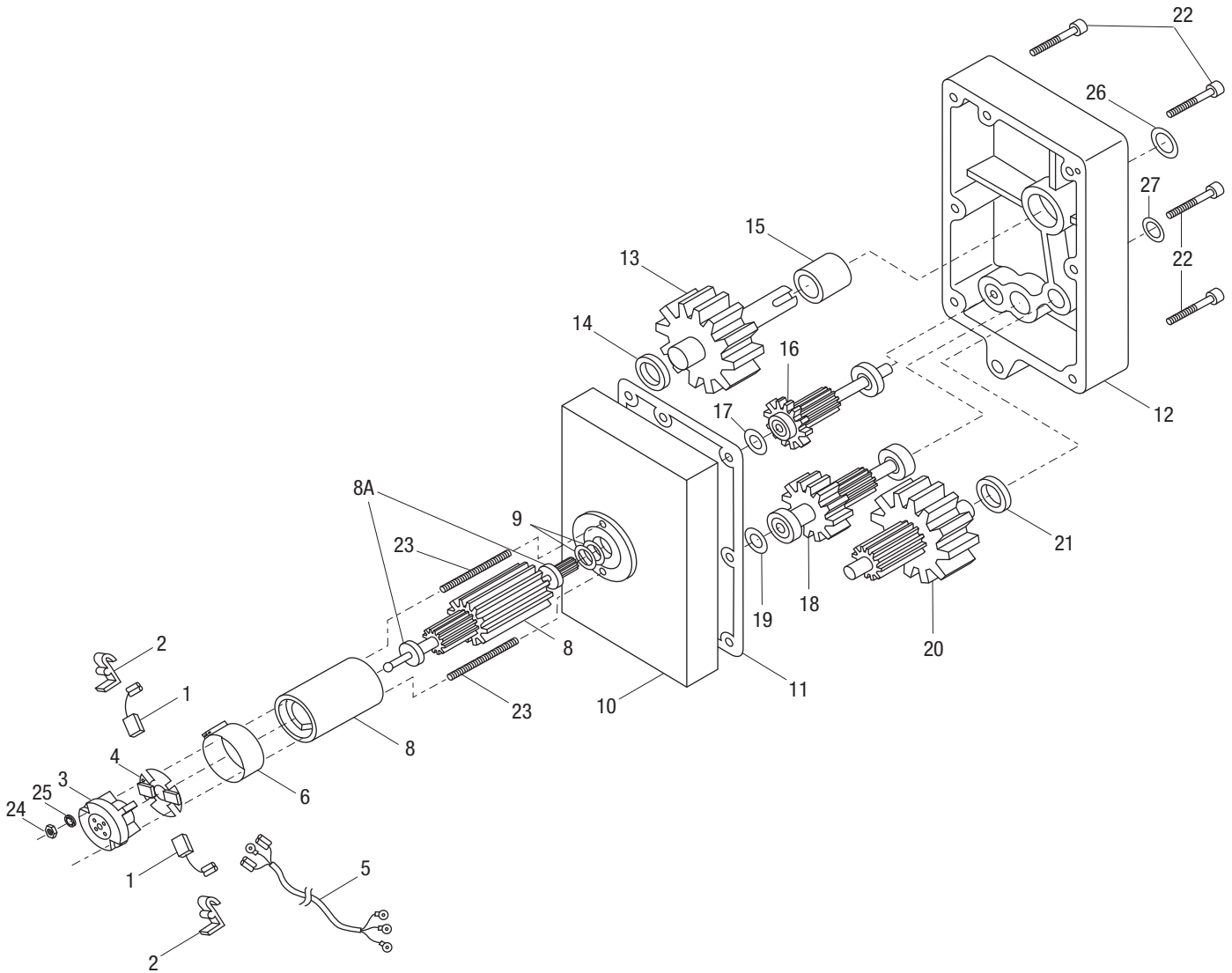
Note: Refer to the "Main Parts List" to identify the parts in this illustration.



The Roller Support Unit exploded view is included with the "Main Exploded View".

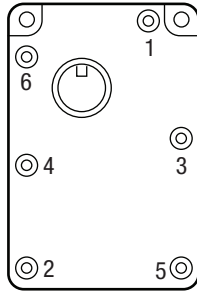
44 Shoe Unit 1-1/2" to 2" consists of 224, 226, 227, 228 and 229

Motor and Gearbox Exploded View



Motor and Gearbox Parts List

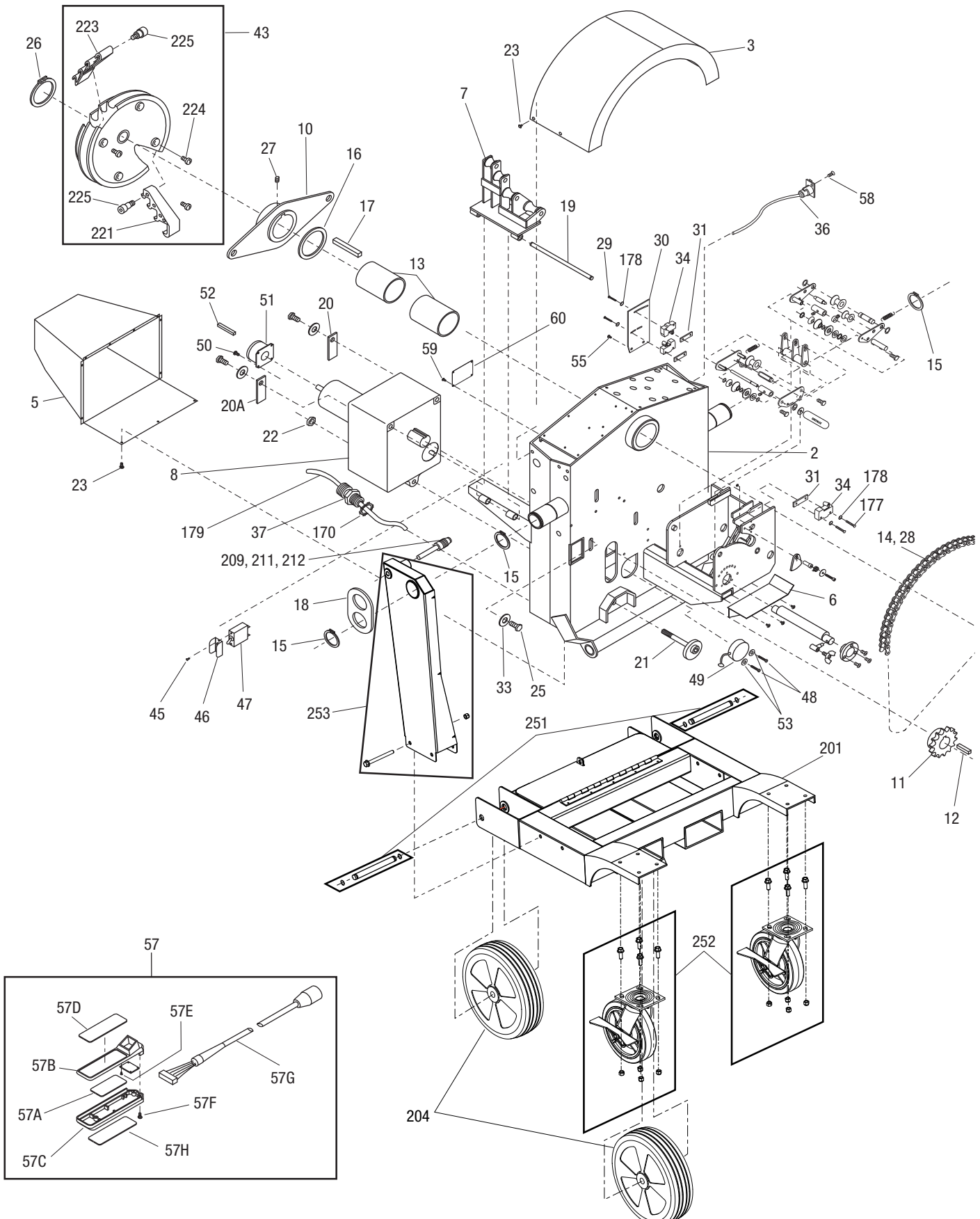
Bolt Tightening Sequence for Gearbox Cover

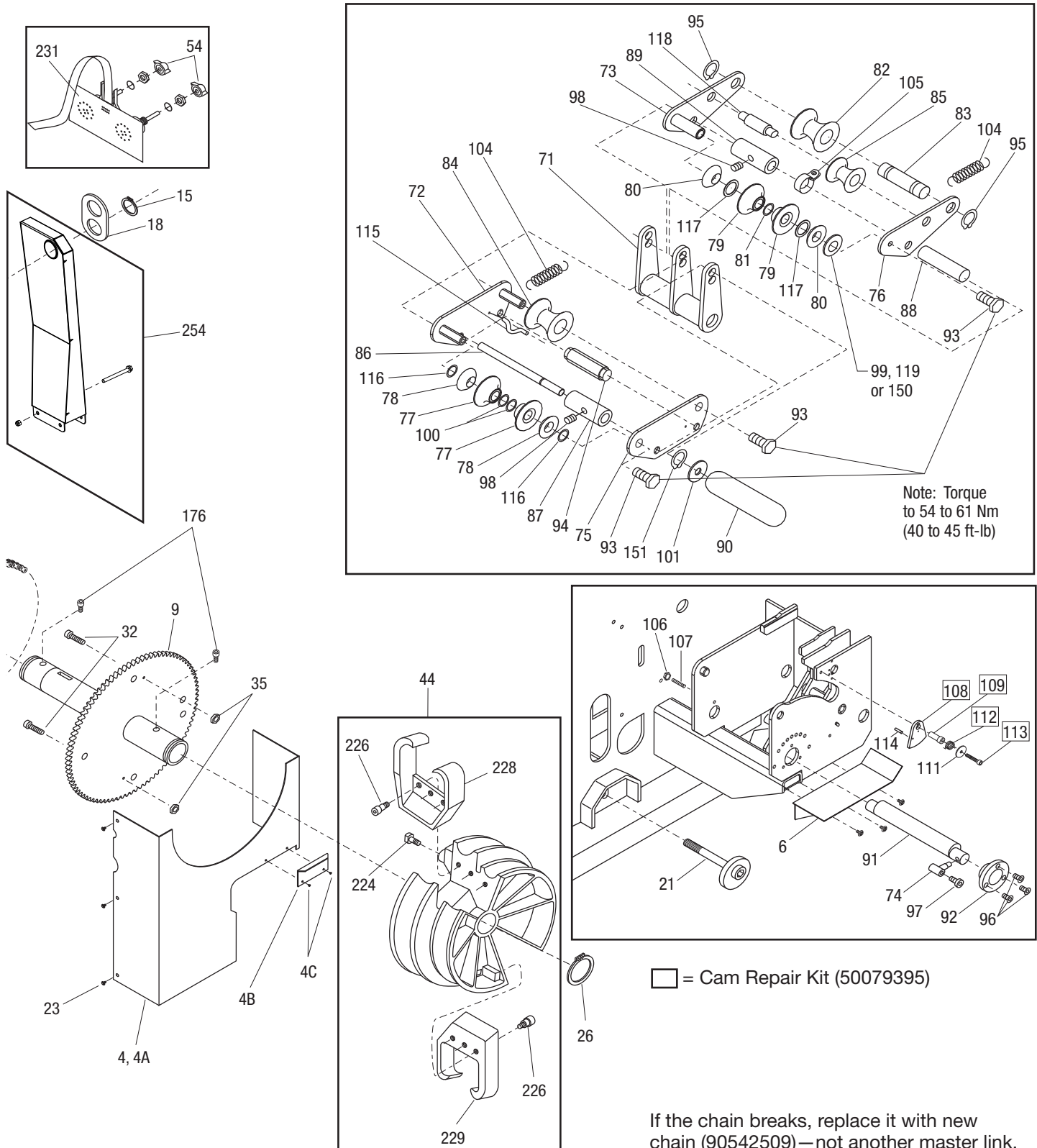


1. Torque gearbox bolts to 11/9 Nm (100/80 in-lb) in sequence shown.
2. Assemble all Belleville washers so that I.D.'s butt and O.D.'s contact bearings.
3. Tighten motor nuts (24) to 3/4 Nm (30/35 in-lb).
4. Insert commutator brushes before connecting push-on terminals.

