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E-280B-AC

WARNING

This manual is for the exclusive use of dealers accredited by Motrec International Inc. and should not be considered an official document constituting any kind of guarantee for the end user. All information and data are subject to change without notice. All photos contained in this document are for illustrative purposes only and may include non-applicable options.

PARTS:
It is recommended that part numbers be confirmed with Motrec International Inc. before ordering by providing the serial number of the vehicle requiring the part. In some cases, the part installed on the vehicle may differ from the manual depending on the options chosen.

Publication date:
July 1, 2015

Edition for vehicles with
a serial number higher than:
1131229

For additional information,
please contact our customer service:

MOTREC INTERNATIONAL INC.
200 Des PME Street
Sherbrooke, Quebec J1C 0R2
Canada
1-866-846-3558

AVERTISSEMENT

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PIÈCES:
Il est recommandé de valider les numéros de pièces avec Motrec International Inc. avant de commander, en fournissant le numéro de série du véhicule pour lequel la pièce est requise. Dans certains cas, il est possible que la pièce installée sur le véhicule diffère du manuel en fonction des options choisies.

Date de publication:
1er juillet 2015

Édition destinée aux véhicules ayant
un numéro de série supérieur à:
1131229

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MOTREC

E-280B AC

OPERATOR AND MAINTENANCE MANUAL
SPARE PARTS LISTS INCLUDED

SERIAL NUMBER : 1131229 & UP

Printed in Canada

One Year Limited Warranty

Effective April 25, 2005, Motrec International Inc. (MOTREC) hereby warrants to the Original Retail Purchaser (Owner) that any of its vehicles shall be free from any defect in materials for a period of 90 DAYS while in the possession of such Original Retail Purchaser. This warranty IS NOT TRANSFERABLE to any subsequent Buyer.

The warranty period is extended to one year or one thousand (1,000) hours, which ever first occurs, on the electric motor, differential (parts that bathe in oil) and the electronic speed controller. MOTREC makes no warranty or representation with respect to the internal combustion engine, tires and batteries, since their respective manufacturers cover such parts. Accessories (light, gage, horn, etc), electrical contacts (switch, solenoid, contactor, relay), diodes & fuses, belts & pulleys, filters & spark plugs, lubricants, brake linings & shoes, brake drums & discs, seals, seats, trim and other items subject to wear are not included in this warranty; nor is any item that in MOTREC sole opinion, shows evidence of neglect, misuse, abuse, collision or alteration.

This warranty shall not apply to normal maintenance requirements as described in the User Manual, and to damages during shipment. The latter is the carrier's responsibility. No compensation will be allowed for delays.

To initiate warranty coverage on any MOTREC vehicle, the Dealer must complete and return the “Sales/Installation Report” to MOTREC within 30 days after delivery to the Original Retail Purchaser; or within 90 days after the delivery date to the Dealer, which ever occurs first. Failure to follow these procedures will result in considering the warranty coverage effective as of the shipment date from the factory.

The defective vehicle must be returned, at the Owner's expense, to an authorised MOTREC Dealer within 30 days after failure. The Owner will not be charged for parts and labour required for warranty repairs, which must be performed by an authorised MOTREC Dealer only. The vehicle will be returned at the owner’s expense. The Warranty Claim Forms must be completed and returned with the defective part(s) to MOTREC within 30 days after repair was done. No compensation will be allowed for damages caused by vehicle downtime.

It is the responsibility of the owner of the vehicle to make sure that the driver is properly trained and instructed in the safety features and operation of the vehicle, including vehicle stability, as required by OSHA and ANSI-B56. Operators shall read, understand and follow the safety and operating instructions in MOTREC Manual before driving the vehicle. Operators shall not be permitted to drive the vehicle unless a complete and adequate training has been provided. Driving a vehicle constitutes a hazard. The driver is responsible for the control of the vehicle while driving and must always evaluate and care for all peculiar situations that he or she may meet while driving. The driver assumes the inherent hazards related to this activity. The vehicle is designed for off-road use only. MOTREC disclaims any liability for incidental or consequential damages, to include, but not be limited to, personal injury or property damage arising from vehicle misuse, lack of maintenance or any defect in the vehicle.

It is the responsibility of the Owner of the vehicle to make sure that the service technicians are properly trained as required by OSHA and ANSI-B56. Service technicians shall read, understand and follow instructions in the MOTREC manual before servicing the vehicle. Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect the vehicle.

MOTREC prohibits, and disclaims responsibility for, any vehicle modification altering the weight distribution and stability, increasing the speed or affecting the safety of the vehicle. Such modifications can cause serious personal injury or property damage for which MOTREC disclaims any responsibility.

For Owners that are located outside North America, the warranty period starts the date of shipment from the factory, and the defective parts must be returned at the Owner's expense to MOTREC prior to warranty repair.

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INSTRUCTIONS

SAFETY WARNINGS FOR OPERATORS

- FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAY RESULT IN SEVERE INJURY.
- It is the responsibility of the owner of this vehicle to train operators to ensure that they understand the operating characteristics of this vehicle, including training in vehicle stability, and obey the following safety rules and guidelines. Owner shall comply with OSHA and ANSI/ITSDF B56.8 & B56.9 Standards for vehicle use, safety rules, operator training and certification. Do not drive this vehicle unless you are a qualified operator.
- Do not drive this vehicle under the influence of drugs or alcohol.
- Do not drive this vehicle on public roads and highways. This vehicle is designed to be driven in buildings.
- The electrical system of this vehicle will make sparks which can ignite inflammable materials. Never use the vehicle in hazardous areas where there are inflammable materials, explosive dust or fumes in the air.
- Have your vehicle inspected regularly by trained personnel, and cease operation if a malfunction occurs.
- Do not open battery compartment to prevent battery explosion, acid splashing, severe damage to eyes or skin.
- Do not open motor compartment. Keep clear from moving, rotating(wheels, sheaves, etc) or lifting parts.
- Never carry more passengers than number allowed for this vehicle. Wait until all occupants are seated and holding on before moving. Always keep all body parts inside vehicle. Keep both hands on steering wheel.
- Do not exceed the vehicle cargo load capacity and gross trailing weight capacity, rated for flat hard even surface. Different operating conditions such as loose terrain or ramps reduce vehicle capacity.
- Avoid loose, unbalanced or top-heavy loads to keep a good stability and prevent overturn. Do not load cargo that can fall off the vehicle. Do not carry cargo that is longer, wider or higher than this vehicle.
- Always depress slowly the accelerator for smooth acceleration. Avoid stunt driving or horseplay.
- Avoid sharp turns, always slow down before turning, to prevent vehicle overturn or trailer jack knife. Vehicle is more sensitive to overturn and jack knife when traveling on inclines or when carrying a heavy load.
- Always drive straight up and down the face of an incline, never across the face, to prevent overturn and trailer jack knife. Drive slower and start applying brakes sooner on inclines to adjust for longer stopping distance.
- Use extra care and drive slowly in reverse, in congested areas or on wet or slippery ground.
- Keep to the right under normal conditions. Maintain a safe distance from all objects.
- Slow down and sound the horn when approaching a corner or other blind intersections.
- Before leaving the vehicle, park on a level ground flat surface, turn off all switches, set the forward/reverse switch to neutral, set the parking brake, remove the key. Do not park the vehicle on an incline.
- Before battery charging, park the vehicle in a well ventilated area set for. Do not operate it when charging. To interrupt a charging cycle, disconnect the AC plug; disconnecting the DC plug or a battery terminal, or operating the vehicle, could damage the charger and produce a spark, battery explosion and acid splashing.
- Use another driver to steer this vehicle while it is towed. Be sure the driver uses brakes when you slow or stop the towing vehicle. Do not exceed 5 MPH or carry any passenger while towing this vehicle.

OPERATING INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions in this manual and ANSI/ITSDF B56.8 & 9 Standards. Do not drive this vehicle unless you are a certified operator as required by OSHA.

BEFORE TURNING ON KEYSWITCH

Set to neutral, set parking brake, check for visible damage, check brake pedal.

AFTER TURNING ON KEYSWITCH

Check safety devices: seat switch, reverse alarm, motion beeper, strobe light, and all other safety devices.

BATTERIES

Never open the battery compartment unless you have received proper training for battery maintenance.
Batteries emit explosive hydrogen gas that can be ignited by a spark or loose terminal. Battery acid causes severe damage to eyes or skin. Flush the contaminated area immediately with water. Park the vehicle in a well ventilated area for battery charging. Most battery chargers come with an electronic control that starts when the charger is plugged and stop when the battery is fully charged. To interrupt the charging cycle, disconnect the AC-plug, do not disconnect the DC plug.

BATTERY DISCHARGE INDICATOR

The green light moves from right to left as batteries are being discharged. When the green light is at the last position on the left the batteries must be recharged. A flashing light warns the operator that further discharge will damage batteries. See HOBBS indicator instructions.

EMERGENCY SAFETY DEVICE

The emergency push button or battery disconnect handle, when present, should only be used in case of emergency. Use the key switch for normal ON/OFF control.

KEYSWITCH

Depress brake pedal and turn the key switch clockwise for on position. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

HORN

Depress the horn button on the steering column or handle bar.

F/R SWITCH

Three positions with neutral at center. Depress the front part of the rocker switch for forward direction. Depress the rear part of the rocker switch for reverse direction. Always set switch to neutral, turn off all switches, set the parking brake, remove the key before leaving the vehicle.

ACCELERATOR PEDAL

It is designed for right foot operation only, and controls the speed of the vehicle. Apply slowly.

FOOT BRAKE PEDAL

It is designed for right foot operation only. The brake force is proportional to the pressure on the pedal.

PARKING BRAKE

Pull handbrake lever to apply. Never park the vehicle on an incline. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

INCHING CONTROL INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions in this manual and ANSI/ITSDF B56.8 & 9 Standards. Do not drive this vehicle unless you are a certified operator as required by OSHA.

INCHING CONTROL FEATURE

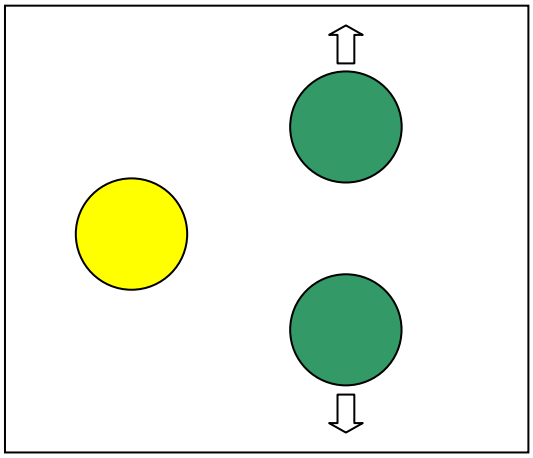
Inching control allows the operator to move the tractor slowly using push buttons located on the rear of the tractor. It is used to facilitate the utilisation of the hitch.

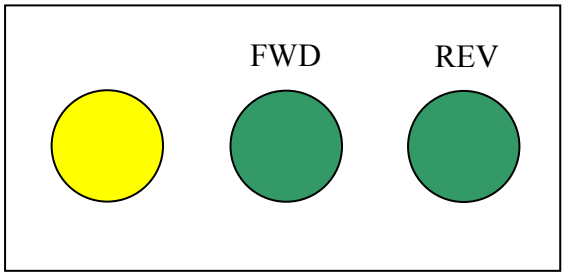
BEFORE USING INCHING CONTROL

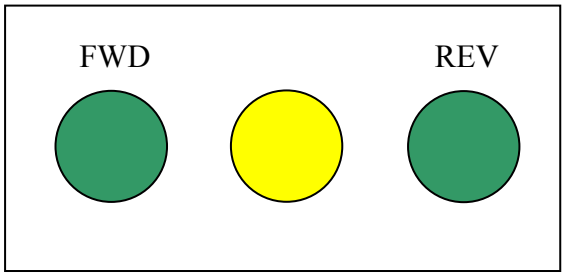
Always use driving position to get close to the trailer: never use inching control if the trailer eye is more than 12'' (inches) far from the hitch. Never use inching control if tractor is on an incline. Inching control also limits the torque and the floor must be clean from debris that could bloc the wheels. Before using inching control, make sure no one else is on or nearby the tractor, key switch is turned on and tractor is set to neutral.

INCHING CONTROL OPERATION

There are three buttons (see illustrations). One black or red and two green. To operate inching control, depress yellow/red button and while maintaining this button depressed, jog the forward or reverse green button. The green button must be jogged to obtain a creeping speed in the desired direction. Do not maintain the green button depressed, the tractor would accelerate and maintain constant speed, too fast for precise hitch positioning.







ELECTROMAGNETIC BRAKE

This vehicle could be equipped with electromagnetic parking brake. This spring applied and electrically released brake keeps the vehicle stationary when it comes to a stop or power is cut. When the accelerator is depressed, the brake is released automatically.

