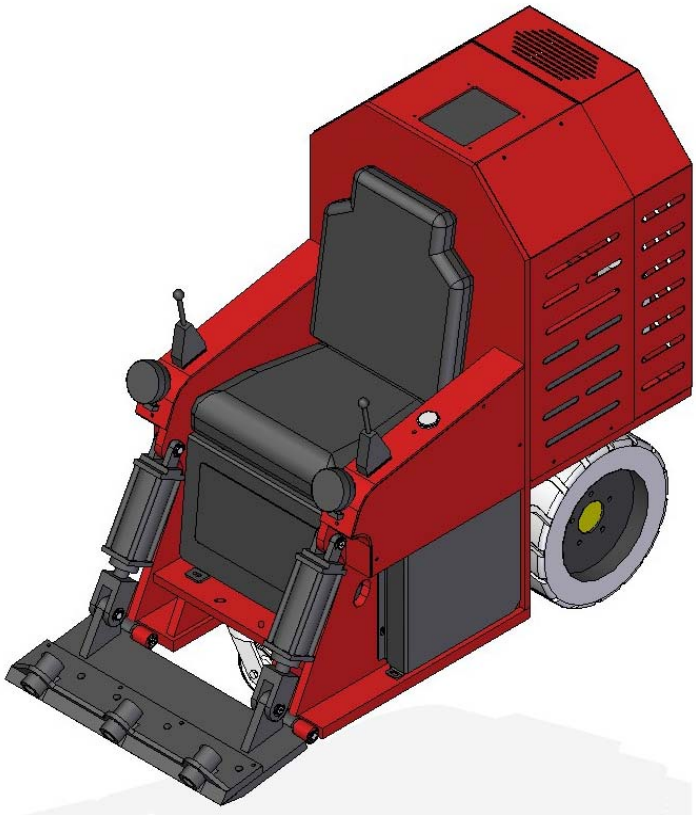


BRB-3100EV
MACHINE MANUAL

BLASTPRO MANUFACTURING, INC. ~ WARRANTY & REGISTRATION CARD
ONE YEAR LIMITED WARRANTY
(1-877-495-6464)

A COPY OF THE WARRANTY CARD ON THE FOLLOWING PAGE, TOGETHER WITH PROOF OF PAYMENT, MUST BE SUBMITTED WITH ANY SERVICE REQUEST. THIS WARRANTY CARD MUST BE RETURNED TO: BLASTPRO MANUFACTURING, INC., 6021 MELROSE LANE, OKLAHOMA CITY, OK 73127, WITHIN TEN (10) DAYS OF ACQUIRING BLASTPRO PRODUCTS IN ORDER TO QUALIFY FOR THE ONE YEAR LIMITED WARRANTY CONTAINED IN THE SALES AGREEMENT.

BlastPro provides as a limited warranty to Original Purchasers of BlastPro equipment, purchased within and situated within the United States of America, who notify BlastPro in writing through completion of the BlastPro Equipment Warranty Card within ten (10) days of acquiring BlastPro Equipment, the following limited warranty.

Subject to the exclusions, limitations and conditions stated above and below, BlastPro will warrant its products against defects in materials and workmanship, provided the Original Purchaser uses such equipment under normal and proper use, for a period of one year or 1,000 hours, whichever occurs first, from the date of delivery to the Original Purchaser.

During the applicable limited warranty period and subject to the exclusions, limitations and conditions contained herein, BlastPro shall, within a reasonable period of time, repair or replace, at its option, any defective components of the equipment. The limited warranty does not cover wear parts, including but not limited to, tires, magnets, seals, casters, liners, wear plates, bearings, cages, blast wheels, blades, belts, electrical wiring components and items of a similar nature.

This limited warranty does not cover damage to BlastPro equipment caused by any of the following: the use of the equipment for purposes other than which the equipment was designed and intended, all external causes such as (without limitation) acts of God, accidents, dropping, collision, fire, water damage, freezing, striking other objects, misuse or otherwise using the equipment contrary to the instructions and warnings contained in the User Manual; altering or modifying BlastPro equipment or accessories; exposure to environmental conditions beyond reasonable limits and the limits stated in the equipment manual; failure to properly maintain and service the equipment; damage caused by the use of any non-BlastPro parts or attachments on the equipment.

To obtain repair or replacement under this limited warranty, the Original Purchaser must contact BlastPro at 1-877-495-6464. The Original Purchaser must be prepared to describe any alleged problem, as well as provide proof of purchase and proof of date of delivery and return of the Equipment Warranty Card. Written authorization from BlastPro must be obtained prior to any BlastPro equipment being returned to BlastPro.

Once BlastPro provides the Original Purchaser with a written authorization, then the Original Purchaser shall deliver the equipment as instructed by BlastPro. The Original Purchaser shall pay the cost of shipping and shall also bear any risk of loss during shipping. Providing the BlastPro equipment is defective and the limited warranty applies, BlastPro shall, within a reasonable period of time, repair or replace any defective components. The Original Purchaser shall be responsible for picking up the repaired equipment or may arrange for shipment at Original Purchaser's expense.

BlastPro's repair or replacement of any defective parts on the equipment does not extend the term of this limited warranty, which shall expire on expiration of the period of one year from the date of Original delivery, subject to the further terms of this warranty.

THIS LIMITED WARRANTY IS THE ONLY WARRANTY APPLICABLE TO BLASTPRO EQUIPMENT. BLASTPRO DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABLILITY OR FITNESS FOR A PARTICULAR PURPOSE, OTHER THAN THOSE WARRANTIES IMPLIED AND INCAPABLE OF EXCLUSION, RESTRICTION OR MODIFICATION UNDER APPLICABLE LAW. ANY SUCH IMPLIED WARRANTIES WHICH MAY BE REQUIRED BY LAW AND ARE NOT DISCLAIMED HEREBY, ARE LIMITED TO THE EXTENT ALLOWED BY LAW TO THE APPLICABLE PERIOD OF THIS IMPLIED WARRANTY OR TO THE APPLICABLE TIME PERIOD PROVIDED BY THE APPLICABLE STATE LAW, WHICHEVER PERIOD IS SHORTER.

UNDER NO CIRCUMSTANCES SHALL BLASTPRO BE LIABLE TO THE ORIGINAL PURCHASER OR ANY OTHER PERSON FOR ANY DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR MISUSE OF THE EQUIPMENT OR ARISING OUT OF ANY BREACH OF ANY WARRANTY OR FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY CHARACTER, INCLUDING WITHOUT LIMITATION, DAMAGES FOR ANY LOSS OF GOODWILL, WORK STOPPAGE OR ANY AND ALL OTHER COMMERCIAL DAMAGES OR LOSSES.

NO CHANGE TO OR ADDITIONAL WARRANTY, NO MATTER BY WHOM MADE OR WHEN MADE, SHALL APPLY TO ANY EQUIPMENT SOLD BY BLASTPRO.

BlastPro Warranty Registration Card

NOTICE!

To ensure the proper warranty coverage is extended to the owner of this machine, fill out the attached card **COMPLETELY** and **ACCURATELY** and return to BlasPro Mfg.

Keep this top portion for your records

USER'S REFERENCE INFORMATION

Delivery Date _____

Delivering Distributors Name and Address _____

Machine Model No. _____

Machine Serial No. _____

Modifications _____

CUT HERE

WARRANTY REGISTRATION CARD

IMPORTANT! To ensure that your BlastPro machine is covered under warranty, please fill in the following information and mail it to BlastPro Manufacturing, Inc.
6021 Melrose Lane, Oklahoma City, OK 73127, or Fax to 405-495-1331

(All boxes must be checked or date filled in)

Operating Manual Received ☐ **Training Scheduled** _____ **Training Complete** ☐

(Please Print)

Company _____

Address _____

City _____ **State** _____ **Zip** _____

Phone Number _____

Contact Person _____

Purchase Date _____ **Delivery Date** _____

Machine Model No. _____

Distributor Name _____

Table of Contents

SECTION 1.1: APPLICATIONS

SECTION 1.2: SPECIFICATIONS

SECTION 1.3: MANUFACTURER

SECTION 1.1: APPLICATIONS

The BRB-3100EV is specifically designed to remove coatings and coverings from horizontal surfaces. Coatings may include glue, epoxies and cementitious overlays. Coverings may include carpet, ceramic tile, and VCT.

A wide variety of tools are available from Blastpro® for your specific application.

In general, the BRB-3100EV uses sharpened spring steel blades along with the weight of the machine itself to perform the scraping function. The variable angle of attack allows for a great deal of flexibility when dealing with different floor coatings.

SECTION 1.2: SPECIFICATIONS

Dimensions (L x W x H)	65.5” x 30” x 53.5” (1664mm x 762mm x 1359mm)
Weight	3100
Charge capacity	Up to 8 hour run time
Electrical System	48 VDC, 48 VAC and 12 VDC
Blade Actuation	Hydraulic
Steering	Hydraulic
Ground Drive	Hydraulic
Blade Widths	2” through 36”

SECTION 1.3: MANUFACTURER

Blastpro Manufacturing
6021 Melrose Lane
Oklahoma City, OK 73127
Toll free: 877-495-6464
Phone: 405-491-6464
Fax: 405-495-4994
Website: www.BlastProMfg.com

SECTION 2.1: GENERAL

SECTION 2.2: MAINTENANCE AND WEAR PARTS REPLACEMENT MODES

SECTION 2.3: WORK SITE ASSESSMENT AND INSPECTION

SECTION 2.4: PERSONAL PROTECTIVE EQUIPMENT

SECTION 2.5: OPERATIONAL SAFETY

SECTION 2.1: GENERAL

Read and understand this Machine Manual prior to operating or performing maintenance on the BRB-3100EV.

This Machine Manual has been developed as a guideline for machine operation. It is not a substitute for proper organizational training and management.

All machine operators and maintenance personnel should be properly trained in operation and safety features of the BRB-3100EV.

Make these operating instructions accessible to all operating and maintenance personnel.

Never weld, modify, cut or grind components of the BRB-3100EV without prior written consent from the manufacturer.

Never use aggressive cleaning chemicals to clean the machine.

SECTION 2.2: MAINTENANCE AND WEAR PART REPLACEMENT MODES

Maintenance mode is defined as placing the machine in a configuration, which minimizes potential electric, hydraulic or stored energy hazards.

In general, the machine should be placed in Maintenance Mode prior to performing any maintenance and/or troubleshooting activities.

MAINTENANCE MODE:

1. Move the machine to a level surface.
2. Lower blade.
3. Flip motor switch to “OFF” position
4. Depress E-stop button.
5. Remove 10 amp fuse connecting 48 v power to controller.
6. Block wheels to prevent the machine from moving.
7. Allow all components to cool prior to carrying out any maintenance work.

In general, the machine should be placed in Wear Parts Replacement Mode prior to changing the blade(s).

WEAR PARTS REPLACEMENT MODE:

1. Move the machine to a level surface.
2. Raise the blade holder so the blade is off of the ground.
3. Flip motor switch to “OFF” position
4. Depress E-stop button
5. Loosen appropriate bolts and replace blade(s).

After performing any maintenance or repair work verify that all safety labels, guards, lids and bolted connections are properly and securely installed on the machine.