| Key | UPC No. 78-3310- | Part No. | Description |
|-----|---------------------|----------|------------------------------------|
| 1 | 86705 | 91867053 | Commutator Brushes |
| 2 | 86706 | 91867061 | Commutator Brush Retention Springs |
| 3 | 86707 | 91867070 | Tail Housing |
| 4 | 86708 | 91867088 | Brush Assembly Plate |
| 5 | 86709 | 91867096 | Cord |
| 6 | 39092 | 50390929 | Shroud |
| 8 | 02863 | 52028638 | Armature/Housing Set |
| 8A | 86071 | 91860717 | Bearing |
| 9 | 54348 | 90543483 | Belleville Washers |
| 10 | 39073 | 50390732 | Rear Gear Housing |
| 11 | 39074 | 50390740 | Gasket |
| 12 | 39075 | 50390759 | Front Gear Housing |
| 13 | 39076 | 50390767 | Output Gear Shaft |
| 14 | 39077 | 50390775 | Short Spacer |
| 15 | 39078 | 50390783 | Long Spacer |
| 16 | 39079 | 50390791 | 2nd Reduction Pinion Shaft w/ BRGs |
| 17 | 53323 | 90533232 | Wave Washer |
| 18 | 39080 | 50390805 | 3rd Reduction Pinion Shaft w/ BRGs |
| 19 | 54248 | 90542487 | Belleville Washer |
| 20 | 39081 | 50390813 | 4th Reduction Pinion Shaft |
| 21 | 39082 | 50390821 | Small Spacer |
| 22 | 54043 | 90540433 | 1/2-20 x 2-1/2 Screw |
| 23 | 02298 | 50022989 | 1/4-28 x 9-1/4" Stud |
| 24 | 51705 | 90517059 | 1/4-28 Hex Nut |
| 25 | 50749 | 90507495 | 1/4" Internal Tooth Lockwasher |
| 26 | 07208 | 50072080 | Oil Seal |
| 27 | 07209 | 50072099 | Oil Seal |

Main Exploded View






If the chain breaks, replace it with new chain (90542509)—not another master link. Because of the high stress on the chain, the addition of a second master link will only weaken the chain further. If the master link breaks, replace it with a new master link (90542517).

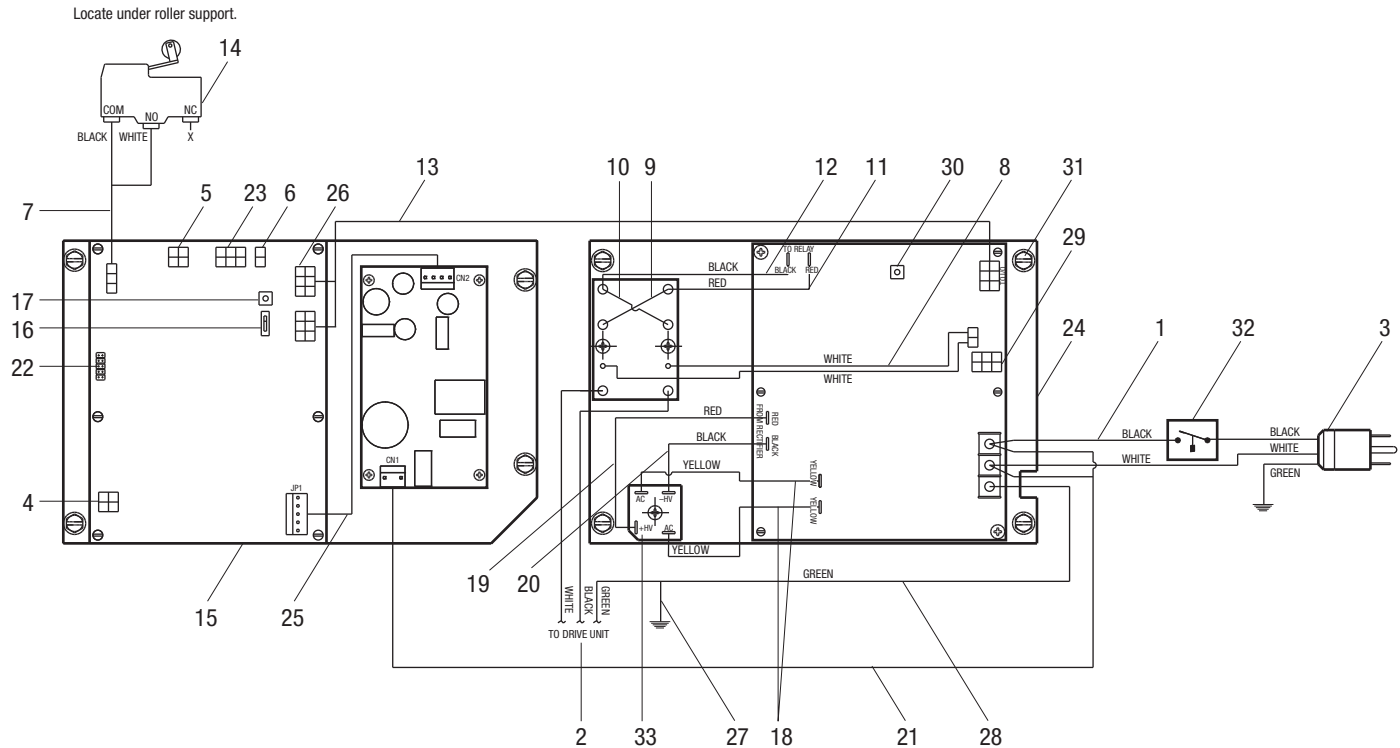
Main Parts List

| UPC No. | | | | UPC No. | | | | | |
|---------|----------|----------|---------------------------------------|---------|-----|----------|----------|--------------------------------------|-----|
| Key | 78-3310- | Part No. | Description | Qty | Key | 78-3310- | Part No. | Description | Qty |
| 2 | | | Frame weldment | 1 | 52 | 38807 | 50388070 | Key, brake | 1 |
| 3 | 38217 | 50382179 | Guard weldment, top chain | 1 | 53 | 54616 | 90546164 | Spacer, round plastic | 2 |
| 4 | 38983 | 50389831 | Guard assembly, front chain | 1 | 54 | 54151 | 90541510 | Knob, plastic w/set screw | 2 |
| 4A | 38236 | 50382365 | Guard, front | 1 | 55 | 54335 | 90543351 | Screw, flng 1/4 x .37 thd | 2 |
| 4B | 38244 | 50382446 | Retainer | 1 | 57 | 01648 | 50016482 | Switch, pendant | 1 |
| 4C | 50160 | 90501608 | Rivet, 3/16" pop | 2 | 57A | 01305 | 50013050 | Board, circuit..... | 1 |
| 5 | 38232 | 50382322 | Guard weldment, motor | 1 | 57B | 33476 | 50334760 | Cover..... | 1 |
| 6 | 01607 | 50016075 | Guard, bottom | 1 | 57C | 33472 | 50334727 | Housing, lower..... | 1 |
| 7 | 38199 | 50381997 | Sppt wldt, 1/2" to 1-1/4" RLR..... | 1 | 57D | 38649 | 50386492 | Switch, membrane | 1 |
| 8 | 38250 | 50382500 | Drive unit..... | 1 | 57E | | | Screw #4-20 | 3 |
| 9 | 01702 | 50017020 | Spindle weldment, main | 1 | 57F | | | Screw #6-32 | 3 |
| 10 | 38193 | 50381938 | Plate weldment, drive | 1 | 57G | 01666 | 50016660 | Cord, pendant..... | 1 |
| 11 | 54253 | 90542533 | Sprocket, #60 14T | 1 | 58 | 35012 | 50350129 | Screw, #4 x 1/2" flat head or | |
| 12 | | | Key, drive sprocket | 1 | | 06683 | 50066838 | rivet, pop 3/32 | 2 |
| 13 | 54255 | 90542550 | Bearing, sleeve #48DU40 | 2 | 59 | 51751 | 90517512 | Screw, drive | 4 |
| 14 | 54250 | 90542509 | Chain, #60 92P..... | 1 | 60 | 38868 | 50388681 | Nameplate..... | 1 |
| 15 | | | Ring, rtng Truarc #5100-200 | 4 | 71 | 38221 | 50382217 | Support weldment, roller | 1 |
| 16 | 38265 | 50382659 | Washer, main spindle..... | 2 | 72 | 00528 | 50005286 | Support weldment, 1-1/2" | 1 |
| 17 | 38268 | 50382683 | Key, shoe drive | 1 | 73 | 00601 | 50006010 | Support weldment, 2"..... | 1 |
| 18 | 38457 | 50384570 | Plate, hoist | 2 | 74 | 38225 | 50382250 | Arm weldment, adjustment..... | 1 |
| 19 | 55204 | 90552040 | Pin, 1/2" to 1-1/4" sprt pvt..... | 1 | 75 | 00543 | 50005430 | Plate, 1-1/2" outer roller..... | 1 |
| 20 | 38257 | 50382578 | Spacer, motor mount | 1 | 76 | 00604 | 50006045 | Plate, 2" outer roller | 1 |
| 20A | 39488 | 50394886 | Spacer, thin motor mount | 1 | 77 | 38254 | 50382543 | Rol, 1-1/2 | 2 |
| 21 | 38228 | 50382284 | Locator weldment, eccentric..... | 1 | 78 | 38264 | 50382640 | Ball, 1-1/2 | 2 |
| 22 | | | Nut, 1/2-13 lock | 1 | 79 | 38255 | 50382551 | Rol, 2..... | 2 |
| 23 | | | Screw, #10-16 x .50 hex head | 31 | 80 | 38263 | 50382632 | Ball, 2..... | 2 |
| 25 | | | Screw, cap 1/2-13 x 1.00 | 4 | 81 | 38262 | 50382624 | Spacer, 2 roller | 1 |
| 26 | | | Ring, rtng Truarc #5100-287 | 2 | 82 | 00599 | 50005995 | Roller unit, 2" | 1 |
| 27 | | | Screw, set 1/2"-20 x .75 socket | 1 | 83 | 00493 | 50004930 | Shaft, 2" rear roller..... | 1 |
| 28 | 54251 | 90542517 | Link, connecting #60 chain..... | 1 | 84 | 38252 | 50382527 | Roller, 1-1/2 I.M.C..... | 1 |
| 29 | | | Screw, #6-32 x 1.00 sltd mach..... | 4 | 85 | 38253 | 50382535 | Roller, 2 tail | 1 |
| 30 | 38246 | 50382462 | Bracket, limit switch | 1 | 86 | 38260 | 50382608 | Shaft, 1-1/2 pivot roller..... | 1 |
| 31 | 38248 | 50382489 | Back-plate, switch..... | 3 | 87 | 32027 | 50320270 | Sleeve, 1-1/2..... | 1 |
| 32 | | | Screw, 5/16-18 x 1.25 skt. cap..... | 2 | 88 | 31728 | 50317288 | Shaft, 2 pivot..... | 1 |
| 33 | 52597 | 90525973 | Washer, flat .56 x 1.37 x .109..... | 4 | 89 | 38151 | 50381512 | Sleeve, 2 | 1 |
| 34 | 85822 | 91858224 | Switch, limit #BZ-2RW822-A2 | 4 | 90 | 23258 | 50232584 | Grip | 1 |
| 35 | | | Nut, hex 5/16-18 reg jam | 2 | 91 | 38256 | 50382560 | Shaft, eccentric | 1 |
| 36 | 01708 | 50017080 | Receptacle unit, pendant | 1 | 92 | 38251 | 50382519 | Sleeve, adaptor..... | 1 |
| 37 | 54124 | 90541243 | Strain relief..... | 1 | 93 | | | Screw, 7/16-14 x 1.00 hex hd | 3 |
| 43 | 38780 | 50387804 | Shoe unit, 1/2" to 1-1/4" | 1 | 94 | 00860 | 50008609 | Shaft, 1-1/2" support | 1 |
| 44 | 38148 | 50381482 | Shoe unit, 1-1/2" to 2" | 1 | 95 | 54819 | 90548191 | Ring, retaining #5100-87..... | 2 |
| 45 | 52203 | 90522036 | Screw, mach #6-32 x .25 | 2 | 96 | | | Screw, cap 1/4-20 x .37 btn hd | 3 |
| 46 | 29708 | 50297082 | Guard, breaker switch | 1 | 97 | | | Screw, 5/16-18 x 1.00 skt hd | 1 |
| 47 | 86385 | 91863856 | Breaker, circuit 20 amp | 1 | 98 | | | Screw, 1/4-28 x .25 set..... | 2 |
| 48 | 54619 | 90546199 | Screw, cap #4-40 x .62 skt..... | 2 | 99 | 53018 | 90539184 | Washer, 1.00 x 1.37 x .03 shim | 1 |
| 49 | 38646 | 50386468 | Encoder unit, optical | 1 | 100 | 54248 | 90542487 | Washer, Belleville 1.362 x .803..... | 2 |
| 50 | 50572 | 90505727 | Screw, cap #8-32 x .50 skt..... | 4 | 101 | 39440 | 50394401 | Washer, .62 x 2.00 x .06 flat..... | 1 |
| 51 | 86646 | 91866464 | Brake, motor | 1 | 104 | 54243 | 90542436 | Spring, extension .75 x 3.50 | 2 |