If the vehicle is not powered and must be moved, the following steps must be done to avoid any damage to the vehicle:

1- Remove the knobs located outside the electrical components compartment.

2- Screw the knobs behind the electromagnetic brake to manually release the brake.

When the vehicle is ready to be used, the knobs must be removed from the electromagnetic brake and put back to their storage location.

MAINTENANCE

SAFETY WARNINGS FOR SERVICE TECHNICIANS

FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.

Owner shall comply with OSHA and ANSI/ITSDF B56.8 & B56.9 Standards for vehicle maintenance.

Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect carriers, vehicles, tractors, and batteries.

Before any maintenance work, park the vehicle on flat level surface, turn off all switches, remove key, lift wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Keep clear from moving parts such as tires, sheaves and motor.

Follow the maintenance instructions applicable to the type of repair, maintenance, or service.

Always wear a face shield and gloves when working around batteries.

Before opening the battery compartment, disconnect the charger, turn off all switches and remove the key. Batteries emit highly explosive gases which greatly increase when charging; do not disturb connections or produce sparks around batteries to avoid a battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.

Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.

Use two counteracting tools, double-wrench technique, when disconnecting or tightening terminals on the battery and the speed controller to avoid cracking the terminal or battery post welds.

Before cleaning or replacing a battery, charger, speed controller, contactor, relay, diode, or any other component in the power circuit, always disconnect the charger, turn off all switches, remove the key, wear a face shield and gloves, identify battery polarity and disconnect battery leads, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-.

After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

On EE-Rated vehicles make sure that the control box is sealed, the static strap makes good contact with the ground, the motor is sealed by bands, the cable protectors are properly installed.

Keep cables and wires clear from mechanical and rubbing action. Make sure that cable insulation is free from cutting or visible damage. Make sure that EE-Rated cable protectors are properly installed.

Before replacing a fuse or circuit breaker, identify the cause of failure and repair.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

SEPEX speed controls are protected by a diode in the power circuit to filter inductive loads in the event of a sudden power interrupt. Some speed controllers require a diode to filter inductive loads on the KSI input. Removing the diodes will cause the speed control failure.

Before resuming maintenance operations, inspect safety warnings stickers and replace any if damage is found and part of the text can't be read.

Check decals and labels, see "DECAL AND LABELS" page.

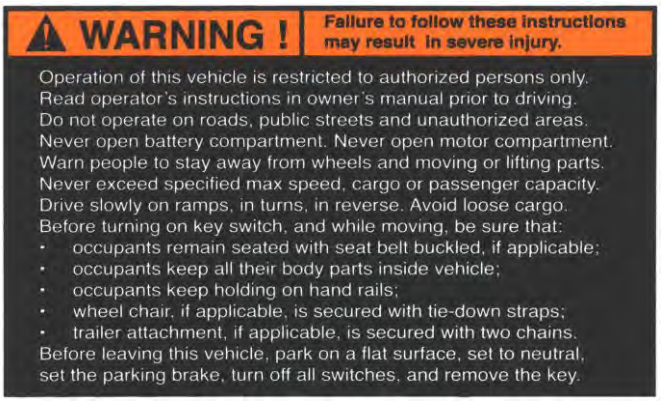
DECALS AND LABELS

! CAUTION !

The images included in this section depict the decals/markings installed on the vehicle. It is of the utmost importance that theses decals/markings remain unaltered and readable. Else, the sticker or the part baring the marking has to be replaced.

Dashboard security warning label:
5100000002

General security warning label:
5100000001



When an emergency push button is installed, this label is required (located under push button): # 3109800006

When a disconnect handle is installed, this label is required (located in front of handle):
4800012J

Respectively, key switch markings, forward/reverse selector markings and light switch marking:

266211

2819321003

1269004

PERIODIC MAINTENANCE CHECKLIST

FOR MODELS WITH DIRECT DRIVE AXLE

REVISION 2014-08-19

! WARNING !

Maintenance operations must be made by properly trained service technicians.

- Keep clear from moving parts such as tires, sheaves and motor.
- Batteries contain sulphur acid that can cause severe burns on skin or eyes.
- When working around batteries, wear acid proof protective equipment: face shield and gloves.
- Use electrically insulated tools to avoid sparks that can cause battery explosion.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity, identify and disconnect battery leads. Don't connect the charger.

CHECK/PERFORM **PERIOD HOURS**	**DAY**	**WEEK 20**	**MONTH 50**	**QUART. 200**	**YEAR 1000**
MECHANICAL DAMAGE, OIL LEAKS	**X**				
REVERSE ALARM, DEADMAN SWITCH	**X**				
STATIC STRAP, min 2" contact with ground	**X**				
TIRE PRESSURE, pressure rating on tire		**X**			
CHECK/FILL BATTERIES, add distilled water to cover plates. Fill to recommended level after batteries have been fully charged.		**X**			
WARNING DECALS & MARKINGS			**X**		
MASTER CYLINDER FLUID (DOT 3)			**X**		
BRAKE PEDAL TRAVEL 2" (50 mm) maximum travel			**X**		
STEERING FOR PLAY			**X**		
PARKING BRAKE LEVER requires 30-40 lbs. (14-18 kg) force to apply			**X**		
CLEAN/TIGHTEN WIRE TERMINALS				**X**	
WASH BATTERY TOP WITH WATER				**X**	
ACCELERATOR ADJUSTMENT -1/8" (3 mm) travel to activate micro-switch; -0 to 50 ohms when micro-switch activated; -4500 to 5500 ohms with pedal down.				**X**	
HYDR. BRAKE LINES FOR LEAK				**X**	
STEERING ASSEMBLY, as instructed				**X**	
BRAKE MECHANICAL LINKAGES for wear & play				**X**	
BRAKE LININGS FOR WEAR 1/16" (2 mm) minimum lining thickness.				**X**	
LUBRICATE (GREASE EP-2) brake pedal pivots, steering column, ball joints and kingpins.				**X**	
OIL (SAE 80W90 GL3 or GL5) LEVEL IN DIFFERENTIAL Before adding oil, check oil seals for leaks.				**X**	
FRONT WHEEL BEARINGS PLAY				**X**	
TIGHTEN NUTS/BOLTS, electric terminals; drive; steering; brakes; suspension; body.				**X**	
REPLACE DIFFERENTIAL OIL(SAE 80W90 GL3 or GL5), QTY 500 ML					**X**
CLEAN AND RE-PACK FRONT HUBS					**X**

OIL GRADE CHART

Vehicle system	Oil grade
Differential	SAE 80W90 GL3 OR GL5
Brakes	DOT 3, concurring with DMVSS116 standard
Bearings, tie rods, pivots	Grease NLGI #2 GC-LB

ACCELERATOR

GEAR

- Remove the cover.
- Backlash between gears must be reduced to a minimum by sliding holder; use locktite 262 to lock the three screws.
- When the plastic gear is fully depressed a small backlash must remain between the gears.
- When the plastic gear is released its rear portion must not exceed the pedal case.

MICRO-SWITCH

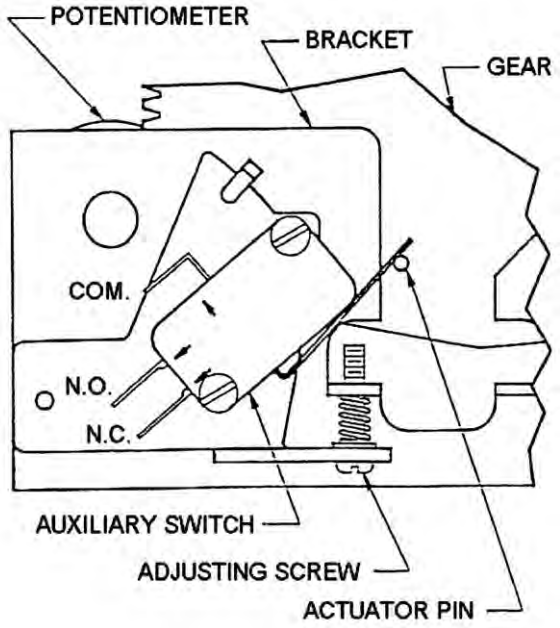
The micro-switch must deactivate the on/off solenoid when the accelerator is released; turn the adjusting screw (shown on figure below) to adjust the micro-switch height.

POT

- Remove the terminals 2 and 3 on PMC to measure resistance signal.
- When the micro-switch is activated the signal must be less than 50 ohms. When the front portion of the pedal is fully depressed the signal must be more than 4600 ohms.
- To modify the resistance, turn the adjusting screw to change the micro-switch height (see figure below).

Proceed with the same verifications after the accelerator cover is on and then connect terminals 2 and 3.

AUXILIARY SWITCH IS WIRED N.O. WITH BLUE LEAD TO COM. & ORANGE LEAD TO N.O. CIRCUIT. THE GREEN LEAD IS GROUNDED. AUXILIARY SWITCH IS SHOWN WITH THE TREADLE IN THE UP POSITION. SWITCH WILL ACTUATE AT BEGINNING OF TREADLE STROKE. SYMBOLS COM., N.O. & N.C. ARE TERMINAL MARKINGS, AS MARKED ON SWITCH.



FOOT PEDAL FP-6 MAINTENANCE GUIDELINES

FEATURES -

- FP 6 is designed for IP rating 64
  - It can work in dusty atmosphere.
  - It has sealing against splashing and spraying water from all side.
  - We do not recommend low pressure or high pressure washing.

SPECIFICATIONS -

- Pedal high point is pedal free condition
- 1st Microswitch Setting ;
  a) First micro switch should operate at 3º ± 1º (i.e. between 2º to 4º) from free condition
- Pot setting
  a) Operate pedal slowly; find reading at which first Microswitch operates.
  b) Pot resistance reading across pot low and wiper (i.e. black and white) must be within 100Ω to 400Ω.
- 2nd Micro switch setting
  a) 2nd micro switch should operate between 4600 Ω and *pot max* resistance, across *pot low and wiper* (i.e. black and white)

INSTALLATION PROCEDURE

Terminology - ***"Pot low", "wiper" and "pot high"*** are pot terminals. (Black, white and red cables respectively) "***Pot max resistance***" is the resistance value across pot low and pot high. (Black and Red cables)

1. MICRO SWITCHES AND POT SETTING

For Foot Pedal FP-6, use pot low and wiper (black and white) for setting micro switches.

- Set Pedal at free condition.
- Adjust pedal at 3° deflection. Set first micro switch to operate about set deflection.
- Adjust pot resistance from high valve to get (100 to 400Ω) across *pot low and wiper* (i.e. black and white).
- Set 2nd micro switch between 4600 Ω and *pot max* resistance.

CHECK LIST / CAUTION

- Pedal angle must be within 30 +/- 3 degree. Check freeness of pedal.
- Select 'resistance' measurement range in as per requirement on the Multi meter. Minimum resistance between pot low and wiper must be less than 10 ohms. Pot Max Resistance (between pot low and pot high) must be within 4500 to 5500 ohms.
- Confirm that micro switch settings are as per specifications.
- Measure the resistance between each of the seven wires and the housing of the Foot Pedal. It should measure "Infinity"
- Visually check the insulating sleeves are put around the soldered side of all seven cables, and that the sleeves are firmly in place.

YEARLY MAINTENANCE

- Remove cover of Pedal.
- Apply 3 to 5 drops oil on pedal return spring.
- Apply 2 drops oil in the slot of front bush.
- Do not apply oil on shaft from outside. It is of no use, due to sealing on the shaft.
    i. Oil Specification
    ii. 20W Motor Oil (Or 3 in one motor oil)
    iii. 20 stand for weight of motor oil.
    iv. W Stands for winter grade.

HYDRAULIC & PARKING BRAKES

FOR DIRECT DRIVE MODELS

Revision 2014-08-19

DRUM BRAKES

Remove brake drums and check lining wear. Replace shoes and springs if the lining thickness is 1/16" (2mm) or less. Turn the brake adjustment to reduce the clearance between lining and drum. Wheels must turn free when the pedal is released.

DISC BRAKES

Check pad linings. Replace pads if lining thickness is 1/16" (2 mm) or less.

PARKING BRAKE

Replace cables and stoppers if cable play exceeds 1/8” (4mm).
Wheels must turn freely when the parking brake is released.

Once cable play has been checked and/or adjusted, turn the knob on the brake lever until a force of 30-40 Lbs or 14-18 kg is required on the handle to set the parking brake. Tighten the locking screw.

BRAKE PEDAL

If the brake pedal becomes soft or spongy, air may have entered the hydraulic system and the brake system has to be bled:

1. fill the master cylinder with brake fluid (DOT-3);
2. bleed front calipers one at a time by having someone applying a steady pressure on the brake pedal, and close the bleeder before allowing the brake pedal to return to up position;
3. fill the master cylinder with brake fluid (DOT-3);
4. bleed rear wheel brakes one at a time, following the same procedure;
5. fill the master cylinder with brake fluid (DOT-3);
6. clean every fitting and line, remove traces of oil;
7. apply a continuous pressure on the brake pedal for about five minutes ;
8. Finally, inspect brake lines and fittings for leaks ;

BATTERY MAINTENANCE

! WARNING !