SECTION 2.3: WORK SITE ASSESSMENT AND INSPECTION

Before starting scraping operations, a site assessment must be performed. During the site assessment verify the following:

- Work area is flat, clean, and dry, free of debris, frost-free, and has no flammable liquids nearby. Also, make sure that the machine will be able to clear all obstructions. **NEVER SCRAPE OVER BOLTS, NUTS, SCREWS, NAILS, OR OTHER DEBRIS AS THIS MAY RESULT IN SIGNIFICANT DAMAGE TO THE MACHINE AND SERIOUS INJURY TO THE OPERATOR.**
- **FLOORS HAVE BEEN THOROUGLY INSPECTED. SOME FLOOR OR DECK SURFACES MAY BE COATED WITH, OR CONTAMINATED BY, DANGEROUS MATERIALS SUCH AS:**

    - **PCBs**
    - **LEAD**
    - **ASBESTOS**
    - **PESTICIDES**
    - **SOLVENTS**
    - **CLEANING FLUIDS**
    - **AND/OR OTHER HARMFUL CHEMICALS**

  DISTURBING SUCH SURFACES CAN CREATE A SERIOUS HEALTH THREAT TO THOSE WHO INHALE OR COME INTO CONTACT WITH THE DUST. THE WORK AREA MUST BE CHECKED FOR THESE MATERIALS BEFORE WORK CAN BEGIN. BLASTPRO MANUFACTURING, INC. DOES NOT WARRANT ITS EQUIPMENT TO BE SUITABLE FOR, OR APPROVED FOR, REMOVING DANGEROUS

MATERIALS. IT IS THEREFORE THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE SAFETY OF THE WORK AREA AND THE EQUIPMENT WITH THE PROPER AUTHORITIES. IT IS ALSO THE RESPONSIBILITY OF THE CONTRACTOR TO WARN ALL STAFF MEMBERS OF ALL THE POTENTIAL SHORT-TERM AND LONG-TERM HEALTH RISKS ASSOCIATED WITH INHALING AND COMING INTO CONTACT WITH DANGEROUS MATERIALS. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ALL WORKERS FROM BEING EXPOSED TO DANGEROUS MATERIALS.

- Operator and any other personnel in the work area are wearing safety glasses with side shields, dust masks, ear plugs, hard hats, steel toed work boots, long sleeved shirts, tight fitting clothing, and gloves. It is also imperative for staff to tie back long hair and to remove all jewelry.
- Work area has been blocked off to pedestrians, unprotected personnel, and untrained personnel. In the event pedestrians, unprotected personnel, or untrained personnel enter the work area, scraping operations are to be stopped immediately.
- Fire extinguishers are nearby. Also, take note of the location and the contact information of fire departments close to the work site.
- All guards are properly installed and in good working order prior to using the machine.
- All glass and equipment, including vehicles, are protected from debris. This can be done by loosely hanging a sheet of visqueen or other protective material in front of the glass or equipment in a curtain-like fashion.
- The operator must be aware of their surroundings and use common sense. **THE OPERATOR IS NOT TO OPERATE THE EQUIPMENT IF HE IS TIRED, DISTRACTED, OR UNDER THE INFLUENCE OF DRUGS, ALCOHOL, OR MEDICATION THAT DECREASES AWARENESS.**

SECTION 2.4: PERSONAL PROTECTIVE EQUIPMENT (PPE)

All personnel working with, or in the vicinity of the BRB-3100EV should, at a minimum, utilize the following PPE:

- Protective boots or shoes
- Eye protection with side shields
- Hearing protection
- Protective leather gloves for handling blades

All personnel should observe PPE requirements particular to each job site.

SECTION 2.5: OPERATIONAL SAFETY

- Support personnel must keep a safe distance from the machine while it is in operation. Do not stand in front of, or behind, the machine while in operation.
- The blade should only be actuated up and down with the operator properly seated on the machine.
- Do not drive the machine with the scraper blade more than ½" off of the floor.
- The operator must be aware of their surroundings. No personnel should operate or perform maintenance on the machine if they are tired, distracted or under the influence of drugs, alcohol or medication that decreases awareness.
- Verify that all protective guards and covers are properly installed and secured.
- Verify that there is sufficient light for the operator to view the work surface. The machine is equipped with headlights to provide additional lighting.

SECTION 3.1: START-UP

SECTION 3.2: SHUT DOWN

SECTION 3.3: BLADE SELECTION

SECTION 3.4: TRANSPORT

SECTION 3.1: START-UP

Only trained, authorized personnel should be allowed to run the BRB-3100EV. If training is needed, please consult with your Blastpro Manufacturing representative or authorized distributor.

Prior to start-up, the work surface should be inspected for hidden studs, electrical boxes, or any other hidden obstructions. These items should be removed or clearly marked so they can be avoided.

To move machine:

1. Operator should be firmly seated in the operator's seat.
2. Verify that the left and right control levers are in the center position.
3. Pull e-stop button up to energize the motor controller.
4. Flip motor switch to "ON" position.
5. Push rocker switch on the right control lever to raise the blade.
6. Push levers forward to move forward; pull backward to reverse. Varying positions of the left and right control levers will turn the BRB-3100EV left and right.
7. Move machine to desired location.

Normal Operation:

1. Insert selected blade into blade holder (see SECTION 3.3: BLADE SELECTION). Always wear leather gloves and use caution when handling the blades.
2. Operator should be firmly seated in the operator's seat.
3. Verify that the left and right control levers are in the center position.
4. Pull e-stop button up to energize the motor controller.
5. Flip motor switch to "ON" position.
6. Flip light switch to "ON" position if additional lighting is needed.
7. Push rocker switch on right control lever to adjust the blade angle. Some materials may require more pressure on blade for removal. This can be accomplished with a higher angle on the blade holder.
8. Move control levers forward to start removal. It is recommended to make a single pass in one direction to expose an edge of the material to be removed. Subsequent passes should be made perpendicular to the initial pass. See FIGURE 3.1.1.

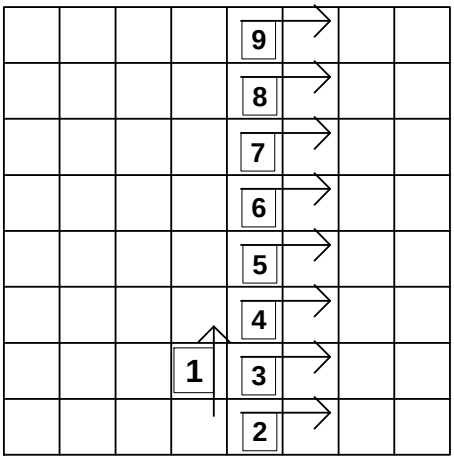


FIGURE 3.1.1

SECTION 3.2: SHUT DOWN

At end of shift or work day:

1. Move machine to level ground for storage.
2. Use the rocker switch in the left control lever to lower the cylinders until the front caster lifts off of the ground.
3. Flip motor switch to “OFF” position.
4. Depress E-stop.

For long term storage:

1. Move machine to level ground in a secure location for storage.
2. Lift blade to upper-most position.
3. Flip motor switch to “OFF” position.
4. Depress E-stop.
5. Remove the blade and/or the blade holder from the front of the machine.
6. Operator should be firmly seated in operator’s seat.
7. Pull E-stop out.
8. Flip motor switch to “ON” position.
9. Use the rocker switch in the right control lever to lower the cylinders until the front caster lifts off of the ground.
10. Flip motor switch to “OFF” position.
11. Depress E-stop.
12. Cover the BRB-3100EV to protect it from dust and moisture.

CAUTION: Many of the components on the BRB-3100EV are not meant to be exposed to high levels of moisture. It is critical, especially if the machine is stored in a location exposed to the elements, that it be protected from rain, splashing or other high levels of water.

SECTION 3.3: BLADE SELECTION

Selecting the proper blade for the application will have a dramatic effect on machine efficiency. If a blade is too wide for the application, there may not be enough pressure on the blade to stay under the material to be removed. If the blade is too narrow, the machine may not be removing the maximum material it is capable of in a single pass.

Based on information about a particular job, start with the widest blade that may be appropriate for removal. Make a test pass to determine if the blade will stay under the material. If so, continue with this selected blade. If removal of the material is relatively easy, consider moving to a larger blade. If it is difficult to stay under the material, move to a narrower blade.

Always wear leather gloves and use caution when handling blades.

In general, flat blades should be used for scraping glues, mastics, epoxies and thinsets. SEE FIGURE 3.3.1.

FIGURE 3.3.1

For carpet, rubberized and elastomeric coatings, a carpet blade should be utilized. The 90° wings on each end of the blade will help keep the removed material manageable. SEE FIGURE 3.3.2.

FIGURE 3.3.2

Blastpro offers a carbide tipped tool for tile removal. This can be inserted into the 3-hole tool adapter on the blade holder. SEE FIGURE 3.3.3

FIGURE 3.3.3

SECTION 3.4: TRANSPORT

Only use factory installed tie-down/lifting lugs when transporting or moving the equipment. These are located at the front of the machine, near the blade, and at the rear of the machine, under the motor mounting plate SEE FIGURE 3.4.1.

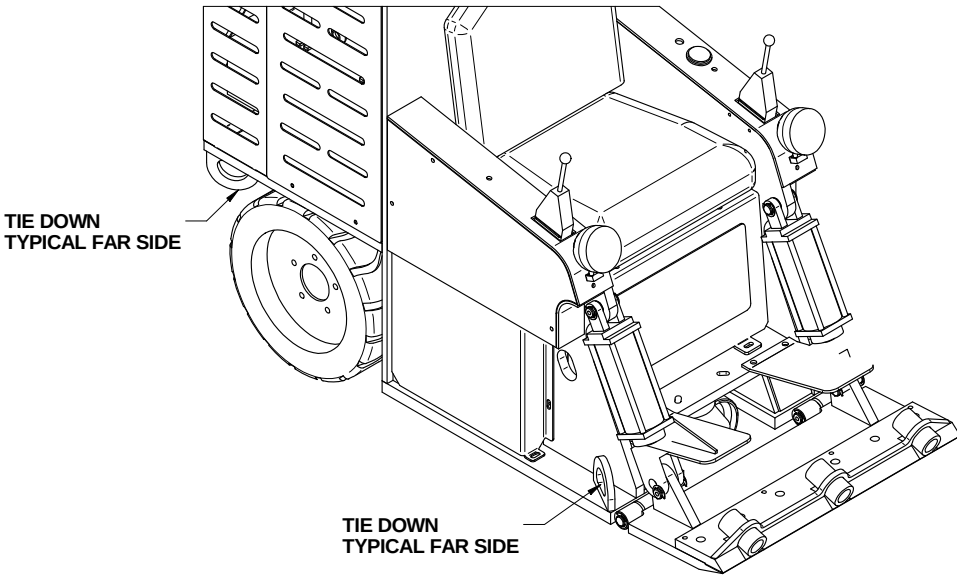


FIGURE 3.4.1

Never secure the machine with straps or chains across the hydraulic cylinders. This can result in damage to the cylinders or premature wear.

Verify that lifting straps or chains are rated for the weight of the machine.

Verify that trailer or truck bed is rated for the weight of the machine.

Remove scraper blade and/or pivoting blade holder prior to securing for transport.

Verify that the blade holder is lowered and that the front swivel caster is off of the truck or trailer bed.

Never allow personnel to stand under the machine when it is being lifted.

SECTION 4.1: MAINTENANCE INTERVALS

SECTION 4.2: TROUBLESHOOTING

SECTION 4.3: MOTOR CONTROLLER FAULT CODES

SECTION 4.4: BATTERY CHARGING

SECTION 4.5: RECOMMENDED SPARE PARTS

SECTION 4.6: RECOMMENDED TOOLS

SECTION 4.7: PARTS LIST AND DRAWINGS

SECTION 4.8: ELECTRICAL SCHEMATIC

SECTION 4.1: MAINTENANCE INTERVALS

Daily, or at the beginning of each shift

Never inspect a pressurized hydraulic system with your hand. Pinhole leaks can inject hydraulic fluid into the body, which can result in serious injury. If additional assistance is required consult your Blastpro representative, authorized Blastpro distributor, or qualified hydraulic systems professional.