Main Parts List (cont'd)

| Key | UPC No. 78-3310- | Part No. | Description | Qty | Key | UPC No. 78-3310- | Part No. | Description | Qty |
|-----|---------------------|----------|---|-----|---|---------------------|----------|--|-----|
| 105 | 54252 | 90542525 | Clamp, loop-type | 1 | Decals (not shown) | | | | |
| 106 | | | Nut, hex 1/4-20 | 1 | | | | Decal, lifting eye | 2 |
| 107 | 54239 | 90542398 | Screw, 1/4-20 x 3/4 ovl pt set | 1 | | | | Decal, deluxe pendant instr. | 1 |
| 108 | 39851 | 50398512 | Cam, retention | 1 | | | | Decal, Slct switch size | 1 |
| 109 | 38463 | 50384635 | Shaft, cam retention | 1 | | | | Decal, Slct switch type | 1 |
| 111 | 38544 | 50385445 | Plate, cam retention | 1 | | | | Decal, bender pivot lock | 1 |
| 112 | 38566 | 50385666 | Spring, cam retention | 1 | | | | Decal, roller adjustment | 1 |
| 113 | | | Screw, 1/4-20 x 1-3/8 skt cap | 1 | | | | Decal, roller engagement | 1 |
| 114 | 50458 | 90504585 | Rollpin, 1/8 x .375 | 1 | | | | Decal, operation | 3 |
| 115 | 38592 | 50385925 | Guide, spring | 1 | | | | Decal, circuit breaker | 1 |
| 116 | 51130 | 90511301 | O-ring, 1.50 x 1.62 x .062 | 2 | | | | Decal, shoe orientation | 2 |
| 117 | 51537 | 90515374 | O-ring, 1.75 x 1.87 x .062 | 2 | | | | Decal, warning | 1 |
| 118 | 38657 | 50386573 | Shaft, 2 middle roller | 1 | | | | Decal, warning | 2 |
| 119 | 52644 | 90526449 | Washer, 1/32 shim | 1 | Optional | | | | |
| 150 | 52645 | 90526457 | Washer, 1/16 shim | 1 | 01711 | | 50017110 | Deluxe pendant control | |
| 151 | 53216 | 90532163 | Ring, retaining | 1 | 38962 | | 50389629 | Vinyl cover (not shown) | |
| 170 | 86263 | 91862639 | Nut, 1/2" conduit lock | 1 | 01700 | | 50017004 | 1/2" to 2" PVC shoe group | |
| 176 | | | Screw, 1/4-28 x 3/8" socket head cap | 2 | Service Only | | | | |
| 177 | | | Screw, #6-32 x 1.25 socket head | 2 | | | | Cam repair kit | 1 |
| 178 | 54355 | 90543556 | Washer, #6 | 6 |  | | 50079395 | Stripping, magnetic - replacement | 1 |
| 179 | 07912 | 50079123 | Power cord | 1 | | | 52020832 | Service kit (includes base and LH & RH trunnions) | 1 |
| 201 | | 52031175 | Base assembly | 1 | | | 52033403 | Decal kit (includes all decals listed above) | 1 |
| 204 | 53390 | 90533909 | Wheel | 2 | 250 | | 52057867 | Axle kit (includes one short axle and two #5160-75 retaining rings) | 1 |
| 209 | 38167 | 50381679 | Pin, trunnion lock | 1 | 251 | | 52057868 | Caster kit (includes one caster with side lock, four 3/8-16 screws, and four locknuts) | 1 |
| 211 | 54244 | 90542444 | Spring, trunnion lock | 1 | 252 | | 52057869 | L.H. trunnion kit | 1 |
| 212 | 38168 | 50381687 | Knob | 1 | 253 | | 52057870 | R.H. trunnion kit | 1 |
| 221 | 31710 | 50317105 | 1/2" to 1-1/4" IMC, Rigid hook | 1 | 254 | | 52057871 | | |
| 223 | 31712 | 50317121 | 1/2" to 1-1/4" EMT hook | 1 | | | | | |
| 224 | | | Drive bolt, 1/2-13 x .62 socket head cap screw | 6 | | | | | |
| 225 | | | 1/2" to 1-1/4" Hook bolts, 3/8-16 x 1-1/4 socket head cap screw | 8 | | | | | |
| 226 | 53396 | 90533968 | 1-1/2, 2" Hook shoulder bolts, 3/4 x 1-1/2 | 6 | | | | | |
| 228 | 31716 | 50317164 | 1-1/2, 2" EMT hook | 1 | | | | | |
| 229 | 38779 | 50387790 | 1-1/2, 2" IMC & Rigid hook | 1 | | | | | |
| 231 | 10299 | 50102990 | Selector switch unit w/o knobs | 1 | | | | | |

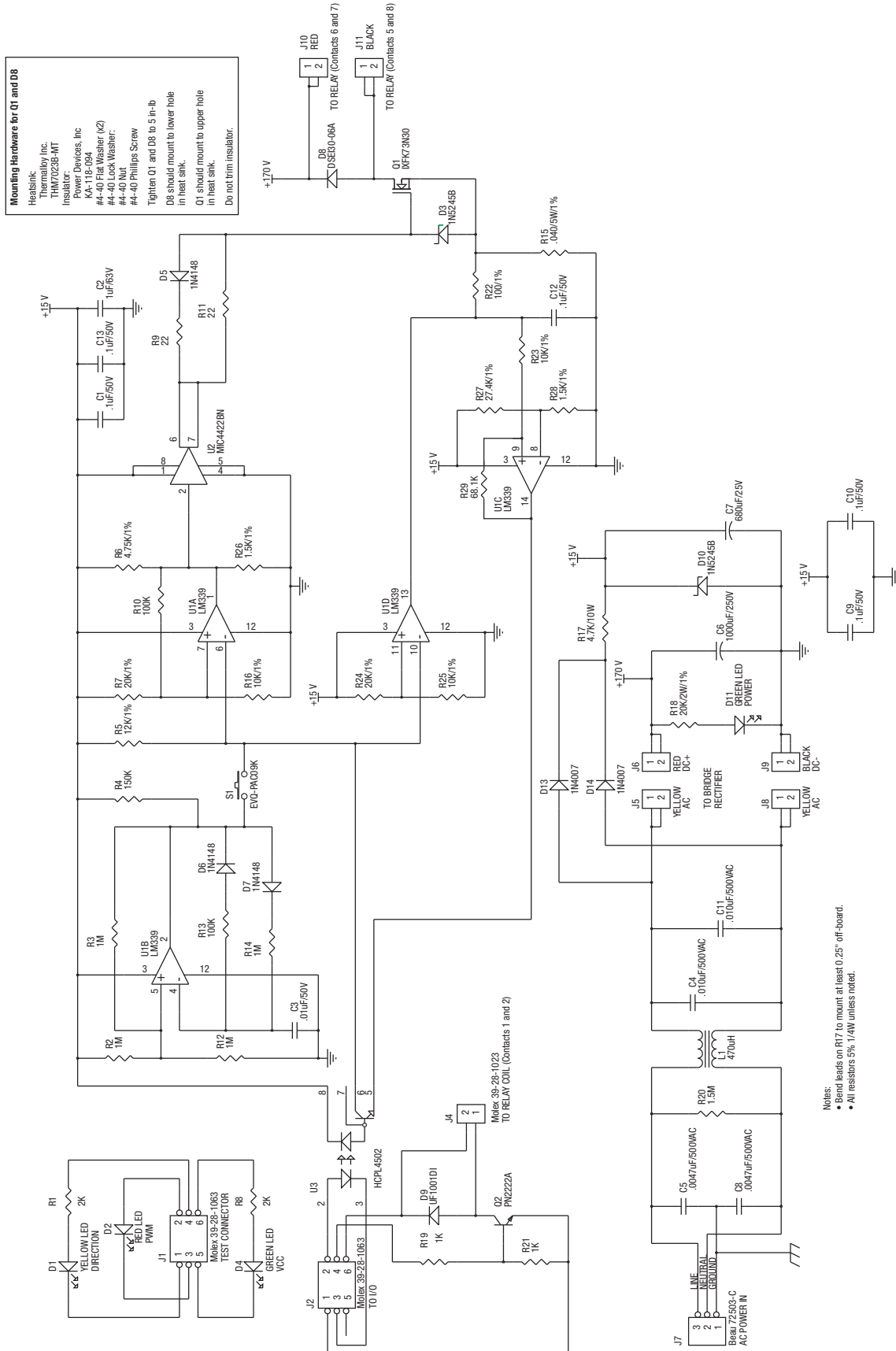
Electrical Control System Layout and Parts List



| Key | Part No. | Description |
|-----|----------|---------------------------------|
| 1 | 50389416 | PGU Power Wire |
| 2 | 50382500 | Motor |
| 3 | 50079123 | Power Cord |
| 4 | 50017080 | Receptacle Unit |
| 5 | 50386360 | Limit Switch Wire Unit |
| 6 | 50386379 | Brake Wire Unit |
| 7 | 50102354 | Unload Lockout Switch Wire Unit |
| 8 | 50060473 | Relay Wire Unit |
| 9 | 50060481 | Red Relay Wire |
| 10 | 50060490 | Black Relay Wire |
| 11 | 50060341 | Red Relay-PGU Wire |
| 12 | 50060350 | Black Relay-PGU Wire |
| 13 | 50386484 | I/O-PGU Wire Unit |
| 14 | 91858224 | Limit Switch |
| 15 | 50060309 | Input/Output Control Unit |
| 16 | | Directional Test Toggle Switch |

| Key | Part No. | Description |
|-----|----------|-----------------------------------|
| 17 | | Test Pushbutton Switch |
| 18 | 50060503 | Yellow Rectifier Wires |
| 19 | 50060384 | Red Rectifier Wire |
| 20 | 50060422 | Black Rectifier Wire |
| 21 | 50060368 | Wire Unit, Power AC |
| 22 | 50081519 | Selector Switch Unit w/o knobs |
| 23 | 50386468 | Optical Encoder |
| 24 | 50054678 | Power Generation Board Assembly |
| 25 | 50060376 | Wire Unit, Power DC |
| 26 | | Test Terminal (Troubleshooting) |
| 27 | 90543297 | Screw, #8-18 x 3/8 Ground |
| 28 | 50060406 | Wire Unit, Ground |
| 29 | | Test Terminal (Troubleshooting) |
| 30 | | Test Pushbutton (Troubleshooting) |
| 31 | 90516559 | Screw, #10-16 x .5 Hex |
| 32 | 91863856 | Circuit Breaker, 20 A |
| 33 | 91859972 | Rectifier, 600 V, 35 A |