- It is the responsibility of the owner of this vehicle to ensure that the service technicians are properly trained, read and obey the safety rules and guidelines in this manual (ANSI B56).
- Maintenance operations must be made by properly trained service technicians only.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all the switches, set to neutral, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity.
- Keep charger disconnected while doing any maintenance work.
- Always wear a face shield and scarf when working around batteries.
- Battery emits highly explosive gases; do not produce sparks to avoid battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.
- Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.
- Use two counteracting tools, double-wrench technique, when disconnecting or tightening battery posts.
- Before cleaning or replacing a battery, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-, identify battery polarity and disconnect battery leads.
- After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

BATTERY LEADS AND CONNECTORS

Check for loose connections, damaged cables, acid spill, loose terminal posts, quarterly.

BATTERY POST CORROSION

If corrosion is present on battery posts, remove the cable connectors, use a wire brush to remove particles, and then clean them with a cloth that has been moistened with ammonia.

ELECTROLYTE LEVEL

Does not apply to sealed battery.

- Disconnect battery connectors on roll-out or lift-out installations.
- Make sure the battery roll-out tray is provided with stops before rolling out.
- Fill with distilled water.
- Daily charged batteries normally require watering once a week. Under watering leads to a shortened battery life. Over watering leads to battery corrosion. Be careful not to overfill any cell to avoid electrolyte to be forced out while charging.
- Fill each cell to plate level with distillated or de-ionized water, before battery charging. When the battery is charged, the fluid expands and can seep out if overfilled. Refill each cell after full charge, when the fluid has expanded to its maximum level.
- Reinstall battery caps before charging.

BATTERY MOUNTING

A loose battery increases damaging effects of vibrations and is more prone to short out.

BATTERY DISCHARGE LIMIT

Discharging below a 20% state of charge cuts down the battery life and the number of cycles available. At 20% state of charge, specific gravity of 6V battery should be 1180; and 1220 for industrial battery.

CHARGING AREA

- Always charge battery in a well ventilated area set for and approved for charging.
- Never leave a charger connected for more than 20 hours.

FREQUENCY OF CHARGE

- When a battery is discharged to its 20% state of charge, it is best to charge immediately.
- Batteries require a low current equalization charge (min 4 hours) at least every week, to equalize battery cells, improve battery performance and life in number of cycles.
- Never leave a charger connected for more than 20 hours.

STORAGE

- Keep the battery from getting cold, it would loose its capacity.
- Let the battery warm up before charging.
- Charge batteries in “stored” vehicles every month.

DEFECTIVE BATTERY

Check specific gravity of each cell; if a cell is shorted, voltage drop may occur only when there is current.

BATTERY CHARGER

! WARNING !

Always unplug the AC and DC electrical cords before attempting any repairs to the charger.

CHARGER DOES NOT TURN ON:

- Dc cord of portable chargers must be disconnected from batteries after every charge to restart;
- Check dc fuse links;
- Check battery voltage at the battery connector;
- Check ac outlet and cordset;
- Replace electronic control ;

RELAY CLOSES AND TRANSFORMER HUMS BUT AMMETER DOES NOT REGISTER:

- Check dc fuse links;
- Check the continuity of the dc output cord, ammeter, diodes and all connections in the dc circuit;
- Check diodes;
- Check capacitor(rapidely increasing resistance);

SINGLE CHARGER FUSE BLOWS:

- Disconnect and check diodes;

BOTH FUSE LINKS BLOW:

- Check the battery pack and battery connector polarity;
- Disconnect and check diodes.

CHARGER OUTPUT IS LOW:

- Disconnect and check diodes;
- Can be caused by a transformer failure.

AMMETER READS 30 AMPS FOR MORE THAN 30 MINUTES:

- Check the battery pack;

CHARGER DOES NOT TURN OFF:

- Check specific gravity in each battery cell;
- As much as 16 hours may be required to properly charge heavely discharged new or cold batteries;
- Replace electronic control.

AC LINE FUSE OR CIRCUIT BREAKER BLOWS:

- Check ac cordset;
- Check ac line fuse rating;
- Replace electronic control;
- Can be caused by a transformer failure.

ELECTRICAL TROUBLESHOOTING

! WARNING !

Maintenance work must be performed by trained service technicians only.

It is the responsibility of the owner of this vehicle to ensure that the services technicians are properly trained, understand and obey the safety rules and guidelines (ANSI B56).

All service technicians must read and understand the maintenance warning section in this manual.

! WARNING !

Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground, secure with jack stands of adequate capacity, disconnect charger.

Always wear safety glasses.

Batteries emit highly explosive gases that can be ignited by a spark. Before disconnecting a high current terminal, turn off all switches, disconnect battery charger and disconnect batteries.

Keep clear from moving parts such as tires, sheaves and motor.

PMC SELF DIAGNOSTIC

If the vehicle has a display, it will give the error codes to help troubleshooting. The PMC also comes with a status LED, which gives a flashing code to help troubleshooting.

BATTERY VOLTAGE

Make sure batteries are securely connected. Measure voltage between + and - terminals. We will call this value B+ or full battery voltage.

ACCESSORIES NOT WORKING

- Check the fuses on the batteries and the DC/DC converter.
- Check voltage across + and – terminals on the battery gage; if not B+, check wiring.
- Turn the key switch ON, check voltage between output terminal on the key switch and the - terminal on the battery gage; if not B+, replace the key switch.
- Check voltage across DC/DC converter output terminals; if not 12-Volt, replace the converter.
- Depress the accessory switch, check voltage across accessory terminals. If not 12-Volt, replace the switch. If 12-Volt, replace the accessory.

FORWARD ONLY

Check the reverse signal input on the controller.
Switch to reverse and check voltage on the reverse control wire. If not B+, replace the F/R switch.

REVERSE ONLY

Check the forward signal input on the controller.
Switch to forward and check the voltage on the forward control wire. If not B+, replace the F/R switch.

TRAVEL AT REDUCED SPEED

Check batteries.

Turn off all switches and disconnect charger. Wear face shield and gloves. Do not disturb any battery connection to avoid sparks. Check the specific gravity of each cell. Cold batteries, highly discharged batteries or dead cells are the most frequent causes of reduced travel speed.

Check potentiometer.

Turn off the key switch, disconnect potentiometer terminals. Check the resistance between terminals.

Other causes of lower speed:
- dragging brakes;
- cold temperature (higher differential oil viscosity).

INTERMITTENT OPERATION

A bad potentiometer is the most probable cause of the following:
- acceleration is not constant;
- maximum speed is erratic;
- sudden stop after a bump or shock;
- erratic starts, requiring several pedal cycles.

Erratic starts could also be the cause of a misadjusted potentiometer or micro-switch; the pot signal must be less than 50 ohms when the micro-switch turns on.

PMC has a HPD safety feature that prevents the vehicle from moving if the accelerator pedal is depressed before the key switch is ON and seat switch is activated.

PMC also has a SRO safety feature that prevents the vehicle from moving if the F/R switch is activated before turning on the key switch and activating the seat switch.

The vehicle stops on a steep and long ramp or while towing a heavy load: the PMC monitors the temperature of the motor and is also equipped with an internal thermal protection that cutback the current until the PMC and/or motor has cooled down.

NO MOTION

Make sure that the PMC surface is clean and dry; check the terminal areas. Dust Particles or acid contamination, can create current leaks and cause a PMC malfunction.

Check F/R switch

Turn on the key switch and set to forward. Check voltage between the forward terminal and the B– post on the PMC, check voltage between the reverse terminal and the B– post on the PMC; if both B+, replace the F/R switch.

Check switches and wiring

Disconnect control terminals on the PMC and check all control signals. If a switch pin does not read B+, check wiring or replace the switch.

Check potentiometer

Turn the key switch to OFF, disconnect potentiometer terminals. Check the resistance across terminals: if not within the recommended limits, adjust or replace the potentiometer. Check for shorts between potentiometer wires and vehicle frame; resistance should read at least 1 megohm.

Check main contactor or solenoid

Check voltage on coil positive terminal; if not B+, check circuit breaker or replace the solenoid. Turn to on the key switch and activate the seat switch. Check voltage across the coil terminals; if not 24V, check wiring and interlock switches. Check resistance across power terminals; if not 0 ohms, replace the solenoid.

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.

9 MAINTENANCE

There are no user serviceable parts in Curtis 1234/36/38 controllers. **No attempt should be made to open, repair, or otherwise modify the controller.** Doing so may damage the controller and will void the warranty.

It is recommended that the controller and connections be kept clean and dry and that the controller's fault history file be checked and cleared periodically.

CLEANING

Periodically cleaning the controller exterior will help protect it against corrosion and possible electrical control problems created by dirt, grime, and chemicals that are part of the operating environment and that normally exist in battery powered systems.

CAUTION

When working around any battery powered system, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, and avoiding loose clothing and jewelry.

Use the following cleaning procedure for routine maintenance. Never use a high pressure washer to clean the controller.

1. Remove power by disconnecting the battery.
2. Discharge the capacitors in the controller by connecting a load (such as a contactor coil) across the controller's **B+** and **B-** terminals.
3. Remove any dirt or corrosion from the power and signal connector areas. The controller should be wiped clean with a moist rag. Dry it before reconnecting the battery.
4. Make sure the connections are tight. Refer to Section 2, page 5, for maximum tightening torque specifications for the battery and motor connections.

FAULT HISTORY

The 1311 programmer can be used to access the controller's fault history file. The programmer will read out all the faults the controller has experienced since the last time the fault history file was cleared. Faults such as contactor faults may be the result of loose wires; contactor wiring should be carefully checked. Faults such as overtemperature may be caused by operator habits or by overloading.

After a problem has been diagnosed and corrected, it is a good idea to clear the fault history file. This allows the controller to accumulate a new file of faults. By checking the new fault history file at a later date, you can readily determine whether the problem was indeed fixed.

PROGRAMMING PARAMETERS 1234 – 6 MPH – E-280B, E-290, E-360, T-236, T-236D

! WARNING
!

The owner of this vehicle shall ensure that the service technicians are qualified, properly trained and obey the safety rules and guidelines in OSHA and ANSI B56 regulations, and in this manual.

Before installing and/or programming the PMC, park the vehicle on a flat level surface, lift the wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

MOTREC-AC			
	Model	MOTREC-AC	
	Protocol Version	2	
	Parameter Block Version	0	
	Model Number	12345371	
	Serial Number	120539	
	Mfg Date Code	14069	
	Hardware Version	2.148	
	OS Version	12	
	Build Number	0	
	SM Version	2.6	
	Param Blk Version	1.03	
	VCL App Version	1.17	

Menu 1 Program	Menu 2	Menu 3	Menu 4	Menu 5	Value	Min	Max	Unit	Read Access	Write Access
	Motrec Parameters									
		Motrec Inputs								
			Interlock Delay			0.5	0	10 Seconds	Dealer	Dealer
			Charger Inhibit		Off	Off	On		Dealer	Dealer
			Throttle Pedal							
				Throttle Pedal Switch Enable	On	Off	On		Dealer	Dealer
				Throttle Pedal Switch Check	On	Off	On		Dealer	Dealer
				Throttle Voltage Neutral Max		1	0	5.5 Volt	Dealer	Dealer
		Motrec Outputs								
			Lights							
				Output Voltage		24	0	48 Volt	Dealer	Dealer
				Lights Always On	On	Off	On		Dealer	Dealer
				Lights Stay On Delay		5	0	60 Seconds	Dealer	Dealer
			Back Up Alarm							
				Output Voltage		36	0	48 Volt	Dealer	Dealer
				Back Up Alarm Only W/Motion	Off	Off	On		Dealer	Dealer
				Back Up Alarm Self Start SPD		-250	6000	0 rpm	Dealer	Dealer
			Brake Relay							
				Output Voltage		24	0	48 Volt	Dealer	Dealer
			EM Brake							
				EM Brake Pull In Voltage		24	0	48 Volt	Dealer	Dealer
				EM Brake Holding Voltage		24	0	48 Volt	Dealer	Dealer
			Main Contactor							
				Output Voltage		24	0	48 Volt	Dealer	Dealer
				Output Holding Voltage		24	0	48 Volt	Dealer	Dealer
			Battery Compensate							
				Battery Compensate Enable	On	Off	On		Dealer	Dealer
		Motrec Speed Limits(KMH)								
			Wheel Diameter(in)			16	15	18	OEM	OEM
			Differential Ratio			16.1	16	28	OEM	OEM
			Maint Due Spd Limit Enable		Off	Off	On		Dealer	Dealer
			KMH Max Speed Limits							
				Rabbit FWD Max Speed		9.6	1	30	Dealer	Dealer
				Rabbit REV Max Speed		4.8	1	30	Dealer	Dealer
				Turtle FWD Max Speed		6.4	1	30	Dealer	Dealer
				Turtle REV Max Speed		3.2	1	30	Dealer	Dealer
				Maintenance Due Speed		4.8	1	30	Dealer	Dealer
	Control Mode Select					1	0	2	OEM	OEM
	1 - Speed Mode									
		Speed Controller								
			Max Speed			1014	100	8000 rpm	OEM	OEM
			Kp			30	0	100 %	OEM	OEM
			Ki LS			30	5	100 %	OEM	OEM
			Ki HS			30	5	100 %	OEM	OEM
			Vel Feedforward							
				Kvff		0	0	500 Ampere	OEM	OEM