Always wear leather gloves and use caution when handling blades.

1. Inspect hydraulic oil cooler for obstructions (dirt, paper, etc.).
2. Inspect hydraulic components and hoses for leaks or abrasions.
3. Inspect blades for excessive wear.
4. Inspect drive wheels for wear.

Every 25 Hours

1. Inspect electrical connections.
2. Grease all blade and cylinder pivot pins.
3. Inspect battery terminals for corrosion.

Every 50 Hours

1. Change hydraulic oil filter.
2. Top off hydraulic oil tank.
3. Tighten rear wheel nuts
4. Grease front caster and inspect for wear or damage.
5. Blow out hydraulic oil cooler fins.

*Perform these maintenance activities more frequently under extremely dusty, dirty conditions.

SECTION 4.2: TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
Electric motor will not start	E-stop is depressed	Turn motor switch to "OFF", pull out E-stop button, and try to start motor.
	Fuse is blown	Replace 10 A fuse
	Batteries are dead	Charge batteries
	Motor controller fault	Remove rear cowling to retrieve fault code on controller, and consult Blastpro Representative or authorized distributor. SEE SECTION 4.3 "FAULT CODES"
Engine seems sluggish during operation	Throttle not set in high position	Move throttle to high position
	Incorrect oil level	Check oil level and fill/remove as necessary
	Dirty air cleaner	Clean/replace air cleaner
Slow coating removal	Blade is dull	Flip or replace blade
	Blade is too wide	Replace with narrower blade
	Incorrect blade angle	Adjust blade angle up or down with hydraulic cylinders
Cylinder movement seems slow	Dirt in cylinder control spool valve	Consult Blastpro representative or authorized distributor
	Damaged cylinder	
Battery charger LED does not come on when the power is applied to the battery charger	Not plugged into a live circuit	Verify that the circuit you are plugged into is live
	Extension cord is damaged	Replace extension cord
	Leads connecting the charger to the battery terminals are damaged or corroded	Repair/replace/clean the leads
Battery charger LED never blinks	Indication of shorted cells in a battery	Replace damaged battery
No power is present across the leads from	The charger will not turn on until the leads are	Connect leads to battery terminal with proper

charger to battery terminal when disconnected	connected	polarity
Batteries do not receive a full charge	Extension cord is too long or too small	Use a shorter or bigger extension cord. **Always use the shortest possible cord.**

SECTION 4.3: MOTOR CONTROLLER FAULT CODES

The motor controller located on the rear of the machine has two LED's, one yellow and one red. There are five different display modes for the LED's.

Neither LED illuminated	Controller is not powered on; vehicle has a dead battery; or severe damage
Yellow LED flashing	Controller operating normally
Yellow and red LED's both on solid	Controller is in Flash program mode
Red LED on solid	Watchdog failure or no software loaded. Cycle on/off and if necessary load software
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code flashed by yellow LED identifies a specific fault; one or two flashes by red LED indicate whether first or second digit will follow

Example of a fault code:

1 red flash
2 yellow flashes
2 red flashes
3 yellow flashes

This indicates fault code 23. This is the number that should be communicated to your Blastpro representative to determine a resolution to the fault.

SECTION 4.4: BATTERY CHARGING

To extend the life of the batteries, the machine should only be used until the charge meter reads 20%. Fully discharging the batteries on a regular basis will dramatically decrease the life of the battery, or cause polarity reversal resulting in complete battery failure. After the battery reaches 10% of charge remaining, the discharge rate increases dramatically.

Warning: It is normal for the charger to become hot when charging. Do not obstruct the flow of air around the charger. Do not allow clothing, blankets or other material to cover the charger. Do not use near fuels, grain, dust, solvents or other flammables.

The battery charger must be grounded to reduce the risk of electric shock. The charger is equipped with a ground type plug, and it must be plugged into a nominal 115 volt, 60 Hz circuit.

Warning: Improper connection of the charger grounding conductor can result in a risk of an electric shot. DO NOT USE THIS CHARGER ON A TWO POLE UNGROUNDED OUTLET OR ATTEMPT TO BREAK OFF THE GROUND PRONG FOR USE ON A RECEPTACLE OR EXTENSION CORD NOT HAVING A GROUND.

Warning: To reduce the risk of fire, only charge this machine on circuits provided with a maximum of 20 ampere branch circuit protection (circuit breaker or fuse, in accordance with the National Electric Code, and all local codes and ordinances.

1. Plug the female end of the extension cord into the charging outlet on the rear of the machine.
2. Plug the male end of the extension cord into a properly rated AC outlet.
3. The charger is equipped with an electronic timer. When the battery reaches the gassing threshold (2.3 V/cell) the timer will activate and run for three hours. During this period the batteries are in gassing mode. After three hours the charger will drop the batteries into float mode (2.26 V/cell), indicated by a blinking LED.
4. To discontinue charging, unplug the extension cord from the power outlet and the machine.

Note: Even after relatively short periods of charging, about 2-3 hours, the battery indicator may initially read 100% charge. This is an indication of the surface charge of the battery, and will decrease quickly to the actual percentage of

charge while running the machine. This is normal. To achieve a deeper charge percentage the machine should be left charging for longer periods of time.

Note: Since there are two sets of four batteries wired in series some cells become uneven during charge/discharge cycles. At least one a month, perform two charge cycles back-to-back. This will bring up cells that are lagging behind fully charged cells. This is important for overall battery performance.

SECTION 4.5: RECOMMENDED SPARE PARTS

It is recommended that the machine owner/operator keep a minimum of spare parts with the machine while it is working. Down time due to part failure or lack of wear parts can far exceed the cost of the parts.

PART NUMBER	DESCRIPTION	QUANTITY
BTP000451	6” CARPET REMOVAL BLADE	Depends on size of job
BTP000553	8” CARPET REMOVAL BLADE	Depends on size of job
BTP000554	10” CARPET REMOVAL BLADE	Depends on size of job
BTP000555	12” CARPET REMOVAL BLADE	Depends on size of job
BTP000853	6” TILE BLADE	Depends on size of job
BTP000854	8” TILE BLADE	Depends on size of job
BTP000855	12” TILE BLADE W/ BEVEL	Depends on size of job
BTP000886	10” TILE BLADE W/ BEVEL	Depends on size of job

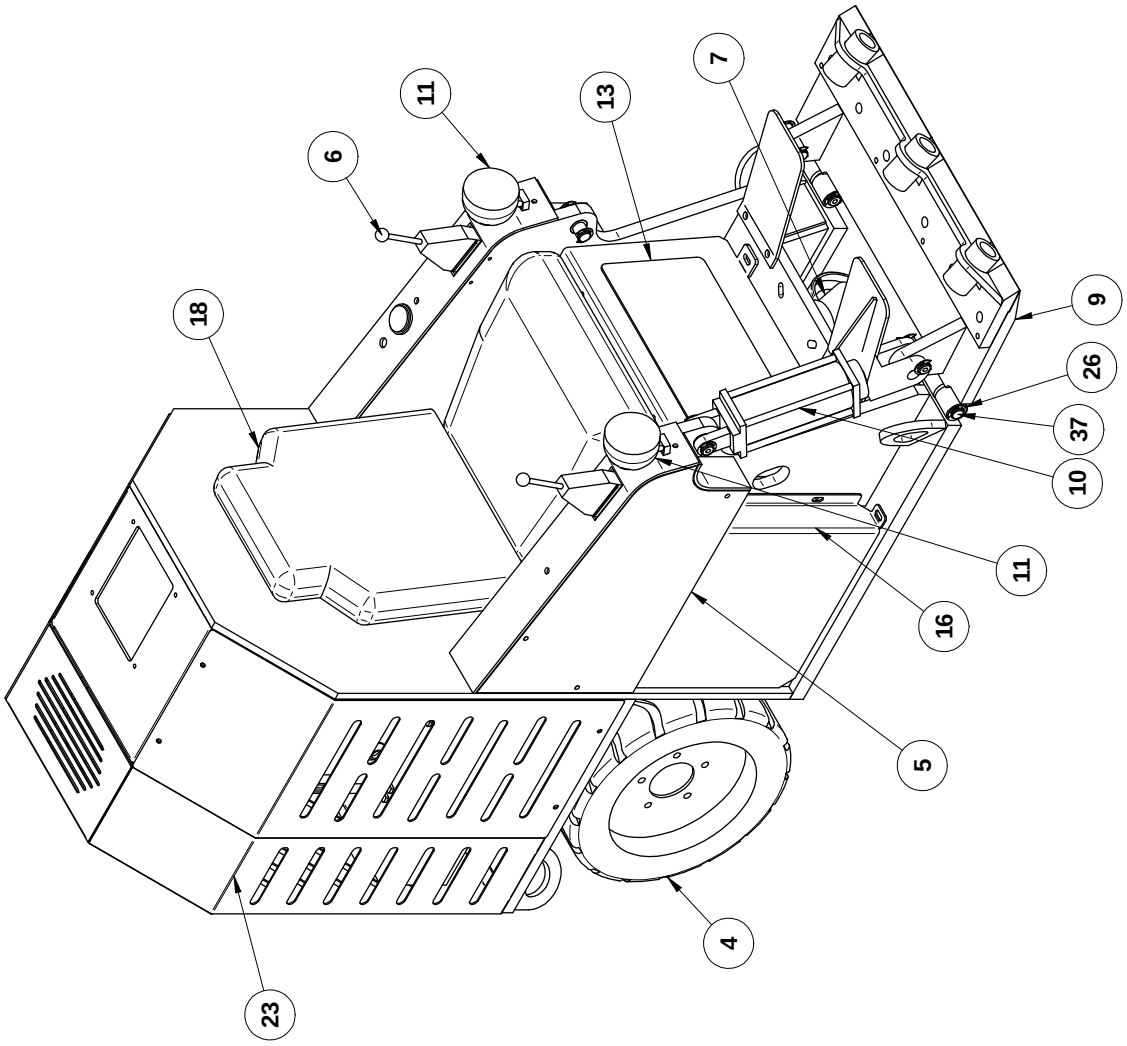
SECTION 4.6: RECOMMENDED TOOLS

“Recommended Tools” is a list of the minimum tools necessary to maintain and/or operate the BRB-3100EV during normal operation. This list is not meant to be exhaustive or to indicate the tools required for more intensive maintenance.