Power Generation Unit (50054678) Schematic Diagram



Power Generation Unit (50054678) Parts List

| Reference | Supplier | Part Number | Description | Qty |
|---------------------|--------------------------------------|---|--|-----|
| C1,C9,C10,C12,C13 | Philips AVX KEMET | A104K29X7RFVWWN SA115C104KAA C420C104K5R5CA | Capacitor, 0.1 uF, 50 volts | 5 |
| C2 | WIMA | MKS21.06310 | Capacitor, film, 1 uF, 63 volts | 1 |
| C3 | Philips AVX | A103M15Z5UFVWWA SA105E103ZAA | Capacitor, .01 uF, 50 volts | 1 |
| C4,C11 | Sprague | 440LS10 | Capacitor, .010 uF, 500 volts AC | 2 |
| C5,C8 | Sprague | 440LD47 | Capacitor, .0047 uF, 500 volts AC | 2 |
| C6 | Panasonic Cornell Dubilier | ECE-S2EU102Z 380LX102M250K052 | Capacitor, 1000 uF, 250 volts | 1 |
| C7 | Panasonic | EEU-FC1E681 | Capacitor, 680 uF, 25 volts | 1 |
| D1 | Panasonic Liteon | LN48YP LTL-4251 | LED, T1, amber | 1 |
| D2 | Panasonic Liteon | LN28RP LTL-4221 | LED, T1, red | 1 |
| D3,D10 | Motorola | 1N5245B | Zener diode, 15 volts, 500 milliwatts | 2 |
| D4,D11 | Panasonic Liteon | LN38GP LTL-4231 | LED, T1, green | 2 |
| D5,D6,D7 | Generic | 1N4148 | Diode | 3 |
| D8 | IXYS Adv Pwr Tech Adv Pwr Tech | DSEI 30-06A APT30D40B APT30D60B | Diode, fast recovery, 30A, 400-600V, TO-247 (see Note 1) | 1 |
| D9 | Vishay | UF1001DI | Diode, ultra-fast switching, 1A, 50V, 50ns, DO-41 | 1 |
| D13,D14 | Generic | 1N4007 | Diode | 2 |
| J1,J2 | Molex | 39-29-0063 | Connector, Minifit Jr., 6-position, gold | 2 |
| J4 | Molex | 39-29-0023 | Connector, Minifit Jr., 2-position, gold | 1 |
| J5,J6,J8,J9,J10,J11 | Keystone | 1287 | Connector, tab, .250 x .032 | 6 |
| J7 | Beau Magnum | 72503-C A202203 | Connector, terminal block, 3-position, no mount holes | 1 |
| L1 | Renco | RL-1328-22-470 | Choke, common mode | 1 |
| Q1 | IXYS Adv Pwr Tech | IXFK73N30 APT30M40LVFR | MOSFET, N channel, 73-76A, 300V, TO-264 (see Note 2) | 1 |
| Q2 | Generic | PN2222A | Transistor, NPN | 1 |
| R1,R8 | Generic | | Resistor, 2 kΩ, 1/4 watt, 5% | 2 |
| R2,R3,R12,R14 | Generic | | Resistor, 1 MΩ, 1/4 watt, 5% | 4 |
| R4 | Generic | | Resistor, 150 kΩ, 1/4 watt, 5% | 1 |
| R5 | Generic | | Resistor, 12.1 kΩ, 1/4 watt, 1% | 1 |
| R6 | Generic | | Resistor, 4.75 kΩ, 1/4 watt, 1% | 1 |
| R7,R24 | Generic | | Resistor, 20 kΩ, 1/4 watt, 1% | 2 |
| R9,R11 | Generic | | Resistor, 22 Ω, 1/4 watt, 5% | 2 |
| R10,R13 | Generic | | Resistor, 100 kΩ, 1/4 watt, 5% | 2 |
| R15 | Dale KRL Riedon | LVR-5 .04W NP-5A .04W MT-5 .04W | Resistor, .040 Ω, 5 watt, 1% | 1 |
| R16,R23,R25 | Generic | | Resistor, 10 kΩ, 1/4 watt, 1% | 3 |
| R17 | Dale KRL Riedon | CW-10 4.7K C-10A 4.7K UT-10 4.7K | Resistor, 4.7 kΩ, 10 watt, 5% (see Note 3) | 1 |
| R18 | Dale KRL | RS-2B-20K C-2A 20K | Resistor, 20 kΩ, 2 watt, 1% | 1 |

Power Generation Unit (50054678) Parts List (cont'd)

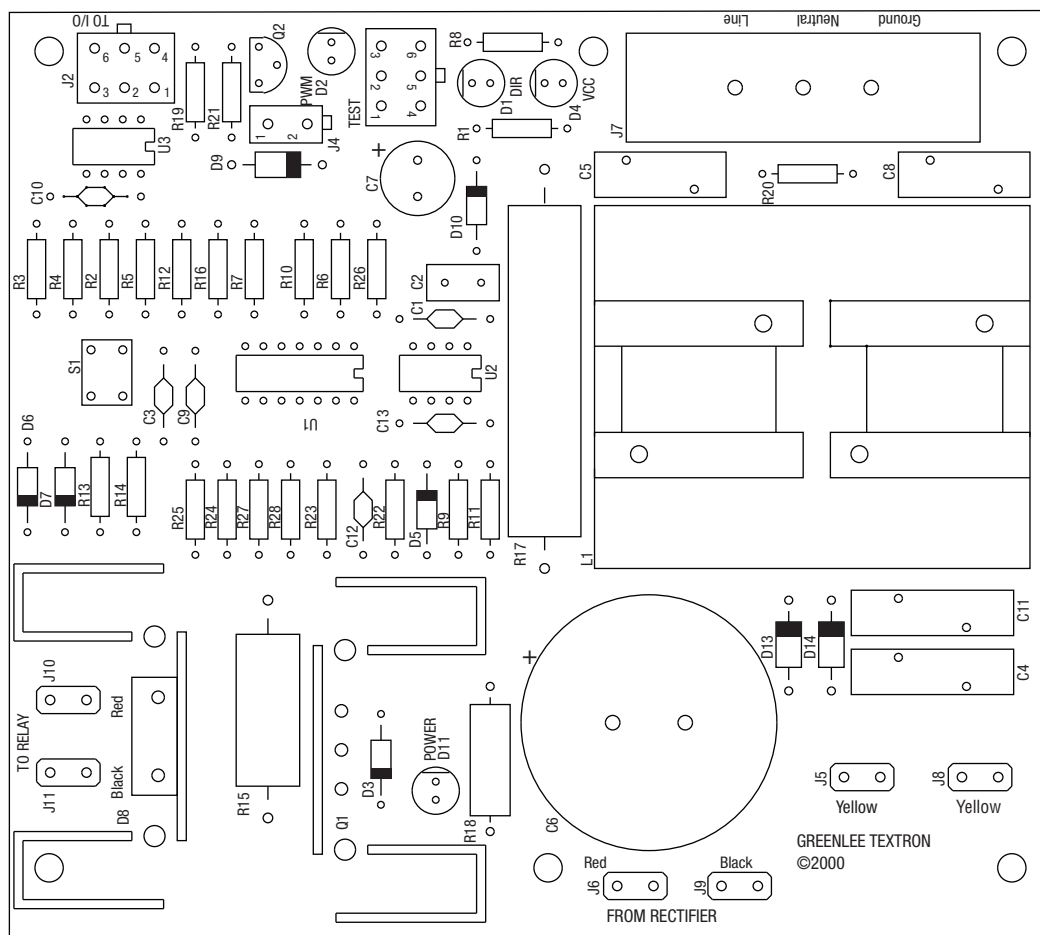
| Reference | Supplier | Part Number | Description | Qty. |
|-----------|--------------------------|-------------------------------|---|------|
| | Riedon | UT-2B 20K | | |
| R19,R21 | Generic | | Resistor, 1 kΩ, 1/4 watt, 5% | 2 |
| R20 | Generic | | Resistor, 1.5 MΩ, 1/4 watt, 5% | 1 |
| R22 | Generic | | Resistor, 100 Ω, 1/4 watt, 1% | 1 |
| R26,R28 | Generic | | Resistor, 1.5 kΩ, 1/4 watt, 1% | 2 |
| R27 | Generic | | Resistor, 27.4 kΩ, 1/4 watt, 1% | 1 |
| R29 | Generic | | Resistor, 68.1 kΩ, 1/4 watt, 1% | 1 |
| S1 | Panasonic | EVQ-PAC09K | Switch, momentary pushbutton | 1 |
| U1 | Motorola | LM339AN | IC, low power quad comparator | 1 |
| U2 | Micrel | MIC4422BN | IC, 9-A peak low-side non-inverting MOSFET driver | 1 |
| U3 | HP QT-Opto Siemens | HCPL4502 HCPL4502 6N136 | IC, opto-isolator | 1 |

Note 1: Mount D8 to bottom hole of heat sink.