			Build Rate		1	0.1	5	Seconds	OEM	OEM
			Release Rate		0.4	0.1	5	Seconds	OEM	OEM
		Acc Feedforward								
			Kaff		0	0	500	Ampere	OEM	OEM
			Kbff		0	0	500	Ampere	OEM	OEM
			Build Rate		1	0.1	5	Seconds	OEM	OEM
			Release Rate		0.4	0.1	5	Seconds	OEM	OEM
	Response									
		Full Accel Rate HS			2	0.1	30	Seconds	OEM	OEM
		Full Accel Rate LS			1.5	0.1	30	Seconds	OEM	OEM
		Low Accel Rate			5	0.1	30	Seconds	OEM	OEM
		Neutral Decel Rate HS			1.5	0.1	30	Seconds	OEM	OEM
		Neutral Decel Rate LS			1	0.1	30	Seconds	OEM	OEM
		Full Brake Rate HS			0.5	0.1	30	Seconds	OEM	OEM
		Full Brake Rate LS			0.5	0.1	30	Seconds	OEM	OEM
		Low Brake Rate			1	0.1	30	Seconds	OEM	OEM
		Fine Tuning								
			Partial Decel Rate		10	0.1	30	Seconds	OEM	OEM
			HS (High Speed)		70	0	100	%	OEM	OEM
			LS (Low Speed)		30	0	100	%	OEM	OEM
			Reversal Soften		20	0	100	%	OEM	OEM
			Max Speed Accel		1	0.1	30	Seconds	OEM	OEM
			Max Speed Decel		10	0.1	30	Seconds	OEM	OEM
Restraint										
	Restraint Forward				50	0	100	%	OEM	OEM
	Restraint Back				50	0	100	%	OEM	OEM
	Soft Stop Speed				0	0	500	rpm	OEM	OEM
	Position Hold									
		Position Hold Enable		Off	Off	On			OEM	OEM
Current Limits										
	Drive Current Limit				100	5	100	%	OEM	OEM
	Regen Current Limit				100	5	100	%	OEM	OEM
	Brake Current Limit				100	5	100	%	OEM	OEM
	EMR Current Limit				100	5	100	%	OEM	OEM
	Interlock Brake Current Limit				100	5	100	%	OEM	OEM
	Power Limiting Map									
		PL Nominal Speed			1900	100	4000	rpm	OEM	OEM
		Delta Speed			500	50	1000	rpm	OEM	OEM
		Drive Limiting Map								
			Nominal		100	0	100	%	OEM	OEM
			Plus Delta		100	0	100	%	OEM	OEM
			Plus 2xDelta		100	0	100	%	OEM	OEM
			Plus 4xDelta		100	0	100	%	OEM	OEM
			Plus 8xDelta		100	0	100	%	OEM	OEM
		Regen Limiting Map								
			Nominal		100	0	100	%	OEM	OEM
			Plus Delta		100	0	100	%	OEM	OEM
			Plus 2xDelta		100	0	100	%	OEM	OEM
			Plus 4xDelta		100	0	100	%	OEM	OEM
			Plus 8xDelta		100	0	100	%	OEM	OEM
Throttle										
	Throttle Type				2	1	5		OEM	OEM
	Forward Deadband				0.5	0	5	Volt	OEM	OEM
	Forward Map				35	0	100	%	OEM	OEM
	Forward Max				4.5	0	5	Volt	OEM	OEM
	Forward Offset				0	0	100	%	OEM	OEM
	Reverse Deadband				0.5	0	5	Volt	OEM	OEM
	Reverse Map				35	0	100	%	OEM	OEM
	Reverse Max				4.5	0	5	Volt	OEM	OEM
	Reverse Offset				0	0	100	%	OEM	OEM
	Throttle Filter				10	2	125	Hz	OEM	OEM
	HPD SRO Type				1	0	3		OEM	OEM
	Sequencing Delay				0.1	0	5	Seconds	OEM	OEM
	VCL Throttle Enable			On	Off	On			OEM	OEM
Brake										
	Brake Pedal Enable			On	Off	On			OEM	OEM
	Brake Type				5	1	5		OEM	OEM
	Brake Deadband				0.5	0	5	Volt	OEM	OEM
	Brake Map				50	0	100	%	OEM	OEM
	Brake Max				4.5	0	5	Volt	OEM	OEM
	Brake Offset				0	0	100	%	OEM	OEM
	Brake Filter				10	2	125	Hz	OEM	OEM
	VCL Brake Enable			Off	Off	On			OEM	OEM
Drivers										
	Main Contactor									
		Main Enable		On	Off	On			OEM	OEM
		Pull In Voltage			67	0	100	%	OEM	OEM
		Holding Voltage			67	0	100	%	OEM	OEM
		Battery Voltage Compensated		On	Off	On			OEM	OEM
		Interlock Type			1	0	2		OEM	OEM
		Open Delay			0.1	0	40	Seconds	OEM	OEM
		Checks Enable		On	Off	On			OEM	OEM
		Main DNC Threshold			5	0	84	Volt	OEM	OEM
		Precharge Enable		On	Off	On			OEM	OEM

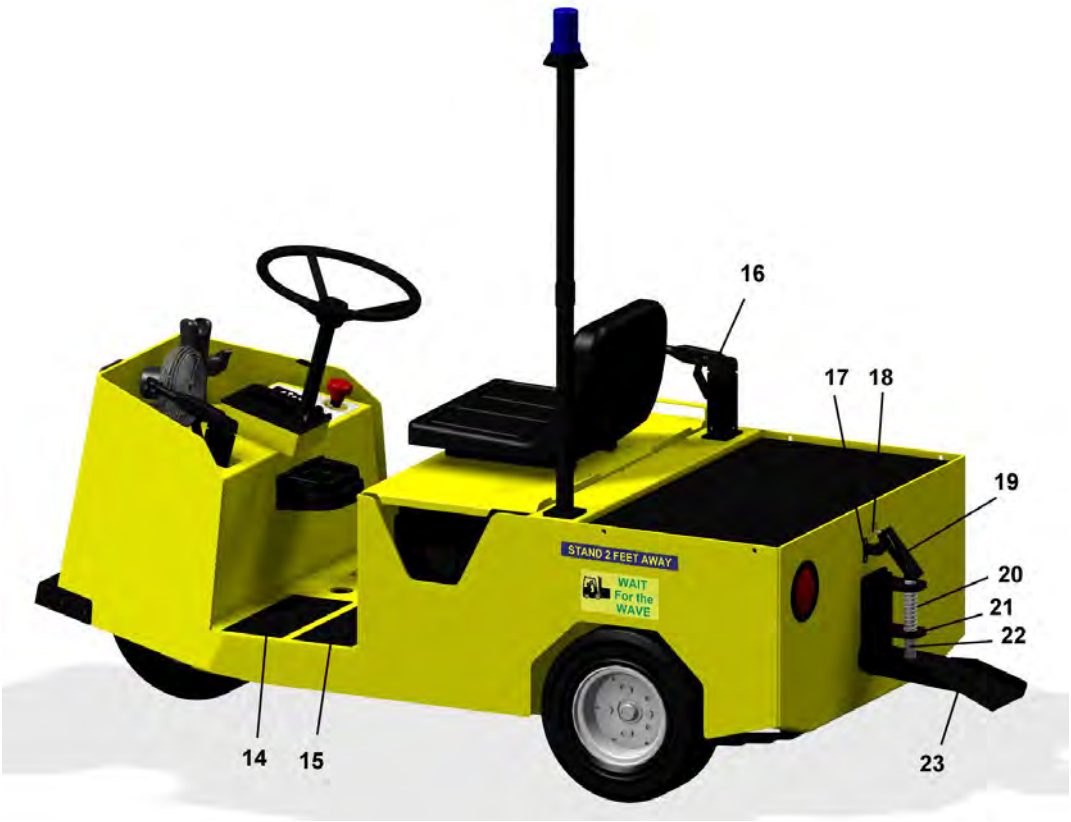
	Fault Checking								
		Driver 1 Checks Enable	On	Off	On			OEM	OEM
		Driver 2 Checks Enable	Off	Off	On			OEM	OEM
		Driver 3 Checks Enable	Off	Off	On			OEM	OEM
		Driver 4 Checks Enable	Off	Off	On			OEM	OEM
		PD Checks Enable	Off	Off	On			OEM	OEM
		External Supply Max		200	5	200	mAmpere	OEM	OEM
		External Supply Min		5	5	200	mAmpere	OEM	OEM
	PWM Frequency			200	100	1000	Hz	OEM	OEM
Motor									
	Typical Max Speed			1014	500	8000	rpm	OEM	OEM
	Swap Encoder Direction		On	Off	On			OEM	OEM
	Swap Two Phases		On	Off	On			OEM	OEM
	Encoder Steps			64	32	256		OEM	OEM
	Encoder Fault Setup								
		Fault Detection Enable	On	Off	On			OEM	OEM
		Fault Stall Time		5	0	10	Seconds	OEM	OEM
		LOS Upon Encoder Fault	On	Off	On			OEM	OEM
		LOS Max Speed		800	100	2000	rpm	OEM	OEM
		LOS Max Current		400	100	650	Ampere	OEM	OEM
		LOS Max Mod Depth		50	15	100	%	OEM	OEM
		LOS Accel Rate		7	2	15	Seconds	OEM	OEM
		LOS Decel Rate		3	2	15	Seconds	OEM	OEM
	Temperature Control								
		Sensor Enable	On	Off	On			OEM	OEM
		Sensor Type		3	1	5		OEM	OEM
		Sensor Offset		0	-20	20	deg C	OEM	OEM
		Temperature Hot		145	0	250	deg C	OEM	OEM
		Temperature Max		160	0	250	deg C	OEM	OEM
		MotorTemp LOS Max Speed		800	100	3000	rpm	OEM	OEM
Battery									
	Nominal Voltage			36	24	96	Volt	OEM	OEM
	Undervoltage Cutback Range			6.3	2	14	Volt	OEM	OEM
	User Overvoltage			125	115	200	%	OEM	OEM
	User Undervoltage			70	50	80	%	OEM	OEM
	Reset Volts Per Cell			2.09	0.9	3	Volt	Dealer	Dealer
	Full Volts Per Cell			2.04	0.9	3	Volt	Dealer	Dealer
	Empty Volts Per Cell			1.73	0.9	3	Volt	Dealer	Dealer
	Discharge Time			34	0	600	Minutes	Dealer	Dealer
	BDI Reset Percent			75	0	100	%	Dealer	Dealer
Vehicle									
	Speed to RPM			211.3	10	3000		OEM	OEM
	Capture Speed 1			4500	0	8000	rpm	OEM	OEM
	Capture Speed 2			4500	0	8000	rpm	OEM	OEM
	Capture Distance 1			50	1	1320		OEM	OEM
	Capture Distance 2			100	1	1320		OEM	OEM
	Capture Distance 3			150	1	1320		OEM	OEM
Emergency Reverse									
	EMR Enable		Off	Off	On			OEM	OEM
	EMR Type			0	0	1		OEM	OEM
	EMR Dir Interlock		Off	Off	On			OEM	OEM
	EMR Time Limit			3	0	30	Seconds	OEM	OEM
	EMR Speed			1000	50	6000	rpm	OEM	OEM
	EMR Accel Rate			0.1	0.1	3	Seconds	OEM	OEM
	EMR Decel Rate			0.1	0.1	3	Seconds	OEM	OEM
Interlock Braking									
	Enable		On	Off	On			OEM	OEM
	Decel Rate HS			1.5	0.1	30	Seconds	OEM	OEM
	Decel Rate LS			2	0.1	30	Seconds	OEM	OEM
	Interlock Brake Timeout			5	0	8	Seconds	OEM	OEM
CAN Interface									
	CANopen Interlock		Off	Off	On			OEM	OEM
	CAN Node ID			38	0	127		OEM	OEM
	Baud Rate			0	-3	2		OEM	OEM
	Heartbeat Rate			100	16	200	ms	OEM	OEM
	PDO Timeout Period			100	0	200	ms	OEM	OEM
	Emergency Message Rate			16	16	200	ms	OEM	OEM
	Suppress CANopen Init			0	0	1		OEM	OEM
Motor Control Tuning									
	Motor Characterization Tests								
		Test Enable		0	0	1		OEM	OEM
		Test Throttle		0	-1	1		OEM	OEM
		Motor Poles		4	2	8		OEM	OEM
		Max Test Speed		1000	500	3000	rpm	OEM	OEM
		Max Test Current		80	20	100	%	OEM	OEM
		SlipGain		2.8	0	200		OEM	OEM
	Field Weakening Control								
		FW Base Speed		1900	200	6000	rpm	OEM	OEM
		Field Weakening		0	0	100	%	OEM	OEM
		Weakening Rate		40	0	100	%	OEM	OEM
		Min Field Current		0	0	800	Ampere	OEM	OEM
	Motor Type			0	0	199		OEM	OEM
Reset Controller				0	0	1		OEM	OEM