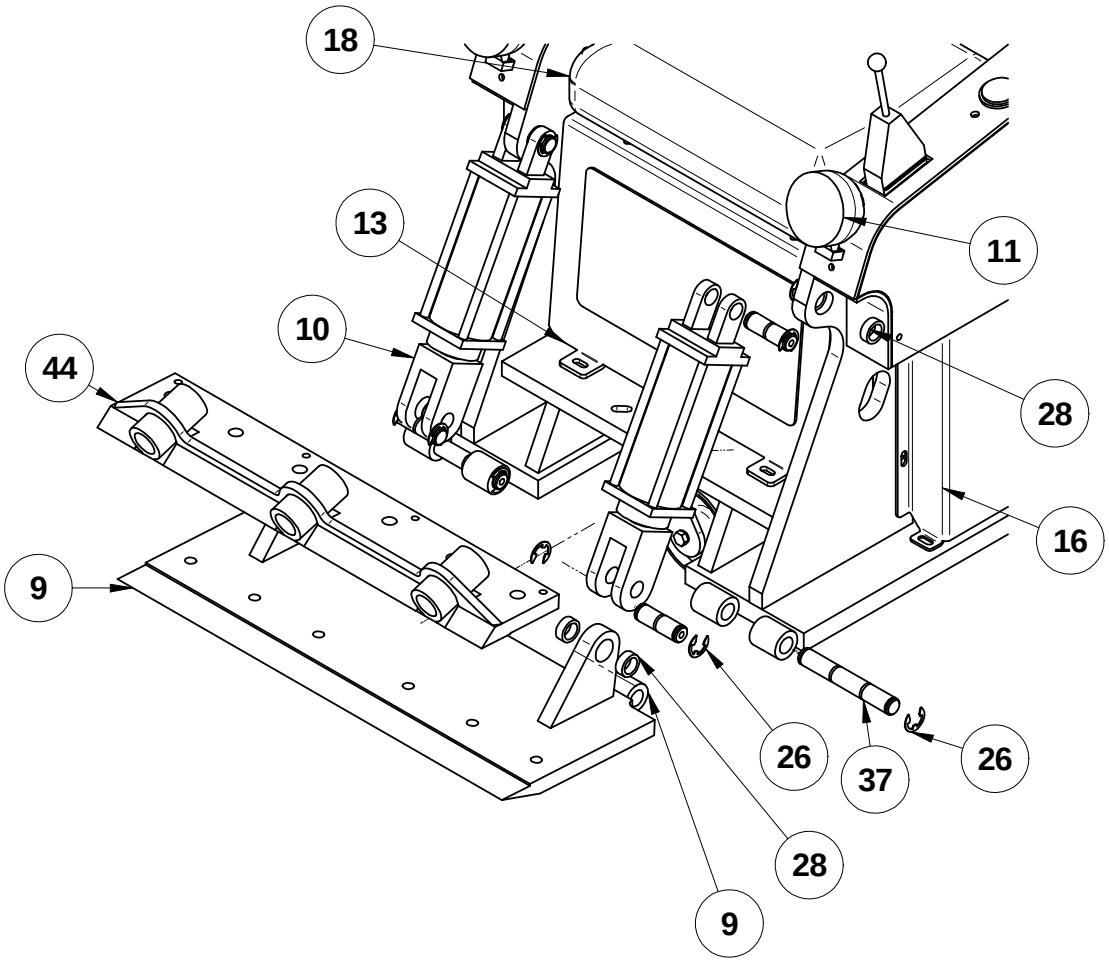
- Ratchet
- Sockets: 7/16”, 1/2”, 9/16” and 3/4”
- Combination wrench: 7/16”, 1/2”, 9/16” and 3/4”
- Utility knife
- Rubber mallet or dead blow hammer
- Leather gloves
- Multi meter with DC and AC capabilities

SECTION 4.7: PARTS LIST

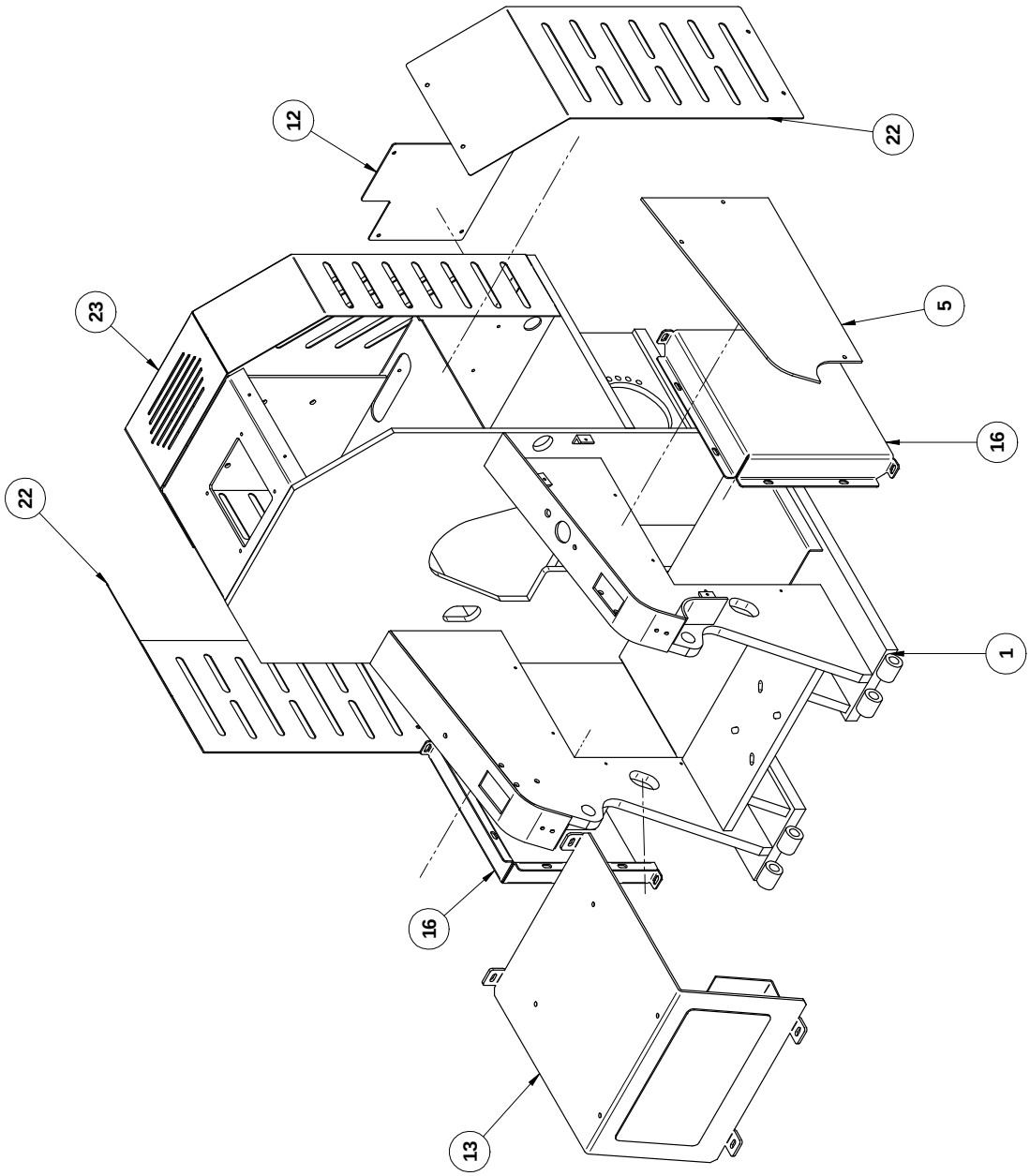
ITEM NUMBER	QUANTITY	DRAWING NUMBER	PART NUMBER	DESCRIPTION
1	1	BP87000506	BP87000506	CHASSIS WELDMENT
2	8	- -	BP85000517	BATTERY DRY CELL AGM
3	2	- -	BP85000003	GROUND DRIVE MOTOR
4	2	- -	SCR0038-1	WHEEL TRACTION DRIVE
5	2	BP87000504	BP87000504	SIDE POD COVER
6	2	- -	BP85000516	VALVE CONTROL LEVER
7	1	- -	BTP000257	CASTER/SWIVEL
9	1	BP85000509	BP85000509	SCRAPER BLADE WELDMENT
10	2	- -	SCR0003	HYDRAULIC BLADE CYLINDER
11	2	- -	ZT-00024	12V LED LIGHT
12	1	BP87000516	BP87000516	WHEEL MOTOR COVER
13	1	BP87000507	BP87000507	FRONT BATTERY COVER
14	1	- -	BP85000513	TANDEM PUMP ASSEMBLY
15	1	- -	BP85000514	MOTOR CONTROLLER/AC DRIVE SYSTEM
16	2	BP87000503	BP87000503	SIDE BATTERY COVER
18	1	- -	SCR0020	HIGH BACK SEAT
19	1	- -	BP87000500	ON BOARD BATTERY CHARGER
20	1	- -	BP87000501	HYDRAULIC COOLER/12VDC
21	1	BP87000502	BP87000502	WELDMENT/HYDRAULIC TANK
22	2	BP87000505	BP87000505	COWLING PANEL
23	1	BP87000508	BP87000508	REAR COWLING WELDMENT
24	4	- -	SCR0016	UPPER CYLINDER PIN
26	12	- -	BT03400013	E CLIP/FOR 1.00" OD SHAFT
27	1	- -	BP87000514	ELECTRIC MOTOR PUMP ADAPTER
28	8	- -	BTP001992	BUSHING LINER TW 1.38OD/0.5L
29	1	- -	BP87000512	SHAFT COUPLING/ 7/8"B
30	1	- -	BP87000513	SHAFT COUPLINIG SPIDER
31	1	- -	BP87000511	SHAFT COUPLING/ 5/8" B
32	1	- -	BP87000515	CONTACTOR
33*	1	- -	BP87000510	CABLE KIT #2 GAUGE
34	1	- -	BP85000008	FILTER
35	1	- -	BP85000009	VALVE LIFT CYL
36*	1	- -	SCR0044	NON SKID TAPE - 2'
37	2	- -	BP85000006	BLADE PIVOT PIN
38*	1	- -	BP87000520	WIRING HARNESS
39*	1	- -	BP87000519	BATTERY CABLE KIT
40*	1	- -	BP87000518	HYDRAULIC HOSE KIT
41*	1	- -	BP87000517	HYDRAULIC FITTING KIT
42*	2		BP500-00122	WELD ON HINGE 3.94"
43	1	BP87000521	BP87000521	MOTOR MOUNTING BRACKET
44	1			THREE HOLE TOOL ADAPTER
45	1		BP87000522	CABLE BRACKET
46	2	BP87000523	BP87000523	NEOPRENE BATTERY CUSHION
47	2		BT07300010	TRANSAXLE CABLE
48	1		ZT-00046	TEMP GAUGE