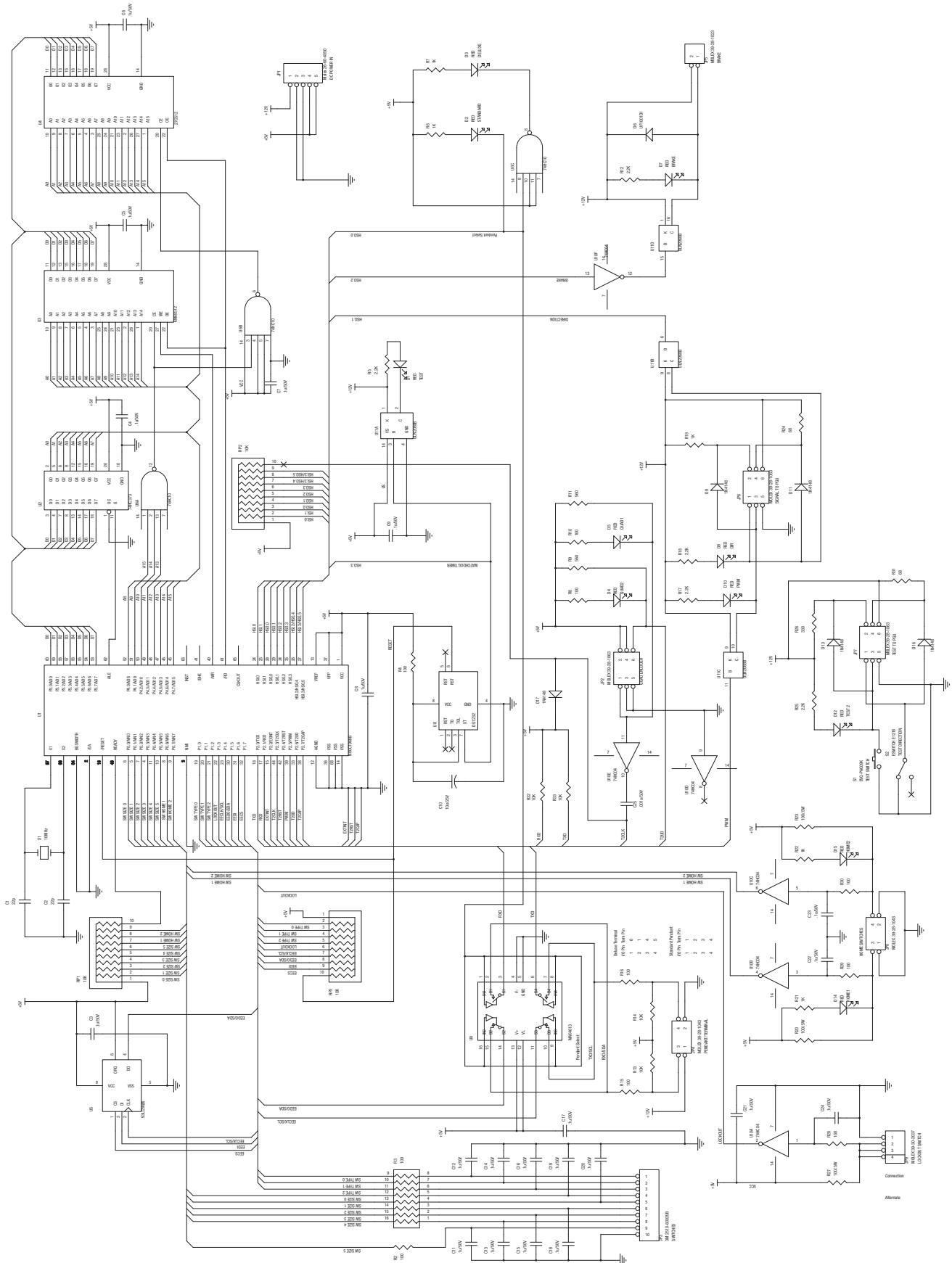
Note 2: Mount Q1 to top hole of heat sink.

Note 3: Bend leads and mount 0.25" off-board.

Power Generation Unit (50054678) Layout Diagram



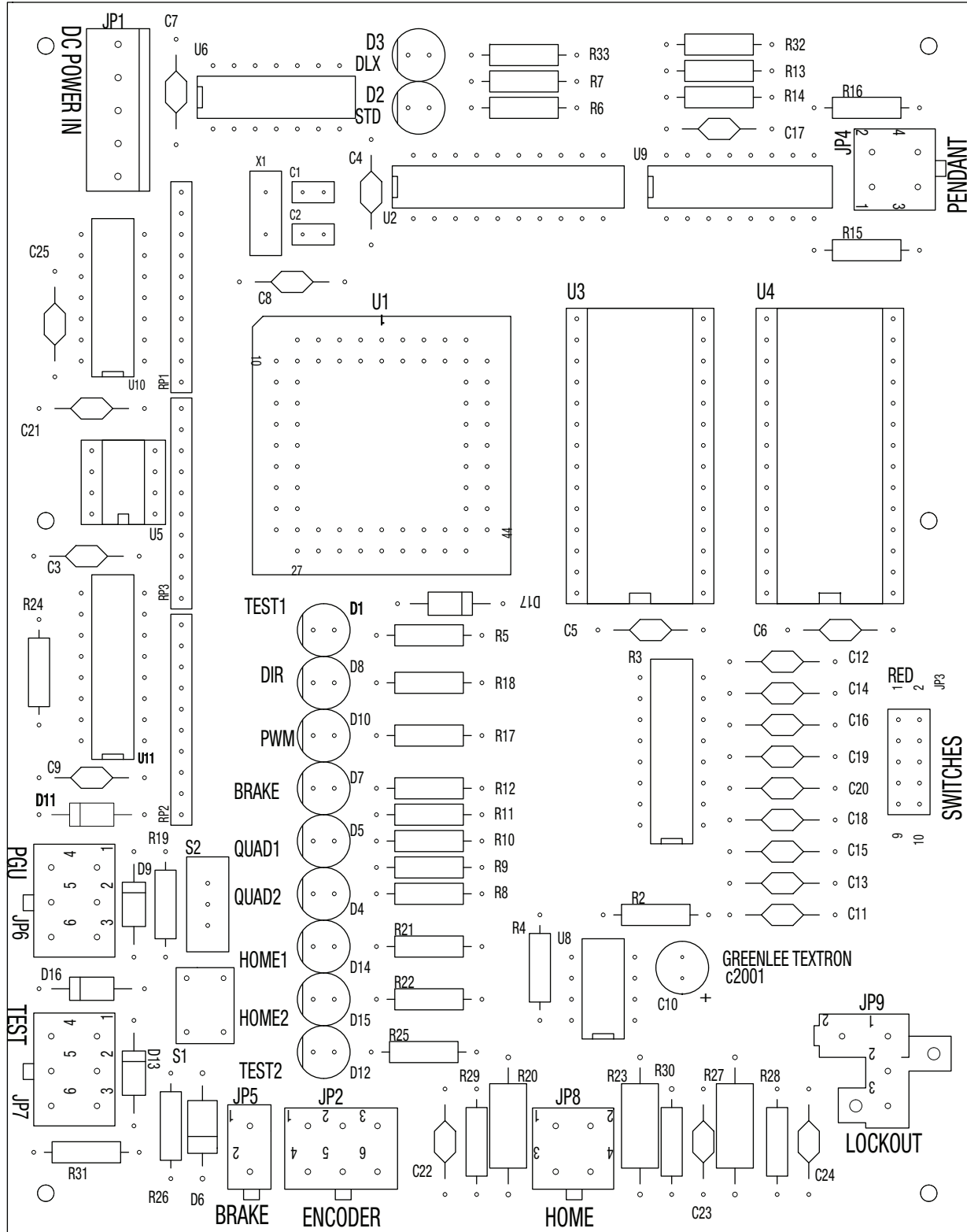
Input/Output Board (50060309) Schematic Diagram



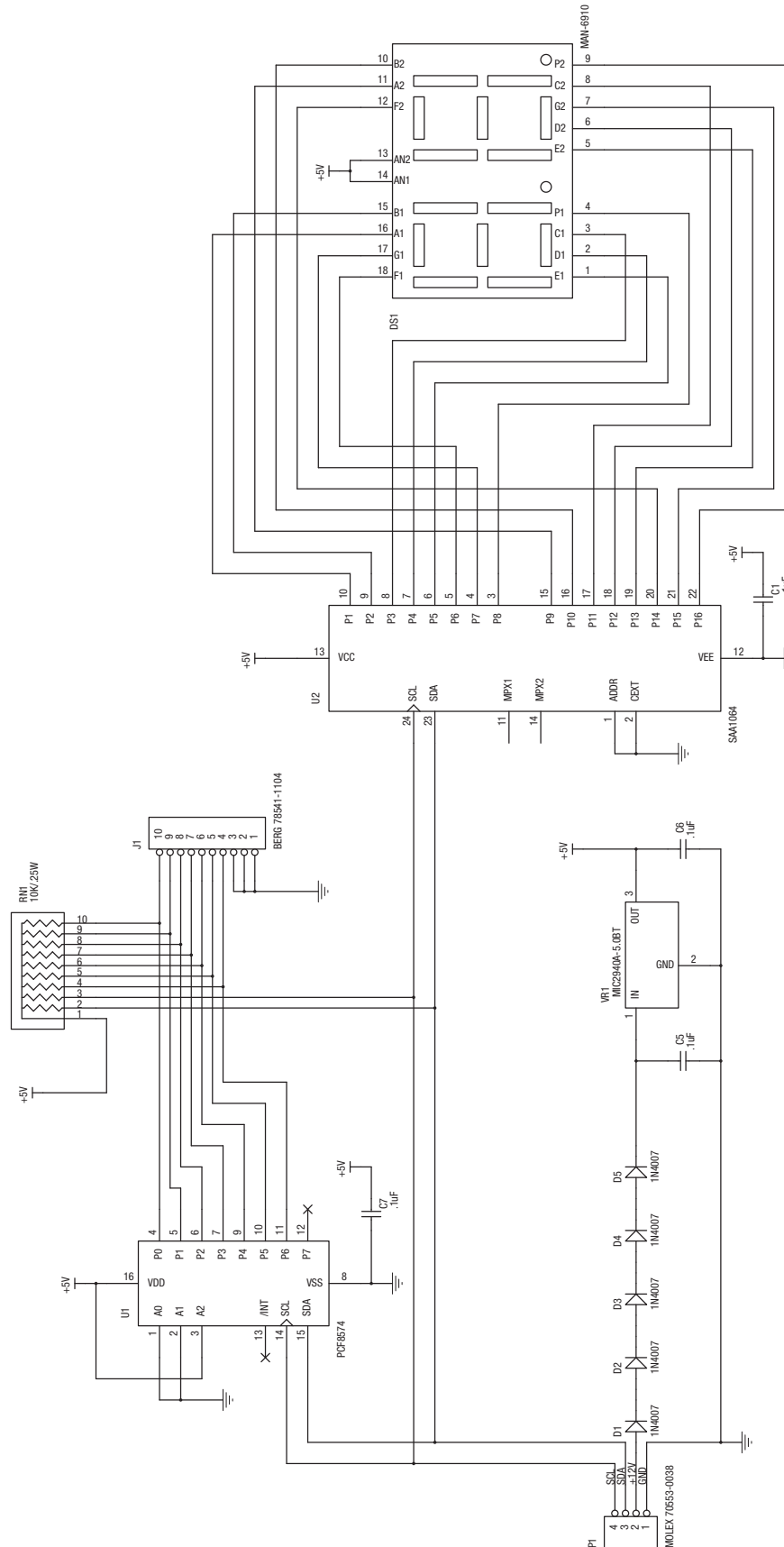
Input/Output Board (50060309) Parts List