SPARE PARTS

BODY


6
5
3
8
7
10
9
12
2
1
11
MOTREC
STAND 2 FEET AWAY
WAIT For the WAVE

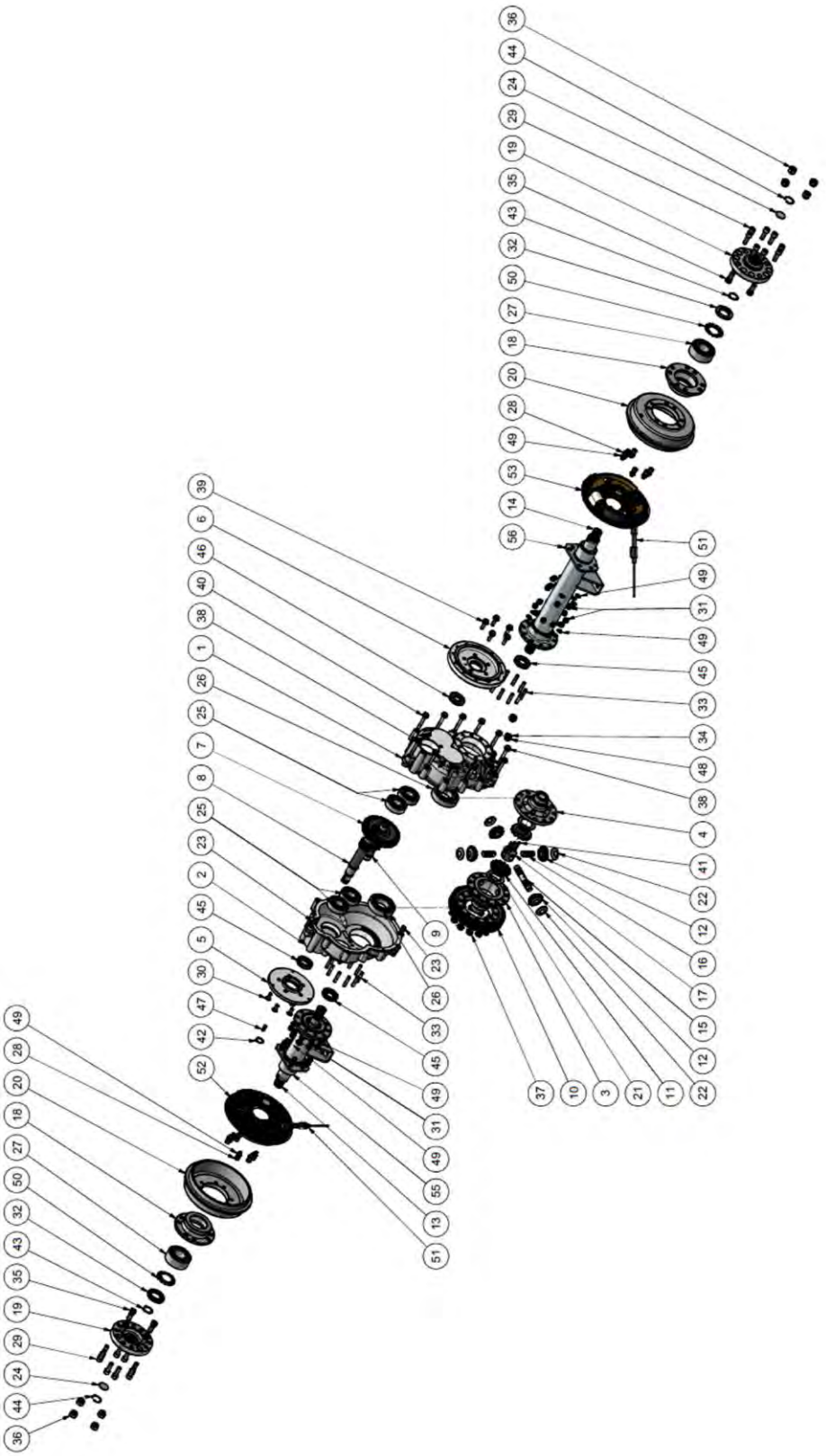

24
7
4
8
13
STAND 2 FEET AWAY
WAIT For the WAVE



REF.	*PART NO*	*DESCRIPTION*
1		BODY
2	2351280004	FRONT SPACER 1”
	2351280001	FRONT SPACER 1-5/8”
	2351280003	SIDE SPACER
	2199000002	BRACKET, GAS SPRING
	2199112060	GAS SPRING
3	2332280003	CARGO DECK
4	2500280003	SS DASHBOARD
5	2385100003	BUCKET SEAT
	2385224001	GRAMMER STYLE SEAT
	240502K	CONVERTIBLE BACKREST KIT
	2383240003	FRONT SEAT
6	2399280003	TOP, BREAKAWAY POLE
	2399280002	BASE, BREAKAWAY POLE
7	3669013	FAN 12V

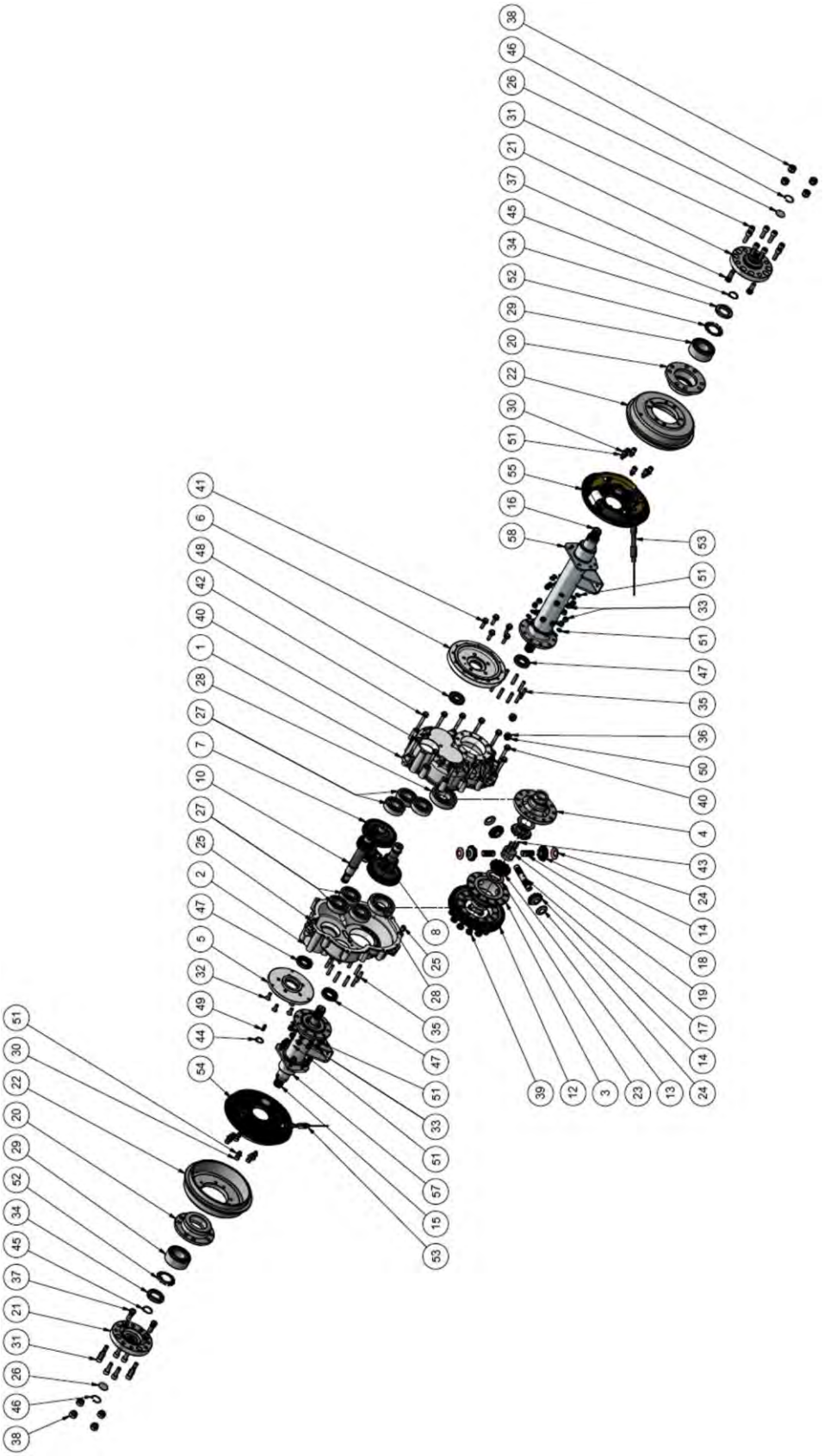
REF.	*PART NO*	*DESCRIPTION*
8	2392000006	RAM ROUND BASE
	2392000007	RAM DOUBLE SOCKET ARM
9	5100280004	DECAL 4" X 8"
10	5100280005	DECAL 1-1/2" X 12
11	2314280017	FRONT BUMPER
12	2223240011	SOLID SOFTY RUBBER
	243001C	480X8 LRC PNEUMATIC
	2407010	NON-MARKING SOLID WHITE RUBBER
13	2399000004	CUP HOLDER
14	5100320008	FRONT SAND STRIP CARPET
15	5100320009	REAR SAND STRIP CARPET
16	2139240002	HAND LEVER
	2130330001	HANDBRAKE PULLING PLATE
	2910000013	YOKE
17	2322280004	PIVOT BRACKET
18	2129000002	CABLE
19	2322280001	PIVOT
20	2191000003	SPRING
21	2321000003	HITCH BASE
22	2329280001	PIN
	2915016001	CLAMP-ON SHAFT
23	2320000006	GUIDE
24	241430	STEERING WHEEL ASS.