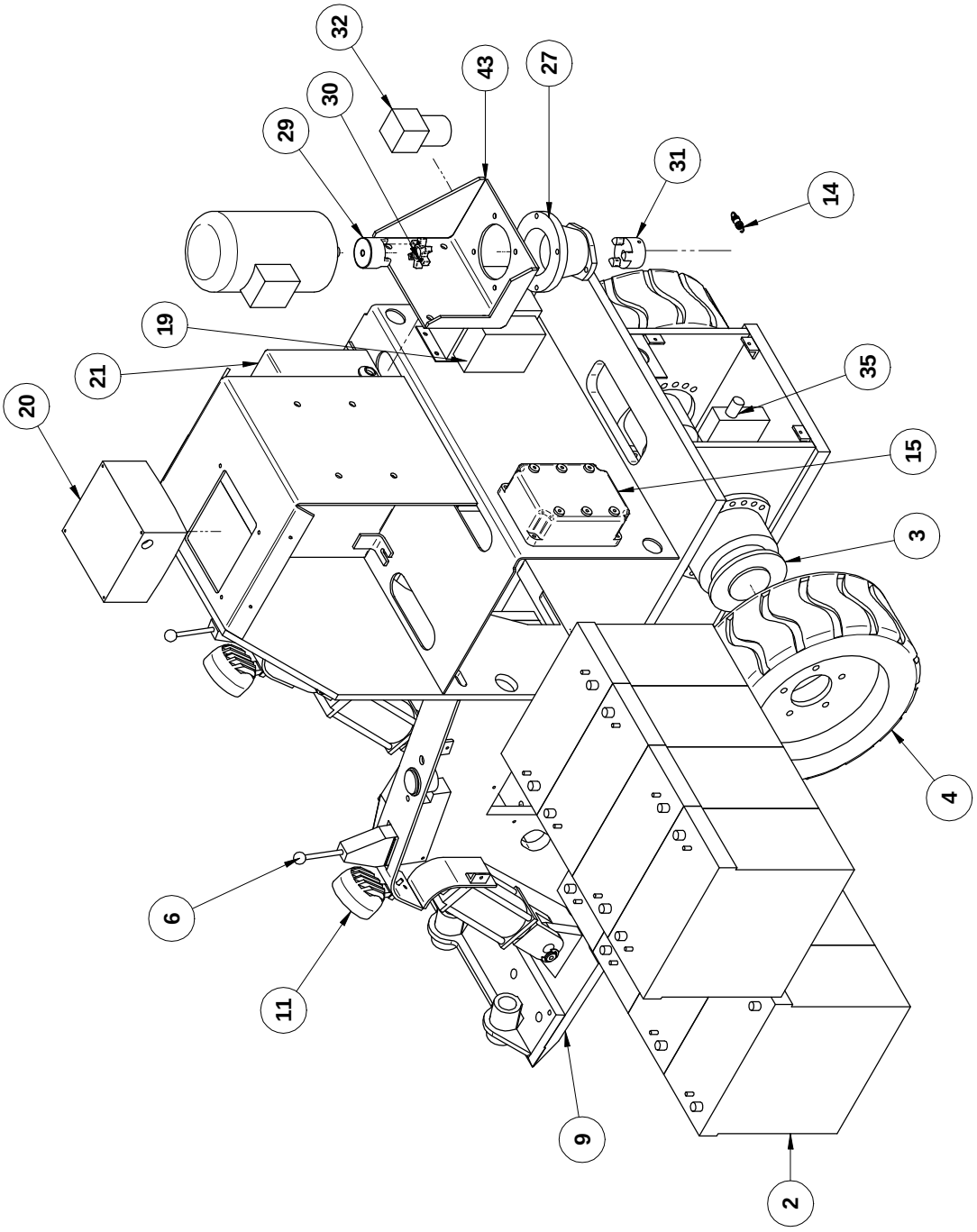
GENERAL ASSEMBLY VIEW



FRONT END ASSEMBLY

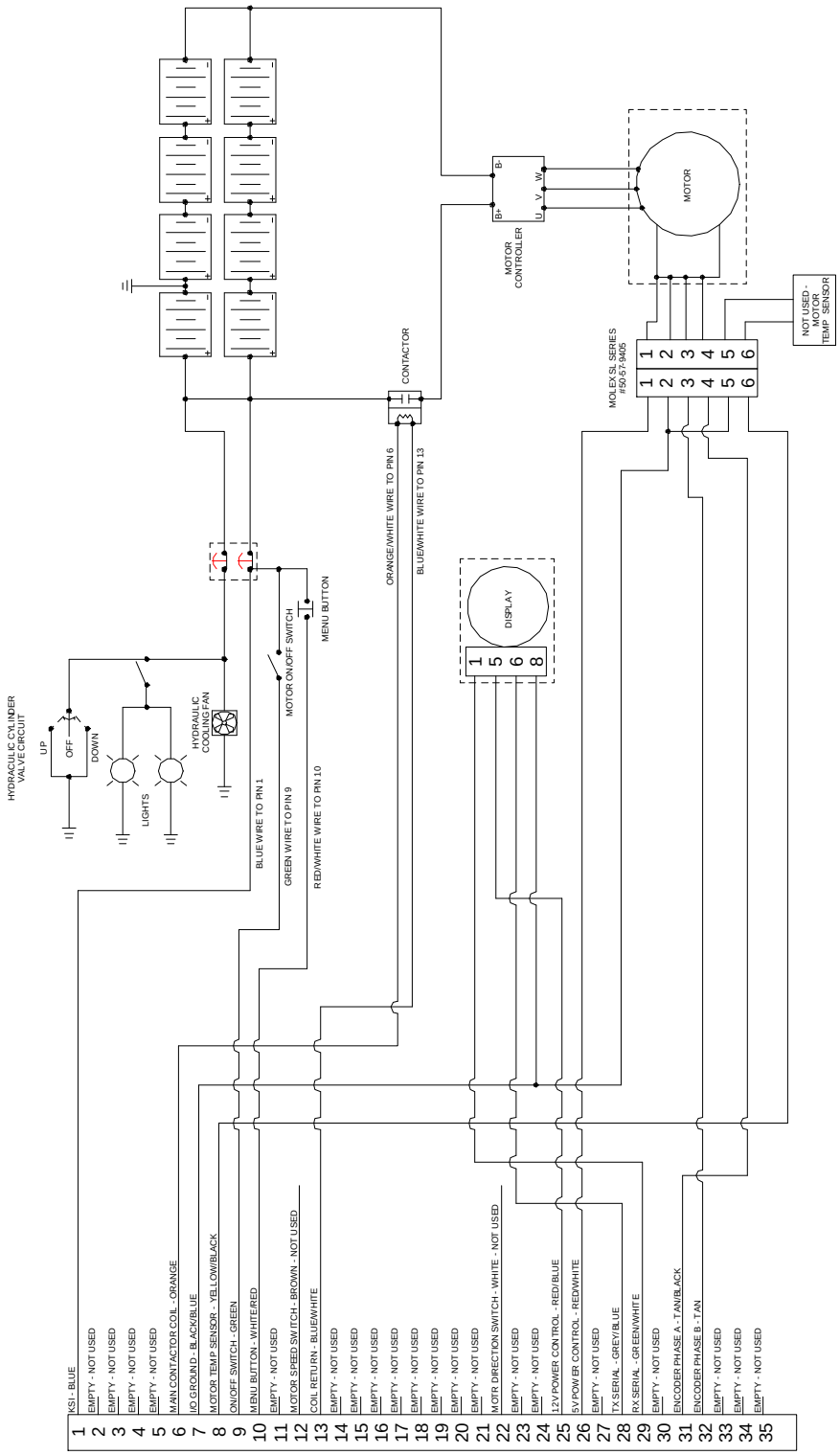


COVERS AND GUARDS

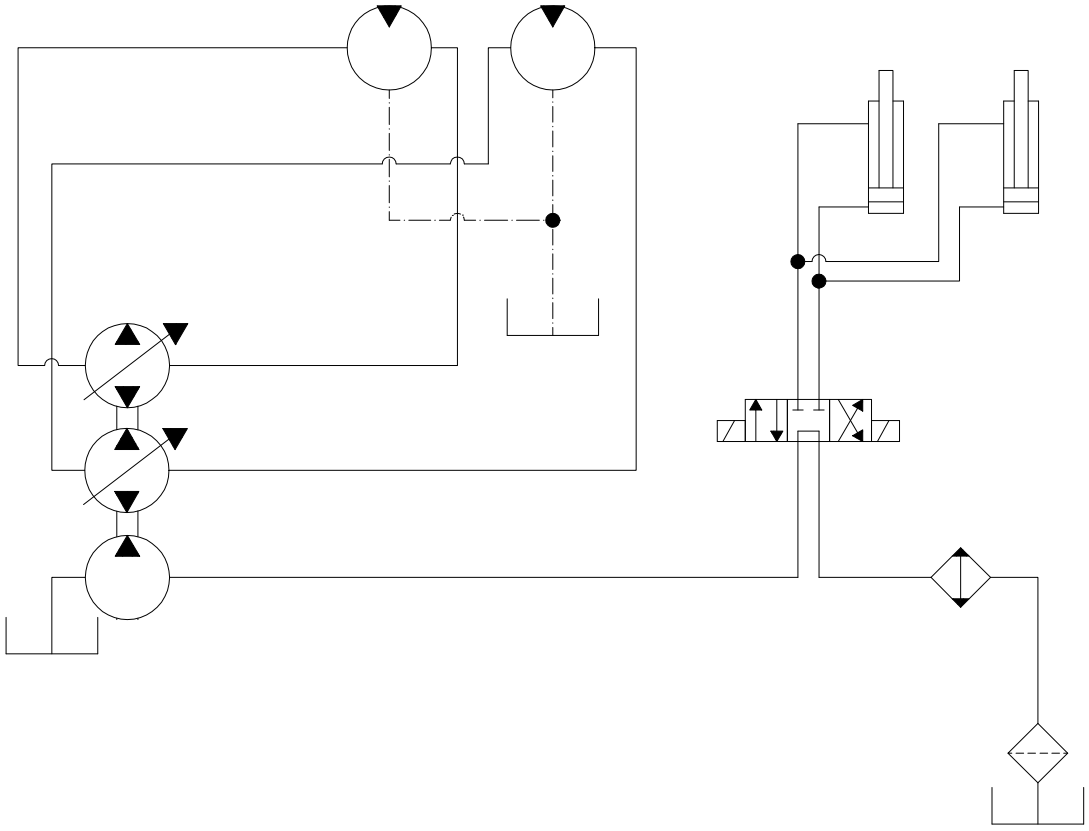


COVERS AND GUARDS REMOVED

SECTION 4.8: ELECTRICAL SCHEMATIC



SECTION 4.9: HYDRAULIC SCHEMATIC



8 DIAGNOSTICS AND TROUBLESHOOTING

These controllers detect a wide variety of faults or error conditions. Faults can be detected by the operating system or by the VCL code. This section describes the faults detected by the operating system.

Faults detected by VCL code (faults 51–67 in Table 5) cannot be defined here as they will vary from application to application. Refer to the appropriate OEM documentation for information on these faults.

DIAGNOSTICS

Diagnostics information can be obtained in either of two ways: (1) by reading the display on a 1311 programmer or (2) by observing the fault codes issued by the Status LEDs. See Table 4 for a summary of LED display formats.

The 1311 programmer will display all faults that are currently set as well as a history of the faults that have been set since the history log was last cleared. The 1311 displays the faults by name.

The pair of LEDs built into the controller (one red, one yellow) produce flash codes displaying all the currently set faults in a repeating cycle. Each code consists of two digits. The red LED flashes once to indicate that the first digit of the code will follow; the yellow LED then flashes the appropriate number of times for the first digit. The red LED flashes twice to indicate that the second digit of the code will follow; the yellow LED flashes the appropriate number of times for the second digit.

Example: Battery Undervoltage (code 23).

In the Fault menu of the 1311 programmer, the words **Undervoltage Cutback** will be displayed; the real-time battery voltage is displayed in the Monitor menu ("Keyswitch Voltage").

The controller's two LEDs will display this repeating pattern:

RED	YELLOW	RED	YELLOW
*	* *	* *	* * *
(first digit)	(2)	(second digit)	(3)

The numerical codes used by the yellow LED are listed in the troubleshooting chart (Table 5), which also lists possible fault causes and describes the conditions that set and clear each fault.

Summary of LED display formats

The two LEDs have four different display modes, indicating the type of information they are providing.

Table 4 TYPES OF LED DISPLAY

DISPLAY	STATUS
Neither LED illuminated	Controller is not powered on; or vehicle has dead battery; or severe damage.
Yellow LED flashing	Controller is operating normally.
Yellow and red LEDs both on solid	Controller is in Flash program mode.
Red LED on solid	Watchdog failure or no software loaded. Cycle KSI to restart, and if necessary load software.
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.

TROUBLESHOOTING

The troubleshooting chart, Table 5, provides the following information on all the controller faults:

- fault code
- fault name as displayed on the programmer's LCD
- the effect of the fault
- possible causes of the fault
- fault *set* conditions
- fault *clear* conditions.

Whenever a fault is encountered and no wiring or vehicle fault can be found, shut off KSI and turn it back on to see if the fault clears. If it does not, shut off KSI and remove the 35-pin connector. Check the connector for corrosion or damage, clean it if necessary, and re-insert it.