| Reference | Supplier | Part Number | Description | Qty. |
|--|-------------------------|---|---|------|
| C1,C2 | Murata Murata | RPE110COG220J050V RPE110COG220J0100V | Capacitor, 22 pF, 50 volts | 2 |
| C3,C4,C5,C6,C7,C8,C9, C11,C12,C13,C14,C15, C16,C17,C18,C19,C20, C21,C22,C23,C24 | Philips AVX KEMET | A104K29X7RFVWWN SA115C104KAA C420C104K5R5CA | Capacitor, 0.1 uF, 50 volts | 21 |
| C10 | Nichicon | UVZ1E100MDH | Capacitor, 10 uF, 25 volts | 1 |
| C25 | Philips | A102K15X7RHVVWA | Capacitor, .001 uF, 100 volts | 1 |
| D1,D2,D3,D4,D5,D7,D8, D10,D12,D14,D15 | Panasonic Liteon | LN28RP LTL-4221 | LED, T1, red | 11 |
| D9,D11,D13,D16,D17 | Generic | 1N4148 | Diode | 5 |
| D6 | VISHAY | UF1001DI | Diode, ultra-fast switching, 1A, 50V, 50ns, DO-41 | 1 |
| JP1 | Molex | 26-60-4050 | Connector, locking, .156" center, 5-position | 1 |
| JP4,JP8 | Molex | 39-28-1043 | Connector, Minifit Jr., 4-position | 2 |
| JP2,JP6,JP7 | Molex | 39-28-1063 | Connector, Minifit Jr., 6-position | 3 |
| JP3 | 3M | 2510-6002UB | Connector, dual row, 10-position | 1 |
| JP5 | Molex | 39-28-1023 | Connector, Minifit Jr., 2-position | 1 |
| JP9 | Molex | 39-30-2037 | Connector, Minifit Jr., 3-position | 1 |
| RP1,RP2,RP3 | Bourns | 4610X-101-103 | Resistor pack, 10KWx8 with common, 1/4 watt, 5% | 3 |
| R13,R14,R32,R33 | Generic | | Resistor, 10K, 1/4 watt, 5% | 4 |
| R6,R7,R19,R21,R22 | Generic | | Resistor, 1K, 1/4 watt, 5% | 5 |
| R3 | Dale | MDP1603-101G | Resistor pack, 100Wx8, individual, 1/4 watt, 5% | 1 |
| R2,R4,R8,R10,R15,R16, R28,R29,R30 | Generic | | Resistor, 100, 1/4 watt, 5% | 9 |
| R5,R12,R17,R18,R25 | Generic | | Resistor, 2.2K, 1/4 watt, 5% | 5 |
| R11,R9 | Generic | | Resistor, 560, 1/4 watt, 5% | 2 |
| R26 | Generic | | Resistor, 330, 1/4 watt, 5% | 1 |
| R20,R23,R27 | Generic | | Resistor, 100, 1/2 watt, 5% | 3 |
| R31,R24 | Generic | | Resistor, 68, 1/4 watt, 5% | 2 |
| S1 | Panasonic | EVQ-PAC09K | Momentary pushbutton switch | 1 |
| S2 | Eswitch | EG1218 | Slide switch, SPDT | 1 |
| U1 | Intel | N80C196KB | Integrated circuit, microcontroller | 1 |
| U1 | AMP | 821689-1 | 68-pin socket, PLCC | 1 |
| U2 | Generic | 74HC373 | Integrated circuit, buffer | 1 |
| U3 | Samsung | KM62256DLP-7L | IC, SRAM, 32K x 8, 70ns, 28-pin x .6" DIP | 1 |
| U4 | Generic | 27C256 | IC, EPROM, 120 nsec, 28-pin x .6" DIP | 1 |
| U3,U4 | Robinson Nugent | ICO-286-S8A-T | 28-pin socket, dual wipe | 2 |
| U5 | Microchip Microchip | 93LC56 93LC56B | Integrated circuit, EEPROM, 128 x 16 bit | 1 |
| U5 | Robinson Nugent | ICO-083-S8A-T | 8-pin socket, dual wipe | 1 |
| U6 | Generic | 74HC10 | Integrated circuit, NAND | 1 |
| U8 | Dallas Dallas | DS1232 DS1232LP | Integrated circuit, timer/reset control | 1 |
| U9 | Maxim | MAX4613 | IC, analog switch, 16 pin x .3" DIP | 1 |
| U10 | Generic | 74HC04 | Integrated circuit, inverter | 1 |
| U11 | Generic | ULN2068B | Integrated circuit, buffer/driver | 1 |
| X1 | Fox | FOX 100-20, HC49U-10.000-MS | Crystal, 10MHz, HC49U case, mylar spacer | 1 |

Input/Output Board (50060309) Layout Diagram



Standard Pendant Switch (50013050) Schematic Diagram



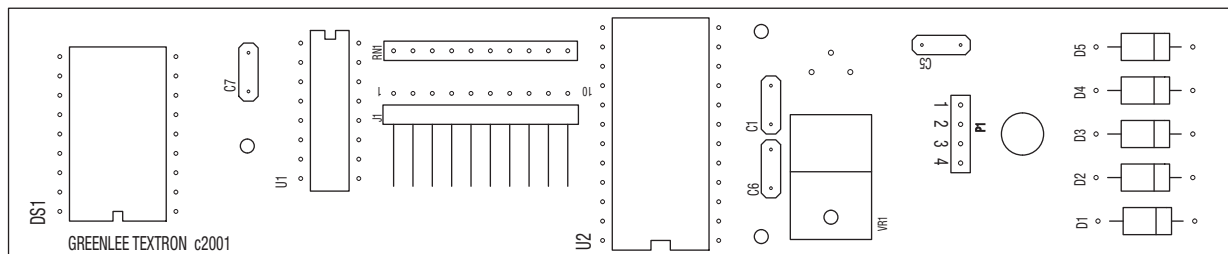
Standard Pendant Switch (50013050) Parts List

| Reference | Supplier | Part Number | Description | Qty. |
|-------------------|-------------------------------------|-----------------------------------|--|------|
| C1,C5,C6,C7 | Vishay or Equal | 1C20X7R104K050B or Equal | Capacitor, ceramic, .1 uF, 50 volts (minimum), radial, .2 cc, X7R | 4 |
| D1,D2,D3,D4,D5,D6 | Generic | 1N400x (x=1 to 7) | Diode | 5 |
| DS1 | QT Opto Agilent Tech or Equal | MAN-6910 HDSP-5521 or Equal | LED display, common anode, 2 digit x .56, 7 seg + dec, 18-lead .6" DIL | 1 |
| J1 | BERG or Equal | 78541-110H or Equal | Connector, .100" cc x .318 mating, 10-position, right angle, single row, 30 micro-in gold over 50 micro-in nickel | 1 |
| P1 | MOLEX | 70553-0038 | Connector, locking, "SL" series, .100" cc, 4-position | 1 |
| RN1 | Generic | | Resistor pack, 10KWx10 with common, 1/4 watt, 5% | 1 |
| U1 | Philips | PCF8574P | Integrated circuit, I2C, 8-bit I/O expander, 16-lead .3" DIL | 1 |
| U2 | Philips | SAA1064 | Integrated circuit, I2C, LED display driver, 24-lead .6" DIL | 1 |
| VR1 | Micrel | MIC2940A-5.0BT | Voltage regulator, fixed 5V, low dropout | 1 |

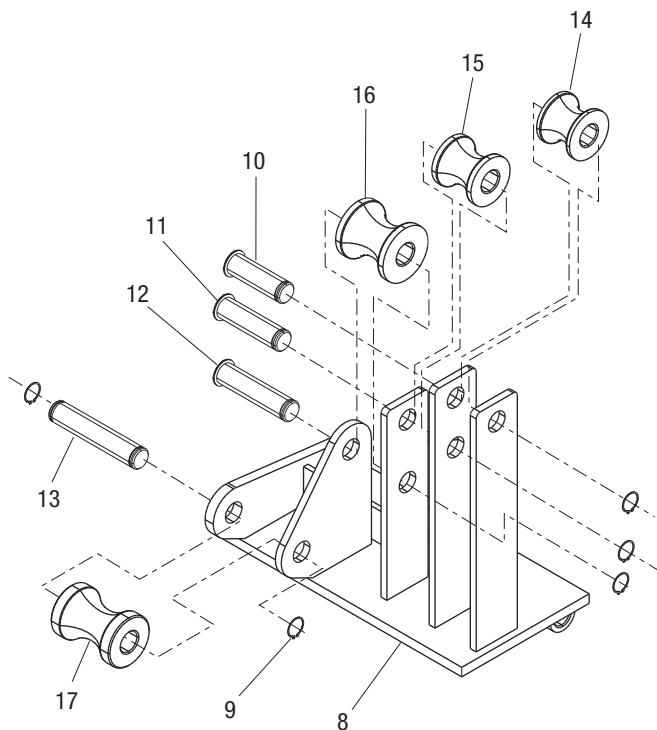
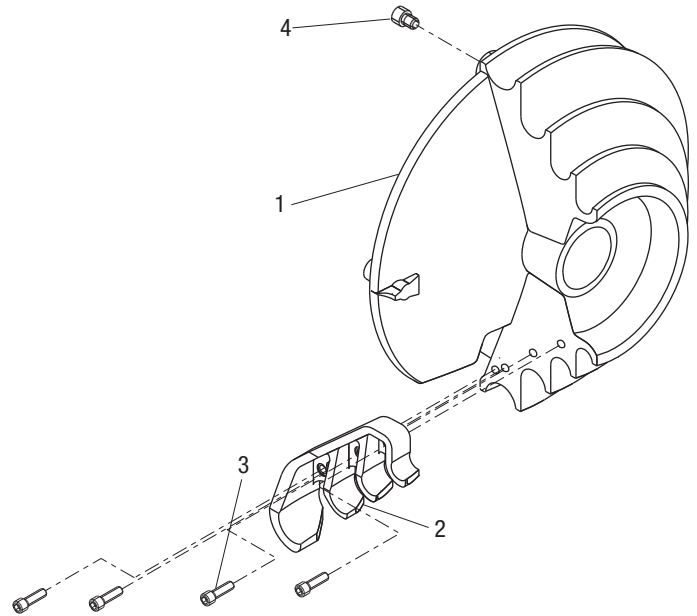
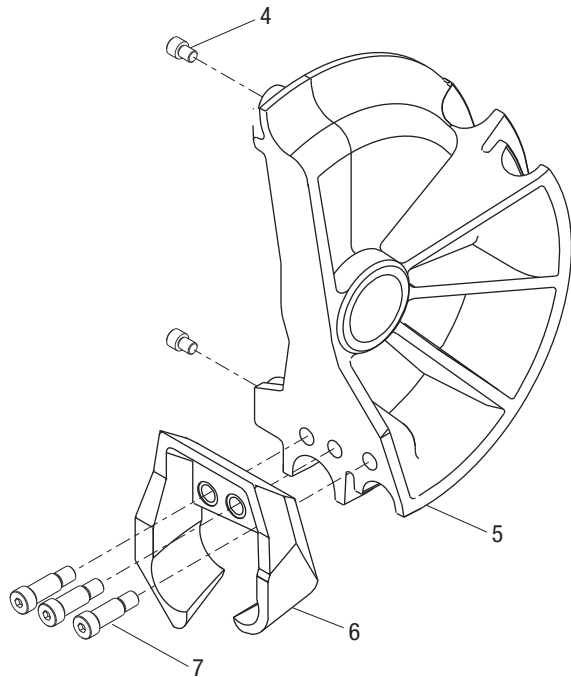
Mounting Hardware for VR1

| | | | |
|---------|----------------------|---|---|
| Generic | #4-40 Hex Nut | ZN steel or stainless, nylon insert, 1/4 x 9/64 | 1 |
| Generic | #4-40 Phillips Screw | ZN steel or stainless, machine, pan head, #4-40 x 0.25" | 1 |