DIFFERENTIAL 16.1:1



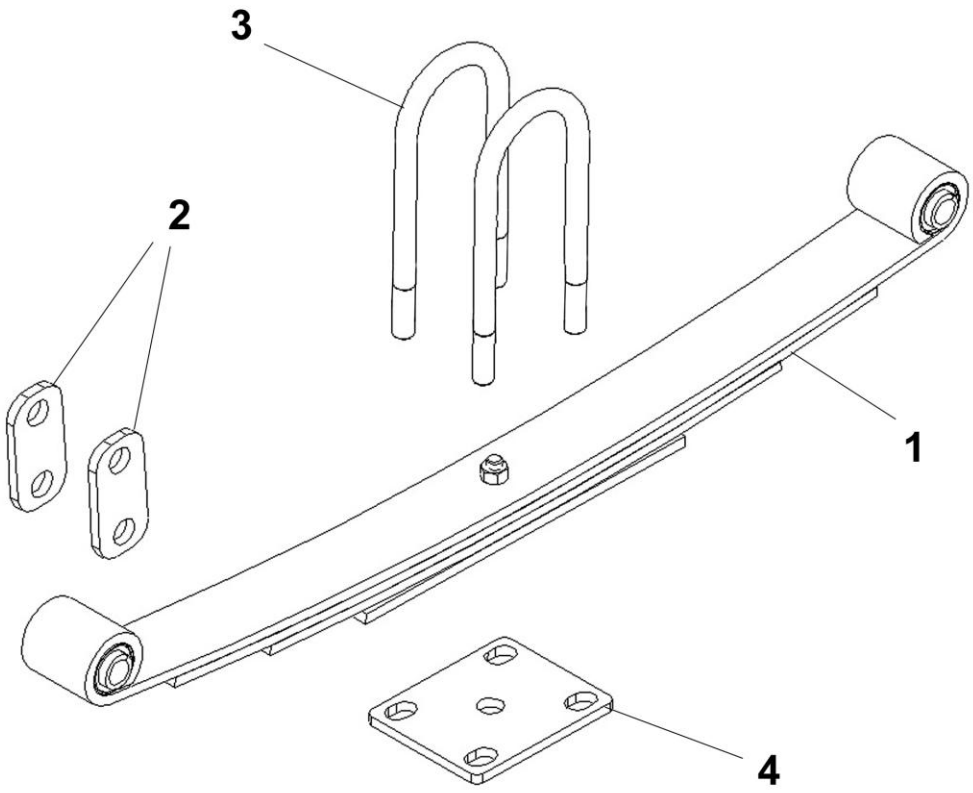
POS	CODE	DESCRIPTION	QTY
1	49.01.3500	Gearbox	1
2	49.01.35011	Gearbox cover	1
3	49.01.3506	Differential case	1
4	49.01.3507	Differential case cover	1
5	49.03.3505	Brake housing	1
6	49.03.3509	Bell housing	1
7	49.05.3519	I reduction driven gear	1
8	49.05.3524	Inout gear with brake	1
9	49.05.3533	II reduction driving gear	1
10	49.05.3534	Differential gear	1
11	49.05.3539	Planet gear	2
12	49.05.3540	Sun gear	4
13	49.06.3595	Axle shaft	1
14	49.06.3596	Axle shaft	1
15	49.07.3600	Differential pin	1
16	49.07.3601	Differential pin	2
17	49.07.3602	Thrust block	1
18	49.08.3610	Internal hub	2
19	49.08.3615	Wheel hub	2
20	49.08.3621	Drum brake 180	2
21	49.11.3640	Planet gear washer	2
22	49.11.3641	Sun gear washer	4
23	49.11.3642	Pin	2
24	49.11.3648	Protection	2
25	50.05.01.08	Ball bearing	4
26	50.05.01.17	Ball bearing	2
27	50.05.18.15	Ball bearing	2
28	50.06.03.17	Socket head bolt	12
29	50.06.03.34	Socket head bolt	16
30	50.06.04.17	Flathead bolt	5
31	50.06.06.53	Locknut	32
32	50.06.07.35	Ring nut	2
33	50.06.08.18	Stud bolt	20
34	50.06.10.14	Oil plug	2
35	50.06.14.1231	Stud screw	8
36	50.06.16.1215	Wheel nut	8
37	50.06.19.10040	Bolt	12
38	50.06.22.08055	Flanged bolt	2
39	50.06.23.08025	Flanged bolt	5
40	50.06.23.08050	Flanged bolt	11
41	50.07.02.05025	Elastic pin	3
42	50.09.01.03	External circlip	1
43	50.09.01.06	External circlip	2
44	50.09.02.028	Internal circlip	2
45	50.10.01.02V	Oil seal	3
46	50.10.01.27	Oil seal	1
47	50.11.01.02	Key	1
48	50.12.01.06	Washer	2
49	50.12.03.03	Washer	44
50	50.12.05.35	Tab washer	2
51	50.14.03.180C4	Park brake cable	2
52	50.14.03.180D	Hydraulic drum brake assembly	1
53	50.14.03.180S	Hydraulic drum brake assembly	1
54	50.26.01.01	Oil	0,500 l
55	71.2.3.0.5.11L	Left tube	1
56	71.2.3.0.5.11R	Right tube	1

DIFFERENTIAL 22.3:1



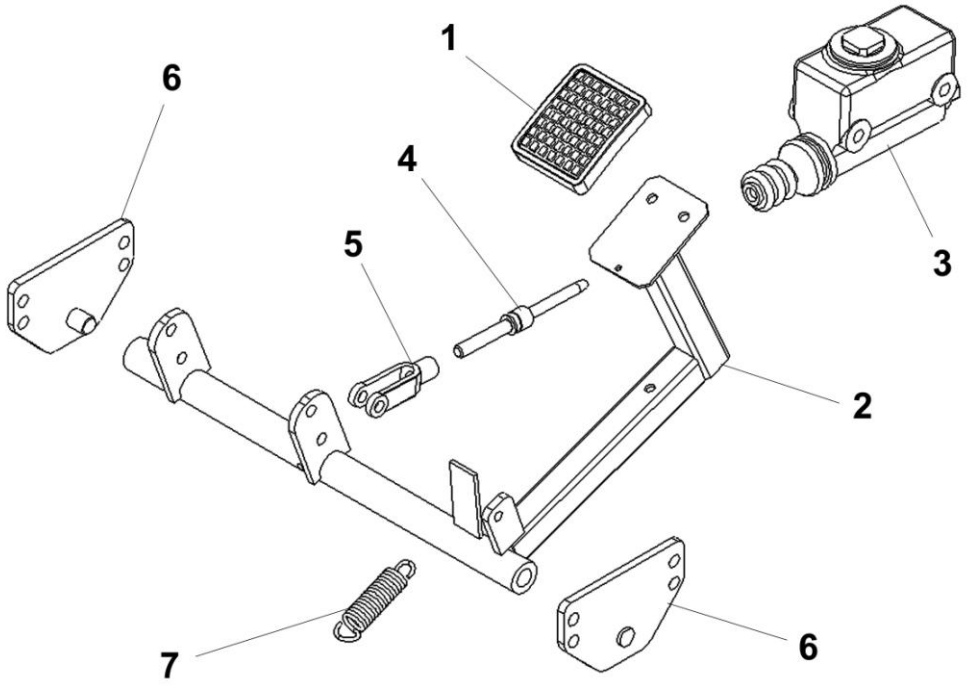
POS	CODE	DESCRIPTION	QTY
1	49.01.3500	Gearbox	1
2	49.01.35011	Gearbox cover	1
3	49.01.3506	Differential case	1
4	49.01.3507	Differential case cover	1
5	49.03.3505	Brake housing	1
6	49.03.3509	Bell housing	1
7	49.05.3511	I Reduction driven gear	1
8	49.05.3512	II Reduction driving gear	1
9	49.05.3513	II Reduction driven gear	1
10	49.05.3522	Inout gear with brake	1
11	49.05.3531	II Reduction driving gear	1
12	49.05.3532	Differential gear	1
13	49.05.3539	Planet gear	2
14	49.05.3540	Sun gear	4
15	49.06.3595	Axle shaft	1
16	49.06.3596	Axle shaft	1
17	49.07.3600	Differential pin	1
18	49.07.3601	Differential pin	2
19	49.07.3602	Thrust block	1
20	49.08.3610	Internal hub	2
21	49.08.3615	Wheel hub	2
22	49.08.3621	Drum brake 180	2
23	49.11.3640	Planet gear washer	2
24	49.11.3641	Sun gear washer	4
25	49.11.3642	Pin	2
26	49.11.3648	Protection	2
27	50.05.01.08	Ball bearing	6
28	50.05.01.17	Ball bearing	2
29	50.05.18.15	Ball bearing	2
30	50.06.03.17	Socket head bolt	12
31	50.06.03.34	Socket head bolt	16
32	50.06.04.17	Flathead bolt	5
33	50.06.06.53	Locknut	32
34	50.06.07.35	Ring nut	2
35	50.06.08.18	Stud bolt	20
36	50.06.10.14	Oil plug	2
37	50.06.14.1231	Stud screw	8
38	50.06.16.1215	Wheel nut	8
39	50.06.19.10040	Bolt	12
40	50.06.22.08055	Flanged bolt	2
41	50.06.23.08025	Flanged bolt	5
42	50.06.23.08050	Flanged bolt	11
43	50.07.02.05025	Elastic pin	3
44	50.09.01.03	External circlip	1
45	50.09.01.06	External circlip	2
46	50.09.02.028	Internal circlip	2
47	50.10.01.02V	Oil seal	3
48	50.10.01.27	Oil seal	1
49	50.11.01.02	Key	1
50	50.12.01.06	Washer	2
51	50.12.03.03	Washer	44
52	50.12.05.35	Tab washer	2
53	50.14.03.180C4	Park brake cable	2
54	50.14.03.180D	Hydraulic drum brake assembly	1
55	50.14.03.180S	Hydraulic drum brake assembly	1
56	50.26.01.01	Oil	0,500 l
57	71.2.4.0.5.10L	Left tube	1
58	71.2.4.0.5.10R	Right tube	1

REAR SUSPENSION



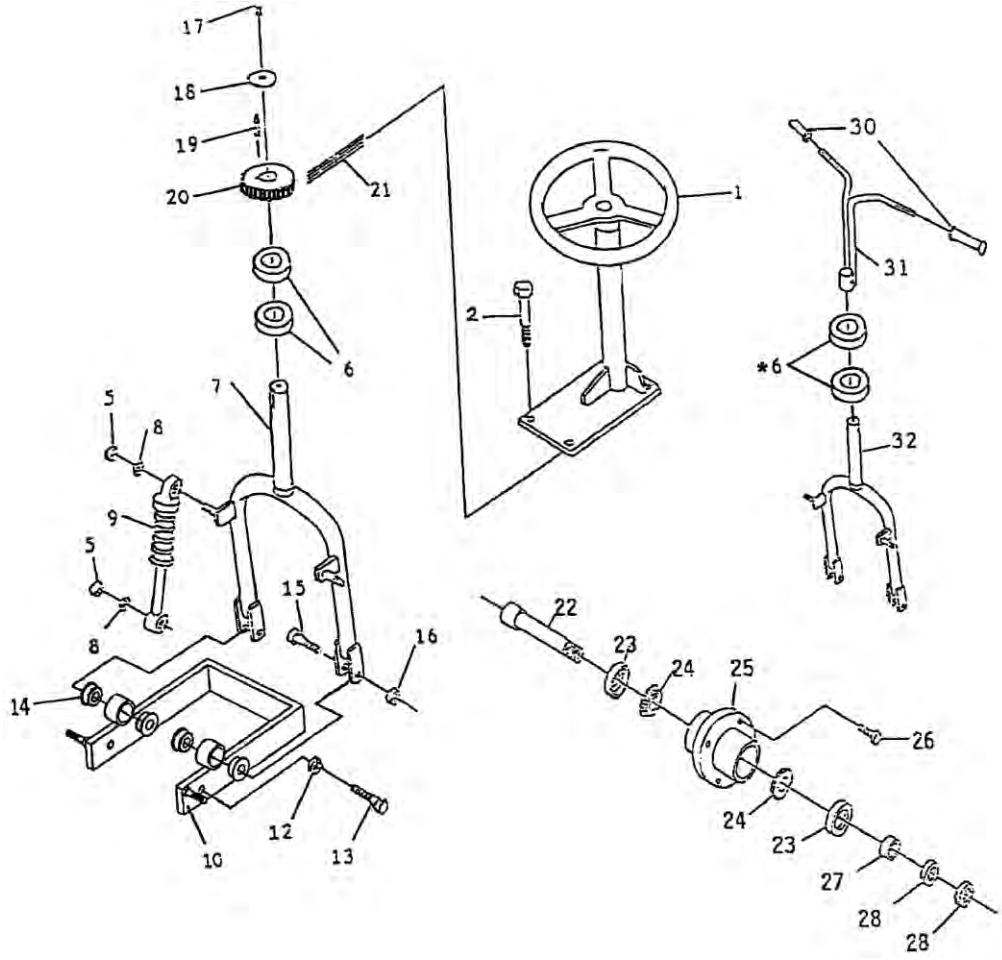
REF.	*PART NO*	*DESCRIPTION*
1	2192280001	4 LEAF SPRING
	2192606001	5 LEAF SPRING
2	2182320001	SHACKLE
3	2816280001	U-BOLT, 2-3/8 I.D.
4	2185280002	PLATE

BRAKE CONTROLS



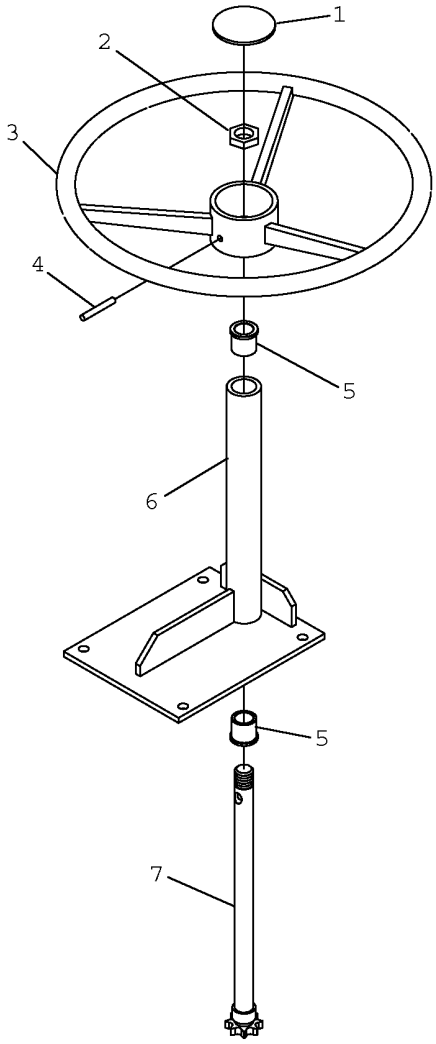
REF	*PART NO*	*DESCRIPTION*	*QTY*
1	2131100002	Rubber	1
2	2131280002	Lever	1
3	2125000008	Master cylinder	1
4	2139280001	Push rod	1
5	2910000015	Yoke	1
6	2132240017	Pivot	2
7	2190000003	Spring	1