Table 5 TROUBLESHOOTING CHART

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
12	Controller Overcurrent *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. External short of phase U,V, or W motor connections. 2. Motor parameters are mis-tuned. 3. Controller defective.	*Set:* Phase current exceeded the current measurement limit. *Clear:* Cycle KSI.
13	Current Sensor Fault *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	*Set:* Controller current sensors have invalid offset reading. *Clear:* Cycle KSI.
14	Precharge Failed *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	2. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging. 1. See Monitor menu » Battery: Capacitor Voltage.	*Set:* Precharge failed to charge the capacitor bank to the KSI voltage. *Clear:* Cycle Interlock input or use VCL function *Precharge()*.
15	Controller Severe Undertemp *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	*Set:* Heatsink temperature below -40°C. *Clear:* Bring heatsink temperature above -40°C, and cycle interlock or KSI.
16	Controller Severe Overtemp *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	*Set:* Heatsink temperature above +95°C. *Clear:* Bring heatsink temperature below +95°C, and cycle interlock or KSI.
17	Severe Undervoltage *Reduced drive torque.*	1. Battery Menu parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See Monitor menu » Battery: Capacitor Voltage. 6. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the Severe Undervoltage limit (see page 55) with FET bridge enabled. *Clear:* Bring capacitor voltage above Severe Undervoltage limit.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
18	Severe Overvoltage *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. See Monitor menu » Battery: Capacitor Voltage. 2. Battery menu parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.	*Set:* Capacitor bank voltage exceeded the Severe Overvoltage limit (see page 55) with FET bridge enabled. *Clear:* Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.
22	Controller Overtemp Cutback *Reduced drive and brake torque.*	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	*Set:* Heatsink temperature exceeded 85°C. *Clear:* Bring heatsink temperature below 85°C.
23	Undervoltage Cutback *Reduced drive torque.*	1. Normal operation. Fault shows that the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu » Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the Undervoltage limit (see page 55) with the FET bridge enabled. *Clear:* Bring capacitor voltage above the Undervoltage limit.
24	Overvoltage Cutback *Reduced brake torque.*	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See Monitor menu » Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage exceeded the Overvoltage limit (see page 55) with the FET bridge enabled. *Clear:* Bring capacitor voltage below the Overvoltage limit.
25	+5V Supply Failure *None, unless a fault action is programmed in VCL.*	1. External load impedance on the +5V supply (pin 26) is too low. 2. See Monitor menu » outputs: 5 Volts and Ext Supply Current.	*Set:* +5V supply (pin 26) outside the +5V±10% range. *Clear:* Bring voltage within range.
26	Digital Out 6 Overcurrent *Digital Output 6 driver will not turn on.*	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	*Set:* Digital Output 6 (pin 19) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function *Set_DigOut()* to turn the driver on again.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
27	Digital Out 7 Overcurrent *Digital Output 7 driver will not turn on.*	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	*Set:* Digital Output 7 (pin 20) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function *Set_DigOut()* to turn the driver on again.
28	Motor Temp Hot Cutback *Reduced drive torque.*	1. Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back. 2. Motor Temperature Control Menu parameters are mis-tuned. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.	*Set:* Motor temperature is at or above the Temperature Hot parameter setting. *Clear:* Bring the motor temperature within range.
29	Motor Temp Sensor Fault *MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.*	1. Motor thermistor is not connected properly. 2. If the application doesn't use a motor thermistor, Motor Temp Sensor Enable should be programmed Off. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.	*Set:* Motor thermistor input (pin 8) is at the voltage rail (0 or 10V). *Clear:* Bring the motor thermistor input voltage within range.
31	Coil1 Driver Open/Short *ShutdownDriver1.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off. *Clear:* Correct open or short, and cycle driver.
31	Main Open/Short *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = On. *Clear:* Correct open or short, and cycle driver
32	Coil2 Driver Open/Short *ShutdownDriver2.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0. *Clear:* Correct open or short, and cycle driver.
32	EMBrake Open/Short *ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type >0. *Clear:* Correct open or short, and cycle driver.
33	Coil3 Driver Open/Short *ShutdownDriver3.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 3 (pin 4) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
34	Coil4 Driver Open/Short *ShutdownDriver4.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 4 (pin 3) is either open or shorted. *Clear:* Correct open or short, and cycle driver.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
35	PD Open/Short *ShutdownPD.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Proportional driver (pin 2) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
36	Encoder Fault *ShutdownEMBrake.*	1. Motor encoder failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	*Set:* Motor encoder phase failure detected. *Clear:* Cycle KSI.
37	Motor Open *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Motor phase is open. 2. Bad crimps or faulty wiring.	*Set:* Motor phase U, V, or W detected open. *Clear:* Cycle KSI.
38	Main Contactor Welded *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	*Set:* Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. *Clear:* Cycle KSI
39	Main Contactor Did Not Close *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact. 3. External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.	*Set:* With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. *Clear:* Cycle KSI.
41	Throttle Wiper High *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	*Set:* Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring throttle pot wiper voltage below the fault threshold.
42	Throttle Wiper Low *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too low.	*Set:* Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring throttle pot wiper voltage above the fault threshold.
43	Pot2 Wiper High *FullBrake.*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too high.	*Set:* Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring Pot2 wiper voltage below the fault threshold.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
44	Pot2 Wiper Low *FullBrake.*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too low.	*Set:* Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring Pot2 wiper voltage above the fault threshold.
45	Pot Low Overcurrent *ShutdownThrottle;* *FullBrake.*	1. See Monitor menu » Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	*Set:* Pot low (pin 18) current exceeds 10mA. *Clear:* Clear pot low overcurrent condition and cycle KSI.
46	EEPROM Failure *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	*Set:* Controller operating system tried to write to EEPROM memory and failed. *Clear:* Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.
47	HPD/Sequencing Fault *ShutdownThrottle.*	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. 3. See Monitor menu » Inputs.	*Set:* HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. *Clear:* Reapply inputs in correct sequence.
47	Emer Rev HPD *ShutdownThrottle;* *ShutdownEMBrake.*	1. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.	*Set:* At the conclusion of Emergency Reverse, the fault was set because various inputs were not returned to neutral. *Clear:* If EMR_Interlock = On, clear the interlock, throttle, and direction inputs. If EMR_Interlock = Off, clear the throttle and direction inputs.
49	Parameter Change Fault *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	*Set:* Adjustment of a parameter setting that requires cycling of KSI. *Clear:* Cycle KSI.
51–67	OEM Faults *(See OEM documentation.)*	1. These faults can be defined by the OEM and are implemented in the application-specific VCL code. See OEM documentation.	*Set:* See OEM documentation. *Clear:* See OEM documentation.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
68	VCL Run Time Error *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.*	1. VCL code encountered a runtime VCL error. 2. See Monitor menu » Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	*Set:* Runtime VCL code error condition. *Clear:* Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
69	External Supply Out of Range *None, unless a fault action is programmed in VCL.*	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned. 3. See Monitor menu » Outputs: Ext Supply Current.	*Set:* The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings (page 52). *Clear:* Bring the external supply current within range.
71	OS General *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.*	1. Internal controller fault.	*Set:* Internal controller fault detected. *Clear:* Cycle KSI.
72	PDO Timeout *ShutdownInterlock; CAN NMT State set to Pre-operational.*	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	*Set:* Time between CAN PDO messages received exceeded the PDO Timeout Period. *Clear:* Cycle KSI or receive CAN NMT message.
73	Stall Detected *ShutdownEMBrake; Control Mode changed to LOS (Limited Operating Strategy).*	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See Monitor menu » Motor: Motor RPM.	*Set:* No motor encoder movement detected. *Clear:* Either cycle KSI, or detect valid motor encoder signals while operating in LOS mode and return Throttle Command = 0 and Motor RPM = 0.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
87	Motor Characterization Fault *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0=none 1=encoder signal seen, but step size not determined; set Encoder Step Size manually 2=motor temp sensor fault 3=motor temp hot cutback fault 4= controller overtemp cutback fault 5=controller undertemp cutback fault 6=undervoltage cutback fault 7=severe overvoltage fault 8=encoder signal not seen, or one or both channels missing 9=motor parameters out of characterization range.	*Set:* Motor characterization failed during the motor characterization process. *Clear:* Correct fault; cycle KSI.
89	Motor Type Fault *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. The Motor_Type parameter value is out of range.	*Set:* Motor_Type parameter is set to an illegal value. *Clear:* Set Motor_Type to correct value and cycle KSI.
91	VCL/OS Mismatch *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. The VCL software in the controller does not match the OS software in the controller.	*Set:* VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. *Clear:* Download the correct VCL and OS software into the controller.
92	EM Brake Failed to Set *ShutdownEMBrake;* *ShutdownThrottle.*	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	*Set:* After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. *Clear:* Activate the throttle.
93	Encoder LOS (Limited Operating Strategy) *Enter LOS control mode.*	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	*Set:* Encoder Fault (Code 36) or Stall Detect Fault (Code 73) was activated, and Brake or Interlock has been applied to activate LOS control mode, allowing limited motor control. *Clear:* Cycle KSI, **or** if LOS mode was activated by the Stall Fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.

Table 5 TROUBLESHOOTING CHART, continued

CODE	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
94	Emer Rev Timeout *ShutdownEMBrake;* *ShutdownThrottle.*	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	*Set:* Emergency Reverse was activated and ran until the EMR Timeout timer expired. *Clear:* Turn the emergency reverse input Off.
98	Illegal Model Number *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Model_Number variable contains illegal value (not 1234, 1236, 1238, or 1298). 2. Software and hardware do not match. 3. Controller defective.	*Set:* Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. *Clear:* Download appropriate software for your controller model.

QUICK START INSTRUCTIONS:

Check that the temporary label on top of the charger marked with the profile setting matches your battery type. If not, see the reprogramming section.

These chargers work very simply. Once connected and plugged into AC power, the LED will flash red for a few seconds, then turn steady red. When the cycle is 80% complete it will turn yellow, and finally green when cycle is complete.

If the profile is set to maintain the battery(s), the LED will flicker green. If the profile is set to shut off, the cycle will end with a steady green. The LED may also flicker when it is at the high limit of the charge cycle.

To discontinue charging, unplug AC power.

Look to the Trouble shooting section for any deviations from this.

EQUALIZATION:

When using multiple batteries in a series string, cells become uneven during charge and discharge cycles. At least once a month perform two charge cycles back to back, this will give a chance for cells that are lagging behind to catch up, and is important to overall battery performance. NOTE: This only needs to be done when using Wet cell, or AGM settings with standard or extended gassing/absorption cycles. (Switch #1 ON).

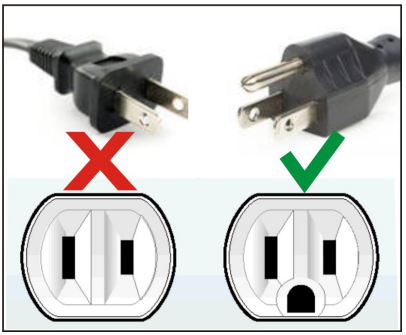
Please read complete instructions before proceeding.

SAFETY INFORMATION AC WIRING:

Before making AC connections, refer to the requirements on the charger ID label. If your charger is not equipped with an AC plug, *for example, a 230 volt charger*, have a qualified electrician install one.

To reduce the risk of fire, use this charger only on branch circuits that are protected by a circuit breaker or fuse, and that are adequate to carry the power drawn by the charger. All wiring should be in accordance with the National Electric Code, ANSI/NFPA 70, and all local codes and ordinances.

This battery charger must be grounded to reduce the risk of electric shock. 117 volt chargers are equipped with a grounding type plug, 230 volt chargers are shipped without a plug. Have a qualified electrician install a properly grounded 3 wire plug.



DO NOT USE THIS CHARGER ON A TWO POLE UNGROUNDED OUTLET OR ATTEMPT TO BREAK OFF THE GROUND PRONG FOR USE ON A RECEPTACLE OR EXTENSION CORD NOT HAVING A GROUND.

If an extension cord must be used, make sure it is in good condition. Use a three conductor cord no smaller than the size being used on the charger, and keep it as short as possible. The use of an improper extension cord could result in a risk of a fire or electric shock. Locate all cords so that they will not be stepped on, tripped over, or otherwise subjected to damage or stress.