Standard Pendant Switch (50013050) Layout Diagram



Optional Bending Attachments for 1/2" to 2" 40 Mil PVC-coated Rigid (50017004) Exploded View and Parts List



| Key | UPC No. 78-3310- | Part No. | Description | Qty |
|-----|------------------|----------|--|-----|
| | 00572 | 50005723 | Shoe unit, 1/2" to 1-1/4" PVC-coated Rigid (includes items 1-4)..... | 1 |
| | 31919 | 50319191 | Shoe unit, 1-1/2" to 2" PVC-coated Rigid (includes items 4-7)..... | 1 |
| | 00934 | 50009346 | Support unit, 1/2" to 1-1/4" PVC-coated Rigid (includes items 8-17)..... | 1 |
| 1 | 00567 | 50005677 | 1/2" to 1-1/4" PVC-coated Rigid shoe..... | 1 |
| 2 | 00570 | 50005707 | 1/2" to 1-1/4" PVC-coated Rigid hook..... | 1 |
| 3 | 51088 | 90510887 | 3/8-16 x 1-1/4" Socket head cap screw..... | 4 |
| 4 | 52479 | 90524799 | 1/2-13 x 5/8" Socket head cap screw..... | 5 |
| 5 | 31918 | 50319183 | 1-1/2" to 2" PVC-coated Rigid shoe..... | 1 |
| 6 | 31916 | 50319167 | 1-1/2" to 2" PVC-coated Rigid hook..... | 1 |
| 7 | 53396 | 90533968 | 3/4" x 1-1/2" Shoulder screw..... | 3 |
| 8 | 00933 | 50009338 | Support weldment, PVC-coated Rigid roller..... | 1 |
| 9 | 51353 | 90513533 | Retaining ring..... | 5 |
| 10 | 00923 | 50009230 | 1/2" Roller axle..... | 1 |
| 11 | 00924 | 50009249 | 3/4" Roller axle..... | 1 |
| 12 | 00925 | 50009257 | 1" Roller axle..... | 1 |
| 13 | 00926 | 50009265 | 1-1/4" Roller axle..... | 1 |
| 14 | 00927 | 50009273 | 1/2" Roller..... | 1 |
| 15 | 00928 | 50009281 | 3/4" Roller..... | 1 |
| 16 | 00929 | 50009290 | 1" Roller..... | 1 |
| 17 | 00930 | 50009303 | 1-1/4" Roller..... | 1 |
| 18 | 54910 | 90549104 | Retaining ring pliers (not shown)..... | 1 |
| 19 | 23818 | 50238183 | Metal storage box (not shown)..... | 1 |

Troubleshooting

| Problem | Probable Cause | Probable Remedy |
|---|---|--|
| Bender does not operate. | No voltage. | Check supply voltage circuit operation. Check that switch is on. Check that pendant is fully plugged in. |
| Bender operates, but display is blank. | Insufficient voltage. | Use shorter or larger gauge extension cord. Check supply voltage (80 VAC minimum). |
| | Pendant was plugged in while bender was on. | Turn bender switch off and on. |
| Display comes on, but bender does not bend. | Bender was advanced 93 degrees. | UNLOAD to desired position. |
| Display comes on, but does not count during bend. | Bender turned on while conduit was fully loaded. | Remove conduit and initialize home position per "Setting the Home Position" under "Operation" in the instruction manual. |
| Bender operates in wrong direction. | Wrong conduit size and/or type selected. | Set selector switches properly. |
| Bends are overbent a few degrees. | Wrong conduit size and/or type selected. | Set selector switches properly. |
| | Too much squeeze on 1-1/2" or 2" EMT, IMC, or rigid aluminum conduit. | Back squeeze off per adjustment instructions. |
| | Unusual conduit characteristics. | Refer to "Accuracy" in the "Adjustments" section or bend to a smaller angle to compensate. |
| Bends are underbent a few degrees. | Wrong conduit size and/or type selected. | Set selector switches properly. |
| | Too little squeeze on 1-1/2" or 2" EMT, IMC, or rigid aluminum conduit. | Increase squeeze per adjustment instructions. |
| | Unusual conduit characteristics. | Refer to "Accuracy" in the "Adjustments" section or bend to a larger angle to compensate. |

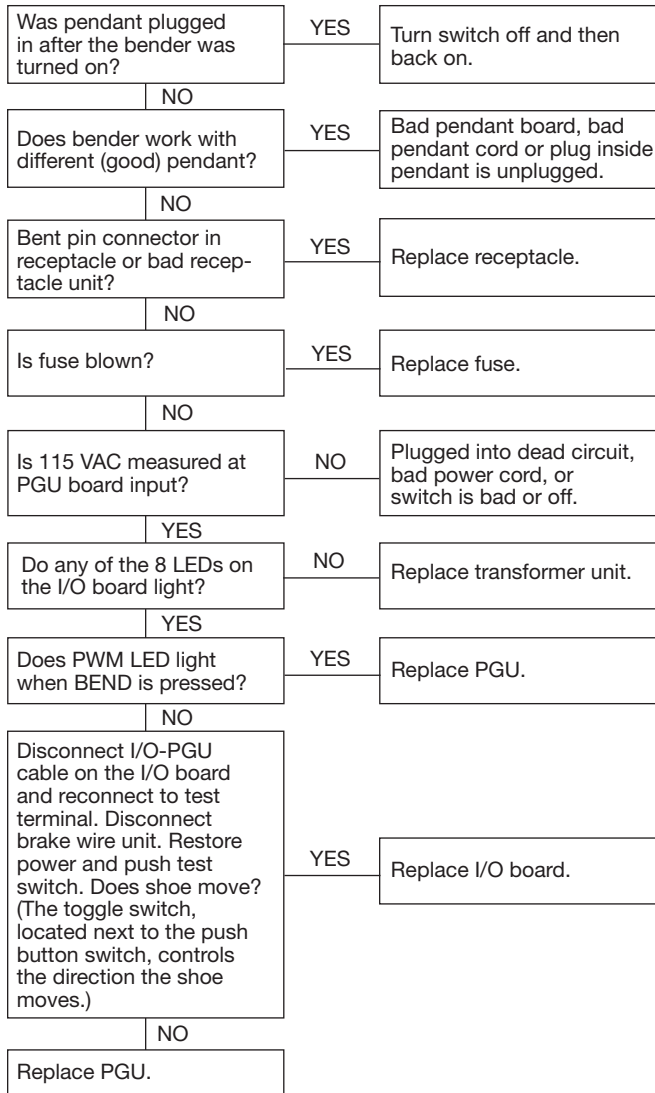
Troubleshooting (cont'd)

| Problem | Probable Cause | Probable Remedy |
|--|--|---|
| UNLOAD key does not work. | Roller support is not all the way down. | Release the roller support. |
| | Unloaded to the starting position. | Release and press UNLOAD again. |
| Locking cam does not engage. | Too much squeeze on 1-1/2" or 2" EMT, IMC, or rigid aluminum conduit. | Back squeeze off per adjustment instructions. |
| | Shoe rotated too far in unload direction. | Rotate shoe with BEND key until locking cam engages. |
| Bend key does not work for 1/2" to 1-1/4" conduit. | Roller support is not all the way down. | Release the roller support. |
| Message "E6" or "CONDUIT SUPPORT UP" appears. | Power was turned off while bending 1-1/2" or 2" EMT, IMC, or rigid aluminum conduit. | Press UNLOAD . Bending shoe will slowly unload until roller support retracts. |
| | Roller support lockout switch or wire harness is bad or poorly adjusted. | Adjust switch. Check for pinched wires and shorts to frame. |
| | Roller support is locked or jammed. | Twist roller support handle counterclockwise. |
| Deluxe pendant displays: "BENDER CANNOT MAKE BENDS THAT CLOSE." | Due to the geometry of the bend, the shoe hook would end up interfering with the first bend while making the second. | Follow the suggestions on the display to adjust the HEIGHT, ANGLE, or STRAIGHT section value. |
| Deluxe pendant displays: "LENGTH IS TOO SHORT" or "HEIGHT IS TOO SHORT." | The first mark must be at least one pipe diameter away from the end of the conduit to prevent damage to the conduit. | Follow the suggestions on the display to adjust the LENGTH or HEIGHT value. |

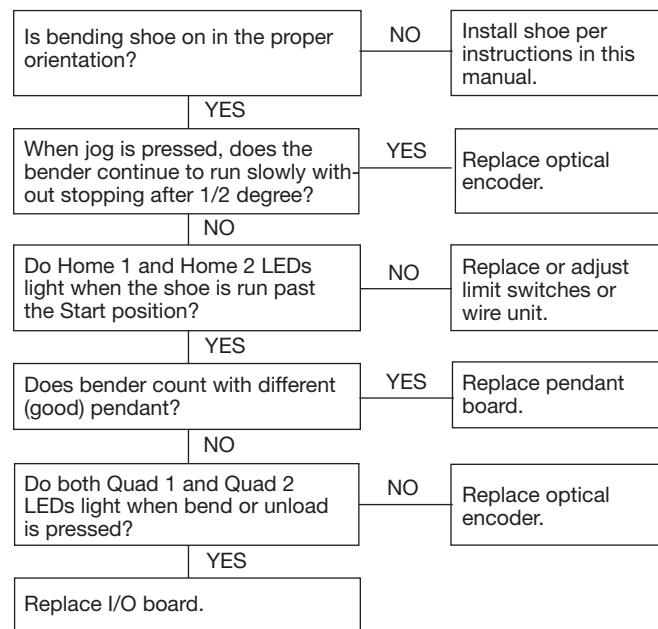
Troubleshooting (cont'd)

The following flow charts show some of the most likely areas to look at for certain problems. They by no means encompass all the possible problems or the only possible solutions.