STEERING ASSEMBLY



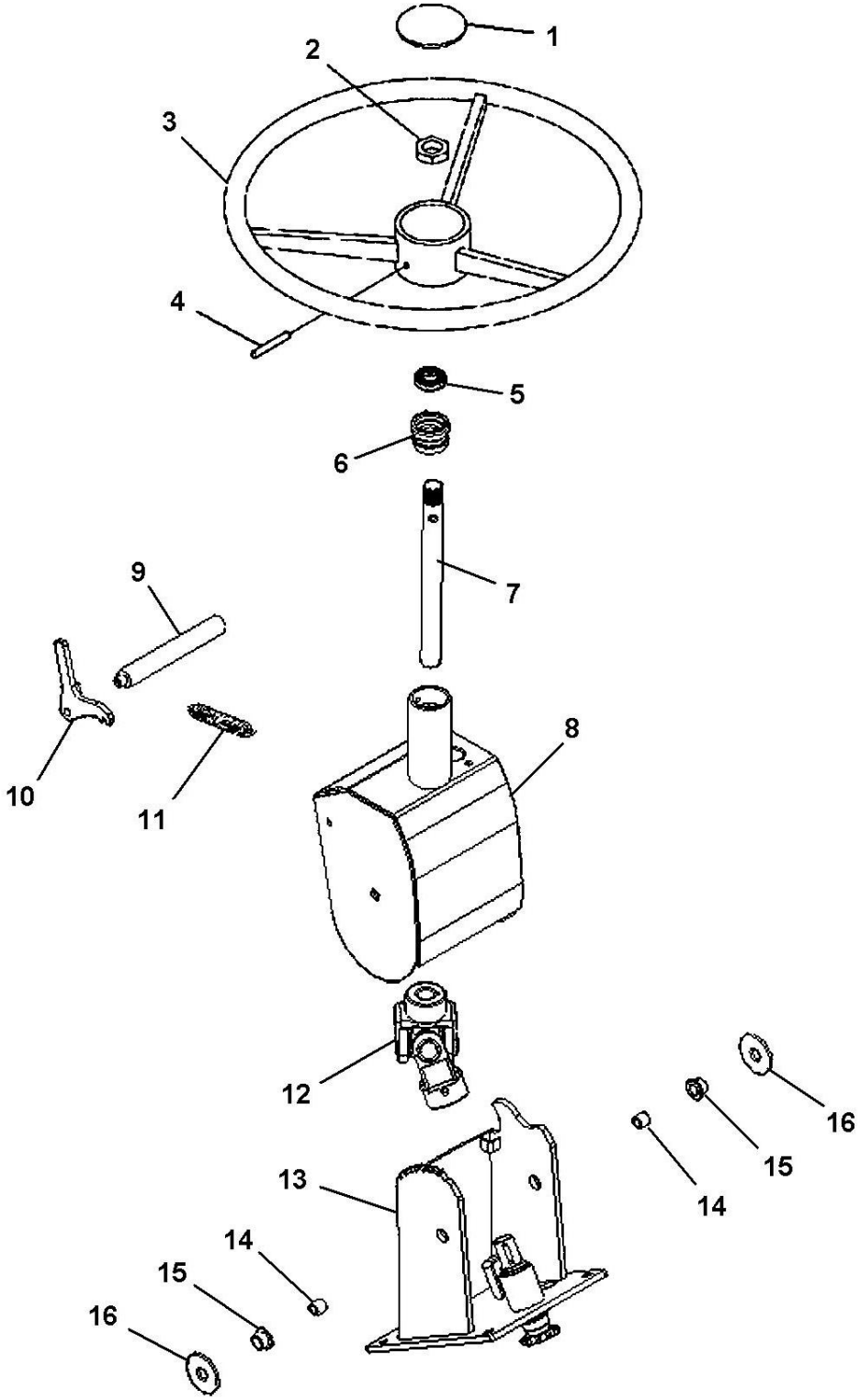
REF.	*PART NO*	*DESCRIPTION*	*REF.*	*PART NO*	*DESCRIPTION*
1	241430	STEERING WHEEL ASS.	**20**	241431	SPROKET
2		BOLT 3/8-NC X 3	**21**	2430010	CHAIN
5		LOCKNUT 7/16-NC	**22**	241001	AXLE
6	241406	BALL BEARING (2.44 O.D.)	**23**	241002	SEAL
	281406	BALL BEARING (3.31 O.D.)	**24**	241003	TAPER BEARING
7	241427	FORK (2.44 BEARING O.D.)	**25**	241004	HUB, 4 BOLT
	281427	FORK (3.31 BEARING O.D.)		281004	HUB, 5 BOLT
9	281409	SHOCK ABSORBER	**26**	241005	WHEEL BOLT
10	281410	SUSPENSION ARM	**27**	241006	BUSHING
12		LOCK WASHER ½	**28**	2910000012	JAM NUT 1-14-NF
13		BOLT ½-NF X 1 ½	**30**	241402	HANDGRIPS, RIGHT & LEFT
14	2440007	NYL-OIL ½ BUSHING, SET FOR 4	**31**	241401	HANDLE BAR
15		BOLT 5/8-NC X 3	**32**	241407	FORK (2.44 BEARING O.D.)
16		LOCKNUT 5/8-NC		281407	FORK (3.31 BEARING O.D.)
17		BOLT ¼-NC X ¾	**33**		BOLT 3/8-NC X ¾
18	261405	FLAT WASHER			
19		KEY ¼			

STEERING WHEEL



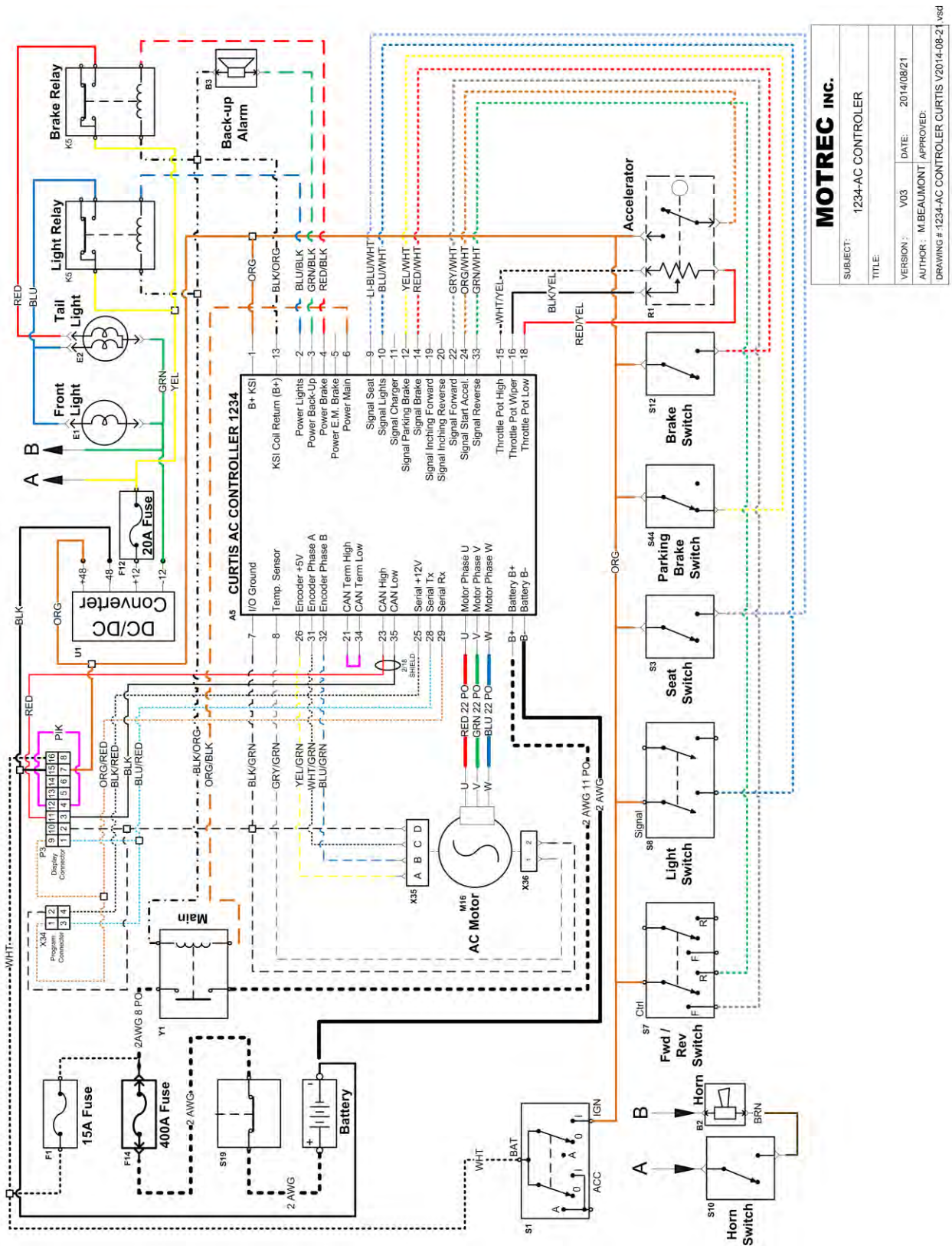
REF.	*PART NO*	*DESCRIPTION*
	241430	STEERING WHEEL ASS.
1	481453	COVER
2	481452	NUT
3	481451	STEERING WHEEL
4	481454	SPRING PIN
5	481437	BUSHING
6	2830011	SUPPORT
7	2830004	SHAFT

TILT STEERING WHEEL

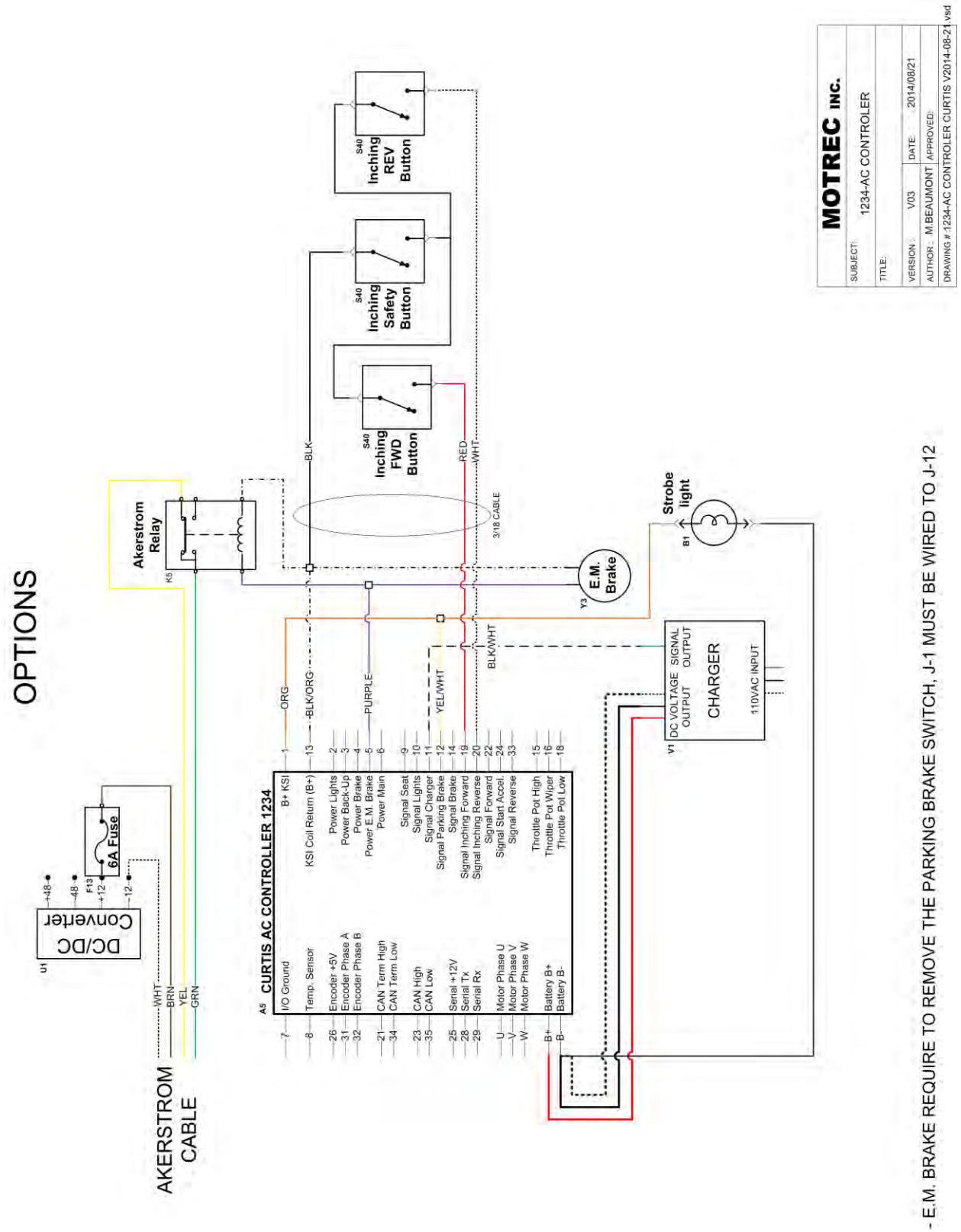


REF.	*PART NO*	*DESCRIPTION*
1	2208240002	COVER
2	2910000022	NUT
3	2208240001	STEERING WHEEL
4	2910000023	SPRING PIN
5	2104300004	SEAL
6	2100300002	BUSHING
7	2209000001	SHAFT
8	2206000010	TILT COLUMN
9	2205000001	PIVOT
10	2118000004	LEVER
11	2190000003	SPRING
12	2104250001	JOINT UNIVERSAL
13	2206000001	STEERING SUPPORT
14	2914240002	WASHER
15	2914240001	FLANGE BUSHING
16	2914240003	SLEEVE