If your charger bears the CE mark, it conforms with the essential requirements of the applicable EC directives for products placed on the market in the European Economic Area.

OTHER SAFETY INFORMATION

Do not use charger if it shows signs of physical stress, or if DC output leads or connector feel hot when used.

Do not disconnect the DC output clamps, or connector from the batteries when the charger is on. The resulting arcing could cause the batteries to explode.

Failure to unplug AC power before moving or driving equipment will result in damage to cords, plugs and receptacles.

BATTERY SAFETY & CARE INFORMATION

Always wear protective eye shields and clothing when working with batteries. Batteries contain acids which can cause bodily harm. Do not put wrenches or other metal objects across the battery terminal or battery top. Arcing or explosion of the battery can result. Do not wear jewelry when working around batteries. Arcing can cause severe burns.

The tops of the batteries and battery hold downs must be kept clean and dry at all times to prevent excessive self discharge and flow of current between the battery post and frame.

With wet cell batteries, maintain the proper electrolyte level by adding water when necessary. Never allow the electrolyte level to fall below the top of the battery plates. Electrolyte levels fall during discharge and rise during charging. Therefore**, to prevent the overflow of electrolyte when charging, add water only after the batteries have been fully charged, or just enough to cover the plates if discharged.** Old batteries require more frequent additions of water than do new batteries.

Do not over discharge batteries. Excessive discharge can cause polarity reversal of individual cells resulting in complete battery

failure. Re-charge batteries as soon as possible after a deep discharge, but not if they are warm, allow a cooling down period.

Provide adequate ventilation when charging batteries. Chargers can ignite flammable materials and vapors. Do not use near fuels, grain, dust, solvents, or other flammables.

Do not charge batteries in excessively hot temperatures; wait till the cool of the evening.

PRE CHARGE INFORMATION:

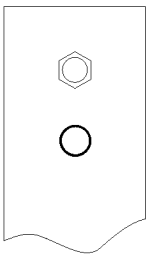
Mount the charger in the desired location, any orientation. Allow space for the charger to dissipate heat, it will get hot while in use. Do not seal the charger in an air tight compartment. Do not cover the charger with any material. **NOTE:** The OB models are *NOT* water proof, they are water resistant. This means they cannot withstand immersion, or continuous exposure from pressure washers, or heavy rain.

DRIVE LOCKOUT OPTION:

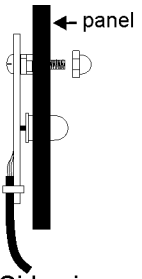
If your charger has an extra pair of small wires with a connector, spade terminals, or just bare wires, it has this option. These wires connect to your equipment if it has this feature. The purpose is to disable the drive mechanism of the equipment when the charger is plugged in so it cannot be moved and cause damage to the AC cord and receptacle. **These wires do not have to be connected for the charger to work.**

REMOTE LED OPTION:

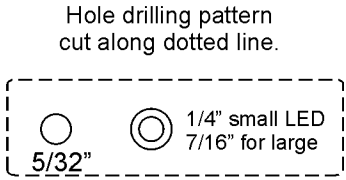
If your charger has this option, install as shown:



Front view
LED mounted
in panel



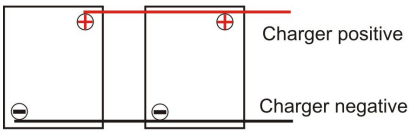
Side view
LED mounted
in panel

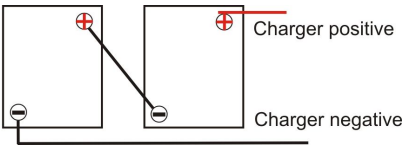


Connect the red charge lead to battery positive, black to negative. But before, make sure the battery pack is of the same voltage rating of the charger. If you are unsure, count the number of cells on the battery pack and multiply by two. This figure should be the same as the DC voltage rating of the charger. (*see ratings label on charger*) Charging a battery with a lower voltage rating than the charger will cause damage to batteries, charger, and can create an explosive atmosphere.

Make sure the AC cord, DC output leads, terminals, connectors, or clamps are all in good working condition. Do not use the charger if there are any signs of stress or damage, or if wires are cut or have damaged insulation. Using this charger with any of these symptoms could result in a fire, property damage, or personal injury. Have a qualified service person make the necessary repairs. Repairs should not be made by people who are not qualified.

Illustration of series and parallel battery connections:





Parallel

When batteries are connected in Parallel the battery amp hour capacity is additive and the voltage remains the same.
Example: two 180 amp hour 12 volt batteries would equal 12 volts and 360 amp hour capacity

Series

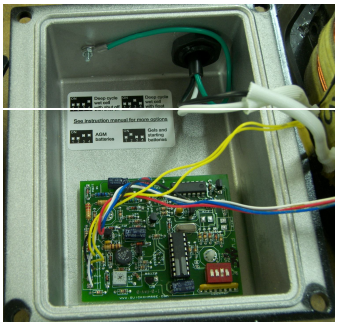
When batteries are connected in Series the voltage is additive and the battery amp hour capacity remains the same.
Example: two 180 amp hour 12 volt batteries would equal 24 volts and 180 amp hour capacity

REPROGRAMMING:

Disconnect the charger from the batteries, and unplug the power cord. Remove the four bolts holding the covers on. Open the side with the LED and remove paper insulator.

Select the switch configuration that most closely matches your application. Whether choosing maintenance mode, or shut off is a personal preference, however the maintenance mode assures batteries will remain charged and won't self discharge.
IMPORTANT: Use switch numbers as a guide, as some boards may be upside down, and reversed.

Replace paper insulator and reassemble, making sure not to pinch any wires in the covers.



LEFT TO RIGHT FACING BOARD

If the switch has 3 positions, ignore #1

AGM batteries
Standard deep cycling applications

AGM batteries
Shallow cycling or starting applications

Deep cycle wet cell batteries
Standard deep cycling applications, and shuts off.

Deep cycle wet cell batteries
Shallow cycling, and shuts off

Deep cycle wet cell batteries
Standard deep cycling applications, and maintains.

Deep cycle wet cell batteries
Shallow discharging, and maintains.

Gel batteries, starting batteries, AGM batteries if standby use.

NOTE: The #1 position is designated for batteries requiring long finish rates. If your performance is poor, it could be the batteries are being undercharged. Verify with specific gravity readings on wet cells**.**

US Battery, and **Full River** are two brands that benefit from longer charge cycles.

TROUBLESHOOTING

Symptom	Cause	Corrective Action
When plugged into AC power the LED flashes red/green.	Connected reverse to battery, or not connected to battery. Break in DC cord, or connector. Battery too dead to charge.	Correct polarity, or connect to battery. Have a qualified person make repair. Replace.
When plugged into AC power the LED does not come on.	No AC power.	Check circuit. Check extension cord for breaks or damage.
When I put a volt meter across the output of the charger there is no power coming out when I plug it in.	The charger must be connected to a battery to turn on.	
The batteries don't receive a full charge. On wet cells, the specific gravity will not rise to a full reading after the charge has completed.	The charger is too small for the battery. The charge profile is not set correctly. The cycle needs more time. The battery is defective.	Check that the charger's output is about 10% of the amp hour rating of the battery. Recheck the dip switch setting. If in doubt, contact us. If you have a 4 position switch, switch #1 position ON. Replace.
When switched on, the LED flashes red/yellow.	Charger and battery voltage mismatch.	Connect the charger to a battery(s) with the same voltage rating.

When powered up the LED is solid red with a yellow flash.	The battery is very low, and the charger is in a slow charge phase until the voltage rises to a safe level before full turn on. .	Leave connected, it may take hours, but if the voltage rises even a little bit, it should recover, and turn the charger full on. (*Do not allow your batteries to deep discharge, it is the number one cause of premature battery failure*.)
The charger blows it's fuse, or branch circuit fuse/circuit breaker as soon as it's switched on.	Charger is shorted.	Contact factory.
The charger blows the branch circuit fuse/circuit breaker a short while after being switched on.	The branch circuit is too small.	Relocate charger to a branch circuit with a heavier rating, or remove other loads on the circuit.
Batteries use water, get hot, or smell.	One or more dead cells. Dip switch not set correctly.	Replace batteries. If charging in a series string, it is best to replace all the batteries rather than mix new with old. If shallow discharging, check that the dip switch is not set to standard, or extended cycle.
After a full charge, the batteries die quickly	The batteries are sulfated.	Sometimes batteries can be recovered. Leave the charger on for some hours, if the voltage falls and the current begins to rise, it is a good sign they can recover under normal charging.
After a full charge the LED is green with a yellow flash	The batteries did not reach 80% charge in 12 hours, or did not reach minimum voltage, and the charger timed out.	The charger is too small for the batteries. Batteries are beginning to age.

		Sometimes running a second cycle will achieve full charge, but battery replacement, or a larger charger may be needed.

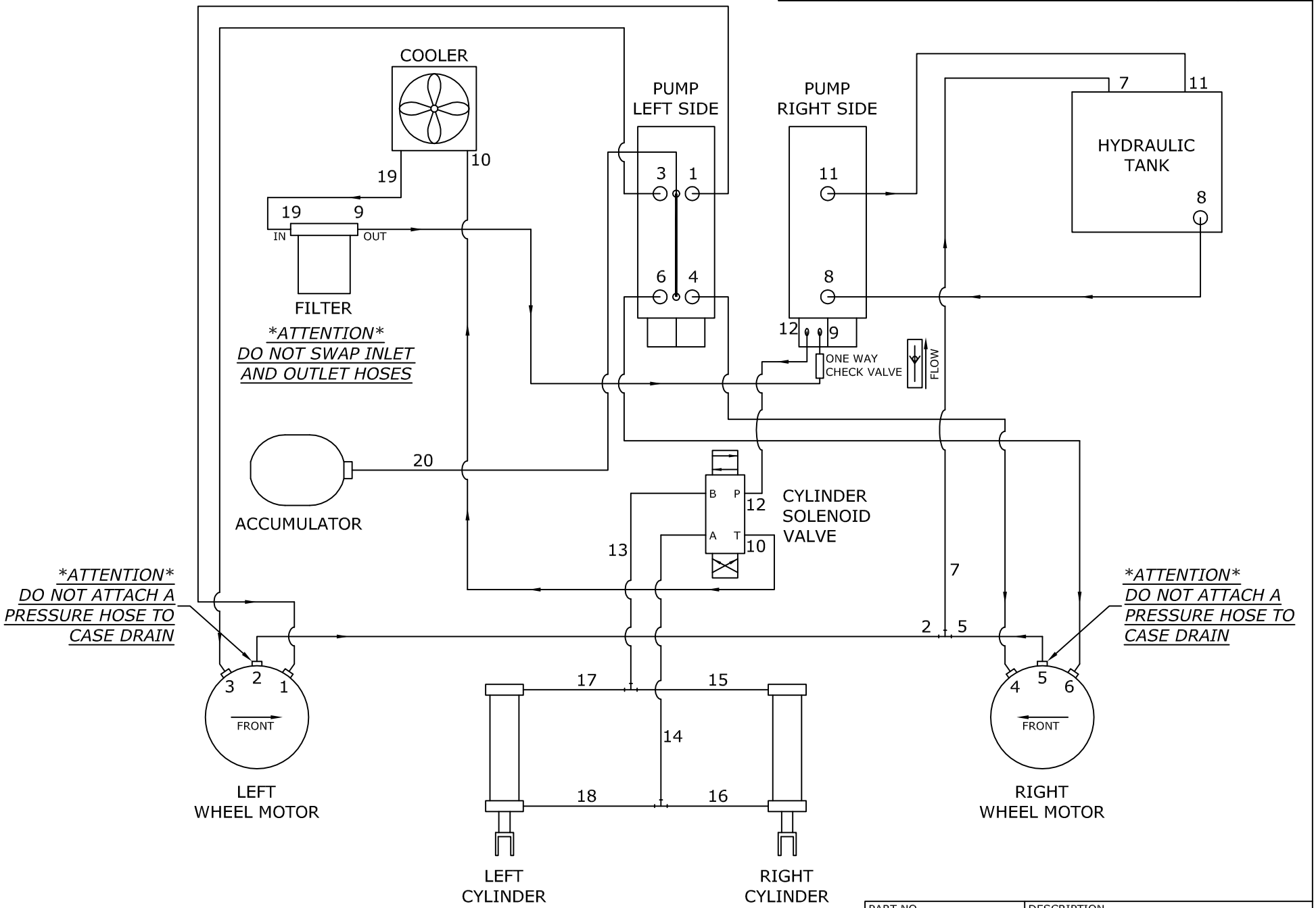
QUICK CHARGE OB Battery Chargers
"LIMITED WARRANTY"