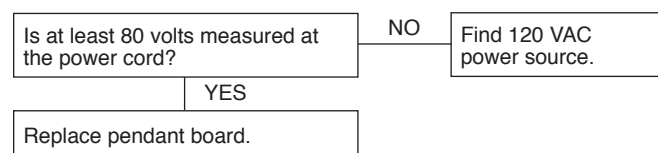
Won't bend – display blank



Will bend – won't count

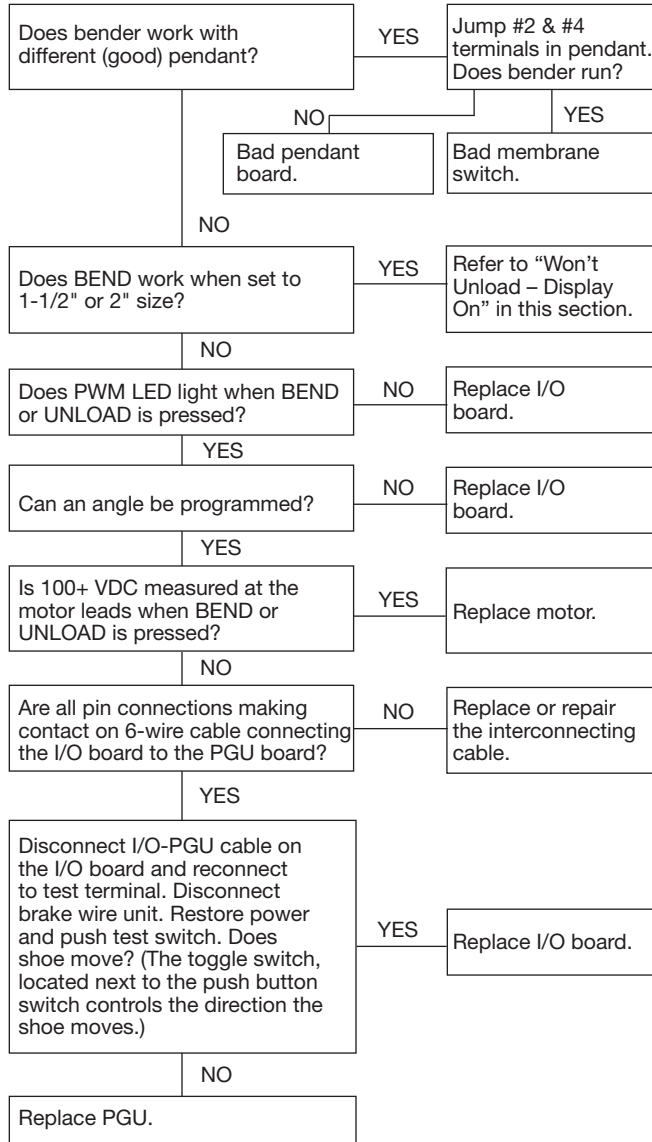


Will bend – display blank

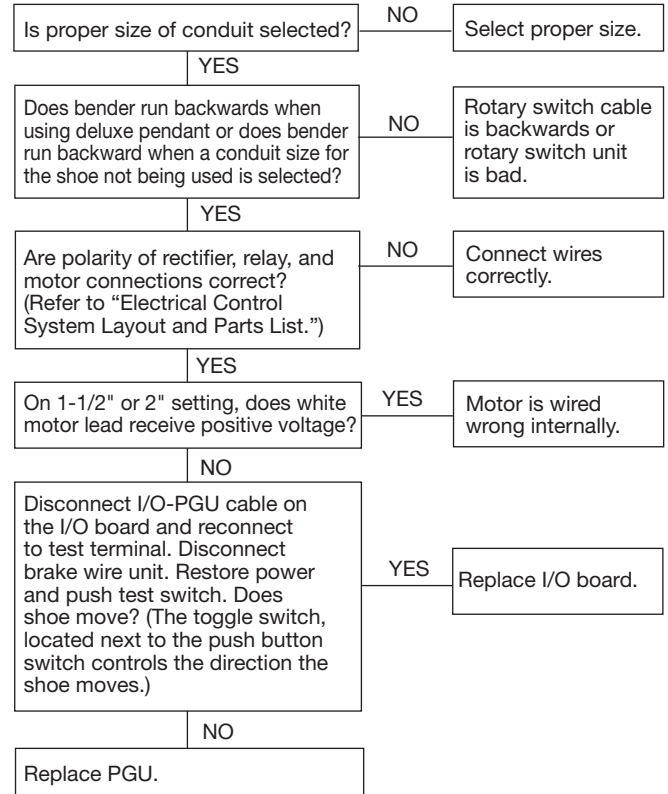


Troubleshooting (cont'd)

Won't bend – display on

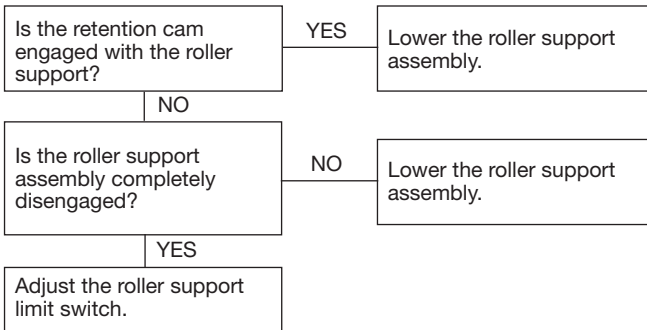


Bender runs backwards for bend and unload

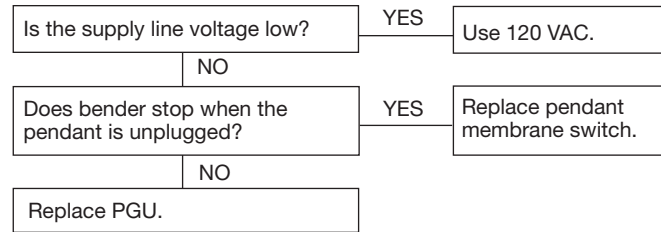


Troubleshooting (cont'd)

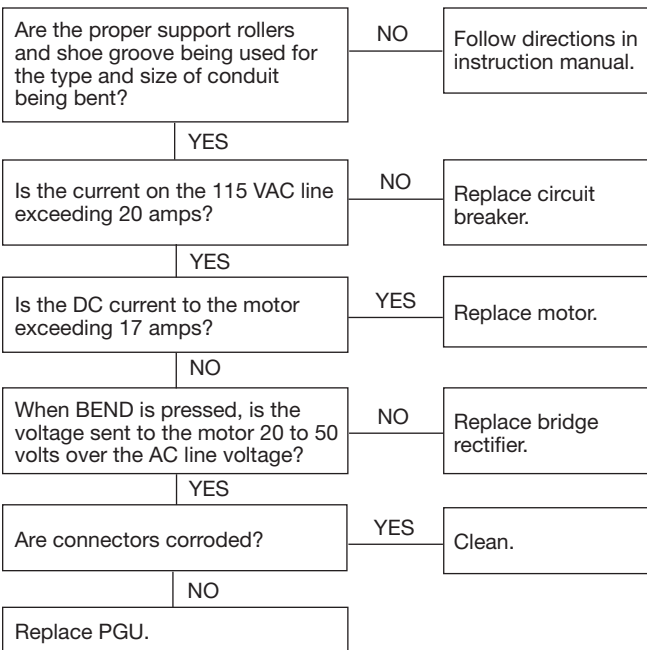
Won't unload – display on



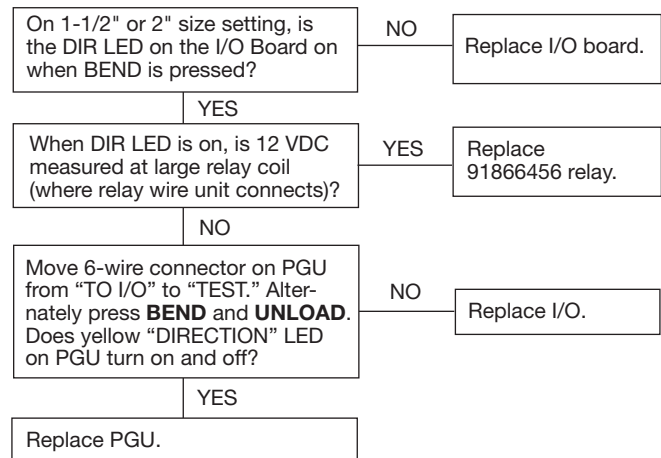
Won't stop



Trips circuit breaker

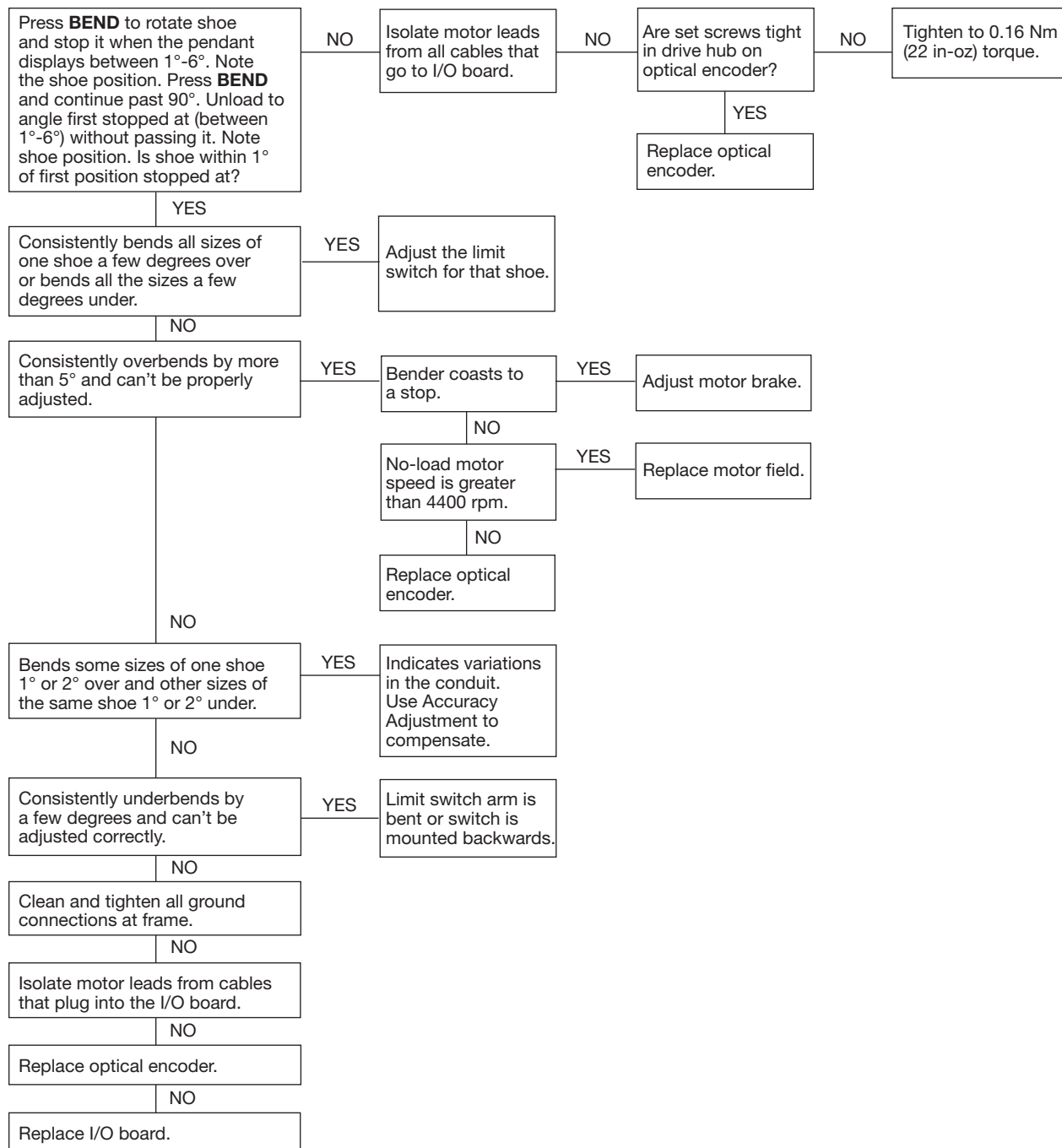


Bender only runs in one direction



Troubleshooting (cont'd)

Makes inaccurate bends



Troubleshooting (cont'd)

Accuracy Adjustment

Due to variations in conduit, you may notice that the bender consistently over- or underbends a particular size and type of conduit. Programmed adjustments can be made to compensate for over- and underbending conduit. Each size and type of conduit can have a unique adjustment ranging from plus 9 degrees to minus 9 degrees.

Standard Pendant

1. Press and hold **CLEAR**, and then press and hold **BEND** until "Pr" is displayed.
2. Use the side switches to select the size and type of conduit to compensate. The display shows the current adjust value ("0" is factory default).
3. Compensate the angle:
 - Press **ANGLE SELECT ▲** to increase the bend to compensate for underbending.
 - Press **ANGLE SELECT ▼** to decrease the bend to compensate for overbending.
 - Press **CLEAR** to reset the compensation to the factory default ("0").
4. Press **BEND** to save the adjust angle and exit the adjust mode.
 - The bender retains the new adjust value even if power is turned off.
 - The only way to change the adjust value is to repeat this procedure.
 - The pendant displays "oP" as it returns to operating mode.

Deluxe Pendant

1. Press **RESET**.
2. Press the 0 key three times. "PROGRAMMING MODE" appears on the display.
3. Key in the desired size and type of conduit to compensate. The display shows the current adjust value ("0" is factory default).
4. When the display prompts "ENTER NUMBER OF DEGREES (USE ● FOR NEGATIVE)," use the numerical keys to enter a number from **0** to **9**. Use the ● (**decimal**) key to toggle the negative sign.
 - Enter positive numbers to increase the bend to compensate for underbending.
 - Enter negative numbers to decrease the bend to compensate for overbending.
 - Press **CLEAR** to reset the compensation to the factory default ("0").
 - Press **RESET** to exit the adjust mode without changing any values.
5. Press **ENTER** to save the adjust angle and exit the adjust mode.
 - The bender retains the new adjust value even if power is turned off.
 - The only way to change the adjust value is to repeat this procedure.

Note: Once in the adjust mode, the pendant can display any compensation value by selecting the size or type. However, only the values of the last size and type viewed are saved to memory when exiting adjust mode.