Quick Charge Corporation warrants the OB line of chargers for three (3) years from the date of purchase. After the warranty period, chargers returned to the factory for repair will be charged a minimum rate of $25.00. Charger will be returned, freight and repair charges, C.O.D. unless other arrangements have been made. This warranty covers all defects in manufacture and performance, provided the unit is operated in compliance with manufacture's operating instructions.
For repairs to be made at the Quick Charge factory, a charger and/or component(s) should be sent, freight prepaid to Quick Charge at:

Quick Charge Corp.
1032 S.W. 22nd St.
Oklahoma City, OK. 73109

Quick Charge, will at it's option, repair or replace the charger or component in question. The repaired item will then be returned, freight prepaid by Quick Charge. This warranty is void if the charger or component have been altered, changed, or repaired by anyone not authorized by Quick Charge, or if the charger or component, have been subjected to misuse, negligence, or harsh environmental conditions. (Except those chargers designed for such conditions)
If returning the charger to the factory is not practical, replacement parts may be shipped to the customer for field repair at no charge. On parts such as circuit boards, the customer will be required to return the board suspected to be defective to Quick Charge, freight prepaid. If such defective parts are not returned, the customer will be invoiced for the repair parts. Field repairs are made at the user's own risk. "Authorization" by Quick Charge to repair refers to maintaining the warranty only. Quick Charge assumes no responsibility or liability for field servicing, and shall not be responsible for incurred travel or labor charges.
Quick Charge corporation shall not in any event be liable for the cost of any special, indirect or consequential damages to anyone, product or thing. This warranty is in lieu of all other warranties expressed or implied. Quick Charge neither assumes nor authorizes any representative or other person to assume for us any liability in connection with the sale of this product.

REV	DESCRIPTION	DATE	BY



PART NO.	DESCRIPTION
	BRB-3100 HYDRAULIC SCHEMATIC

TOLERANCES
ANGLES ± .500
1 PL DEC ± .060
2 PL DEC ± .010
3 PL DEC ± .005

BLASTPRO MFG.

6021 MELROSE LANE
OKLAHOMA CITY, OK
73127 USA

SCALE	DRAWN BY
	DWF
SHEET	DATE
1 OF 1	01/15/16

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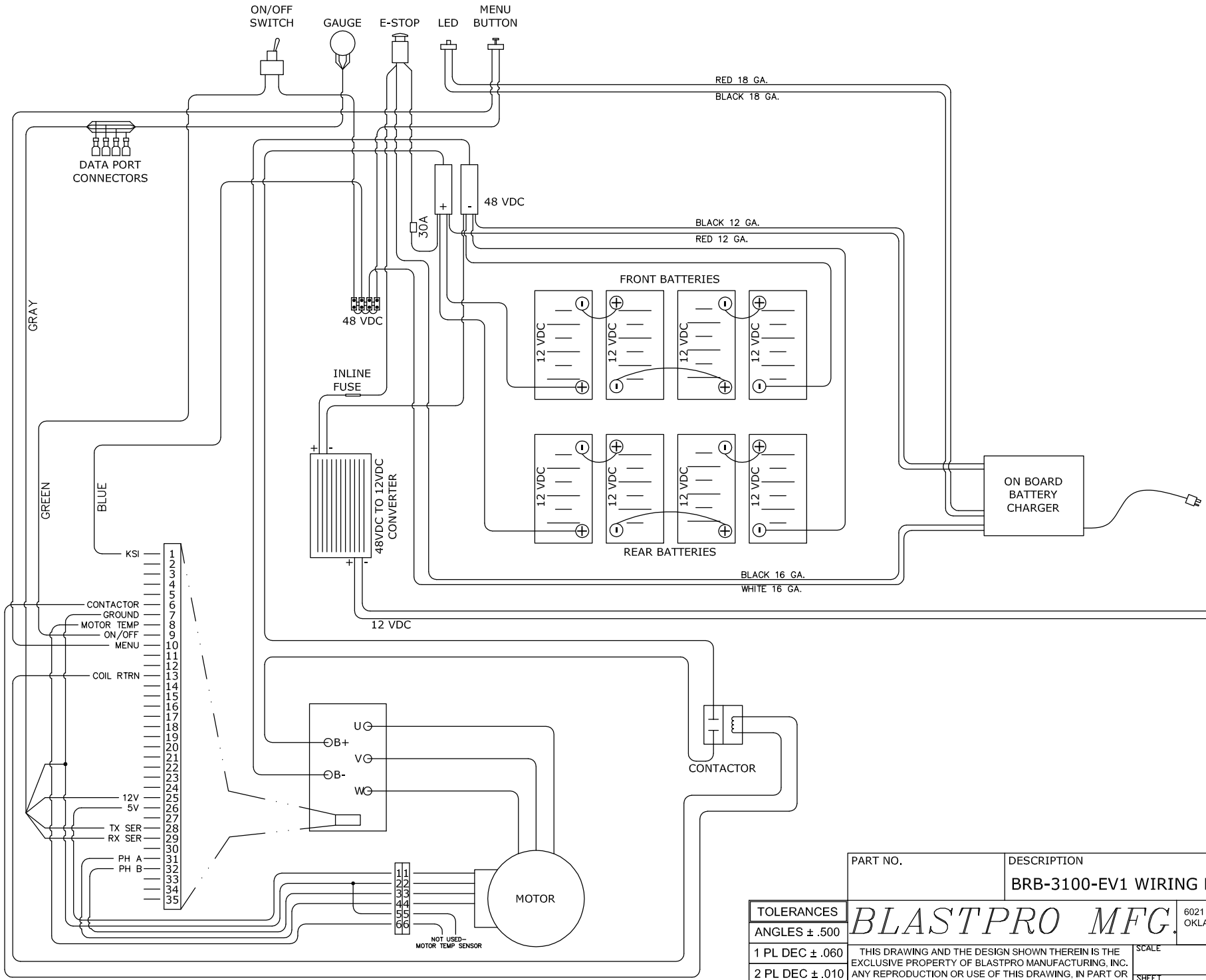


PART NO.	DESCRIPTION
	BRB-3100-EV1 WIRING DIAGRAM

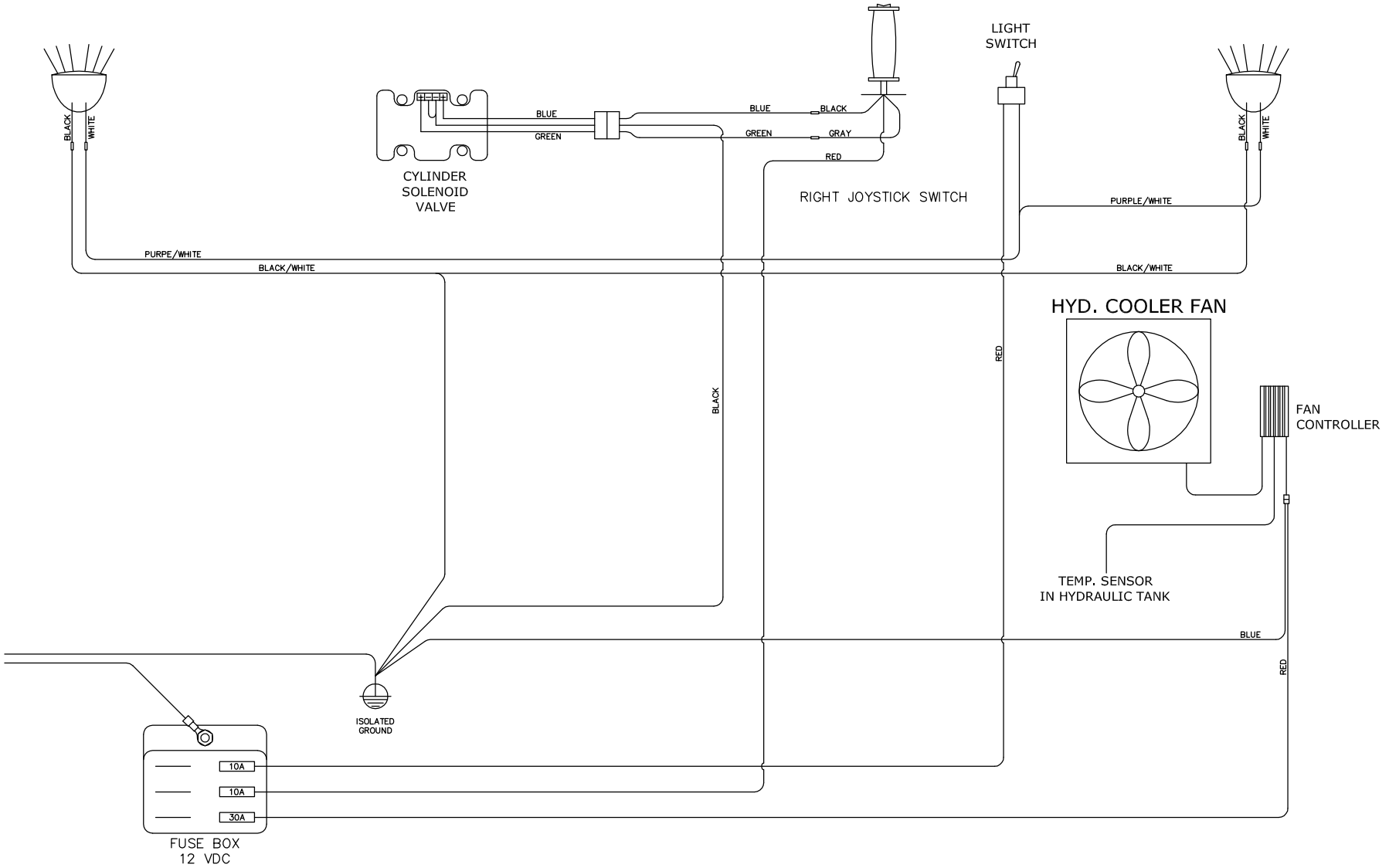
TOLERANCES
ANGLES ± .500
1 PL DEC ± .060
2 PL DEC ± .010
3 PL DEC ± .005

BLASTPRO MFG.

6021 MELROSE LANE
OKLAHOMA CITY, OK
73127 USA

SCALE	DRAWN BY
	DWF
SHEET	DATE
1 OF 2	02/11/16

REV	DESCRIPTION	DATE	BY



PART NO.	DESCRIPTION
	BRB-3100-EV1 WIRING DIAGRAM

TOLERANCES
ANGLES ± .500
1 PL DEC ± .060
2 PL DEC ± .010
3 PL DEC ± .005

BLASTPRO MFG.

6021 MELROSE LANE
OKLAHOMA CITY, OK
73127 USA

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2 OF 2	02/11/16