ELECTRICAL DIAGRAM – MAIN CIRCUIT
DIAGRAMME ÉLECTRIQUE – CIRCUIT PRINCIPAL

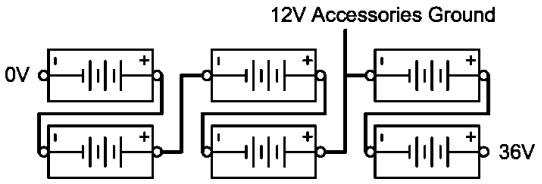


ELECTRICAL DIAGRAM – OPTION CIRCUIT
DIAGRAMME ÉLECTRIQUE – CIRCUIT OPTIONNEL

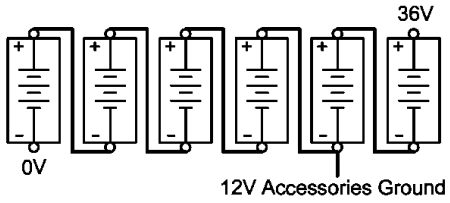


BATTERY CONFIGURATIONS - 36V
CONFIGURATIONS DES BATTERIES – 36V

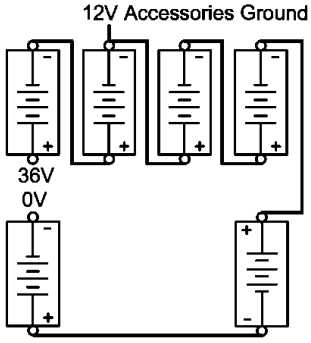
E-280B LIFT-OUT
E-320
E-330
E-360



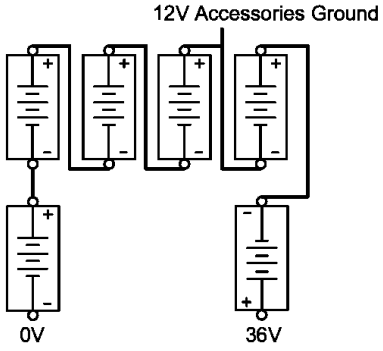
E-300
E-302
E-322



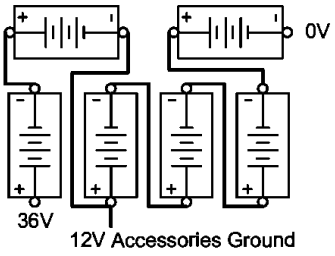
E-276



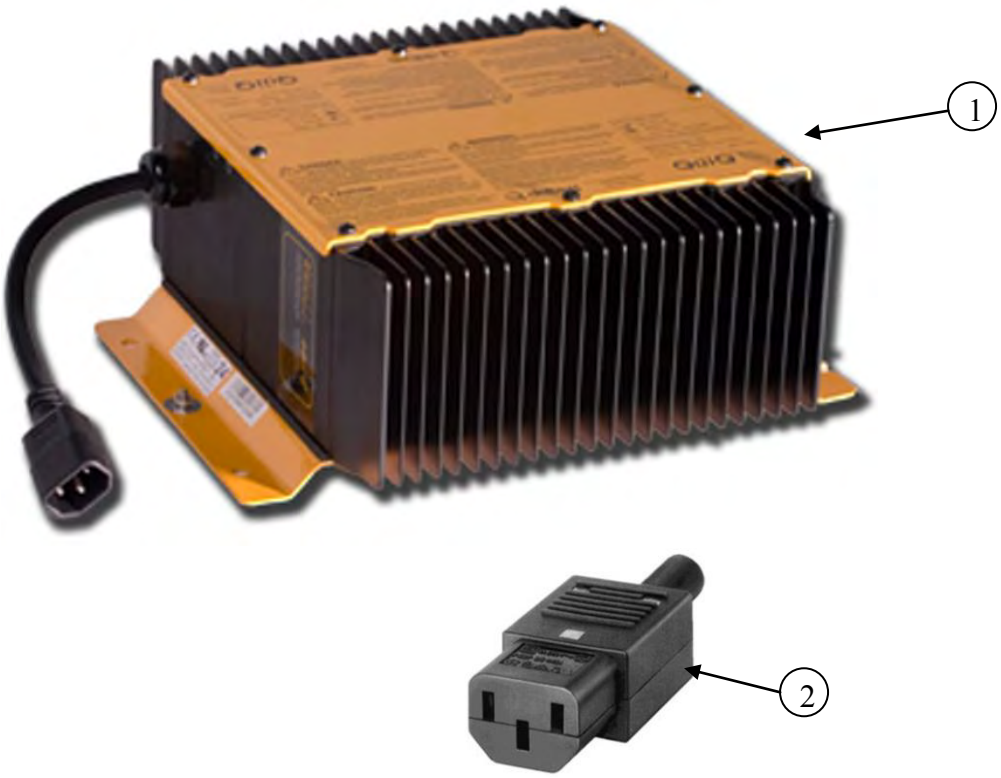
E-266



E-266 ROLL-OUT



DELTA-Q HF CHARGER



NO	*DESCRIPTION*	*PART NO*		
		BUILT-IN	PORTABLE WITH SB-50	PORTABLE WITH SB-350
1	24V CHARGER (U.S. BATTERY)	3102240002	3102240009	3102240013
	24V CHARGER (LIFELINE BATTERY)	3102240003	3102240010	3102240014
	24V CHARGER (GEL 180AH BATTERY)	3102240004	3102240011	3102240015
	24V CHARGER (27TM BATTERY)	3102240005	3102240012	3102240016
	36V CHARGER (U.S. BATTERY)	3102302001	3102302004	3102302007
	36V CHARGER (LIFELINE BATTERY)	3102302002	3102302005	3102302008
	36V CHARGER (GEL 180AH BATTRY)	3102302003	3102302006	3102302009
	48V CHARGER (U.S. BATTERY)	3102480002	3102480005	3102480008
	48V CHARGER (LIFELINE BATTERY)	3102480003	3102480006	3102480009
	48V CHARGER (GEL 180AH BATTERY)	3102480004	3102480007	3102480010
	72V CHARGER (U.S. BATTERY)	3102720001		
2	CONNECTOR C13	3119000011		
*	PORTABLE CHARGER AC CORD		3120000001	3120000001
*	BUILT-IN CHARGER AC CORD	3120000002		
*	CORDSET, YELLOW PLUG & SB-50G		3120000003	

* NOT ILLUSTRATED

QuiQ™ HF/PFC Battery Charger

Product Manual for:
QuiQ 912-24xx / 36xx / 48xx / 72xx

delta-q TECHNOLOGIES
Unit 3 – 5250 Grimmer St.
Burnaby, BC, Canada V5H 2H2
Tel: 604.327.8244 Fax: 604.327.8246
www.delta-q.com

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety, operating, and installation instructions – read before using charger.

Battery Safety Information

Warning: Use charger only on battery systems with an algorithm selected that is appropriate to the specific battery type. Other usage may cause personal injury and damage. Lead acid batteries may generate explosive hydrogen gas during normal operation. Keep sparks, flames, and smoking materials away from batteries. Provide adequate ventilation during charging. Never charge a frozen battery. Study all battery manufacturers' specific precautions such as recommended rates of charge and removing or not removing cell caps while charging.

Electrical Safety Information

Danger: Risk of electric shock. Connect charger power cord to an outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded outlet is required to reduce risk of electric shock – do not use ground adapters or modify plug. Do not touch uninsulated portion of output connector or uninsulated battery terminal. Disconnect the AC supply before making or breaking the connections to the battery while charging. Do not open or disassemble charger. Do not operate charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or otherwise damaged in any way – refer all repair work to qualified personnel. Not for use by children.

INFORMATIONS IMPORTANTES DE SÉCURITÉ

Conserver ces instructions. Ce manuel contient des instructions importantes concernant la sécurité et le fonctionnement.

Information de Sécurité de la Batterie

Attention: Utiliser seulement sur les batteries 72V avec un algorithme approprié au type spécifique de batterie – voire le manuel. D'autres types de batteries pourraient éclater et causer des blessures ou dommages. Les batteries peuvent produire des gaz explosives en service normal. Ne jamais fumer près de la batterie et éviter toute étincelle ou flame nue à proximité de ces derniers. Fournisser la bonne ventilation lors du chargement. Ne jamais charger une batterie gelée. Prendre connaissance des mesures de précaution spécifiées par le fabricant de la batterie, p. ex., vérifier s'il faut enlever les bouchons des cellules lors du chargement de la batterie, et les taux de chargement recommandés.

Information de Sécurité Électrique

Danger: Risque de chocs électriques. Ne pas toucher les parties non isolées du connecteur de sortie ou les bornes non isolées de la batterie. Toujours connecter le chargeur à une prise de courant mise à la terre. Ne pas ouvrir ni desassembler le chargeur – referer toute reparations aux personnes qualifiés. Pas à l'usage des enfants.

Operating Instructions

1. Always use a grounded outlet. When using an extension cord, avoid excessive voltage drops by using a grounded 3-wire 12 AWG cord.
2. The charger will automatically turn on and go through a short LED indicator self-test (Models 912-xx0x will flash all LED's in an up-down sequence and Models 912-xx1x will alternatively flash its LED RED-GREEN) for two seconds. If the charger is connected to battery pack, a trickle current will be applied until a minimum voltage is reached. If the charger is used in an off-board application and the charger is waiting to be plugged into a battery pack, the charging algorithm number will be displayed for 11 seconds (see "Check / Change Charging Algorithm") before ultimately displaying an under-voltage fault (fault disappears when plugged into battery pack).
3. Once a minimum battery voltage is detected, the charger will enter the bulk charging constant-current stage. Models 912-xx0x will display the current to the battery on the bargraph and Model 912-xx1x will flash its LED GREEN off more than on to indicate <80% charge status. The length of charge time will vary by how large and how depleted the battery pack is, the input voltage (the higher, the better), and ambient temperatures (the lower, the better). If the input AC voltage is low (below 104VAC), then the charging power will be reduced to avoid high input currents (Models 912-xx0x 'AC' LED and Models 912-xx1x single LED both flash YELLOW). If the ambient temperature is too high, then the charging power will also be reduced to maintain a maximum internal temperature (Models 912-xx0x bargraph flashes and Models 912-xx1x single LED flashes YELLOW).
4. When the battery is at approximately 80% state of charge, the bulk stage has completed and an >80% charge indication is given (Models 912-xx0x turn on the '80%' LED and Models 912-xx1x will flash its LED GREEN on more than off). In the next phase known as the absorption or constant-voltage phase, the last 20% of charge is then returned to the battery. The charging could be terminated at this point if the vehicle requires immediate usage, however, it is highly recommended to wait until 100% charge indication is given to ensure maximum battery capacity and life.
5. A low current "finish-charge" phase is next applied to return and maintain maximum battery capacity (Models 912-xx0x will flash the '100%' LED).
6. When Models 912-xx0x '100%' LED or Models 912-xx1x single LED is continuously GREEN, the batteries are completely charged. The charger may now be unplugged from AC power (always pull on plug and not cord to reduce risk of damage to the cord). If left plugged in, the charger will automatically restart a complete charge cycle if the battery pack voltage drops below a minimum voltage or 30 days has elapsed.
7. If a fault occurred anytime during charging, a fault indication is given by flashing RED with a code corresponding to the error. There are several possible conditions that generate errors. Some errors are serious and require human intervention to first resolve the problem and then to reset the charger by interrupting AC power for at least 15 seconds. Others may be simply transient and will automatically recover when the fault condition is eliminated. To indicate which error occurred, a fault indication will flash RED a number of times, pause, and then repeat.
   [1 FLASH] Battery Voltage High: auto-recover
   [2 FLASH] Battery Voltage Low: auto-recover
   [3 FLASH] Charge Timeout: the charge did not complete in the allowed time. This may indicate a problem with the battery pack (voltage not attaining the required level), or that the charger output was reduced due to high ambient temperatures.
   [4 FLASH] Check Battery: the battery pack could not be trickle charged up to the minimum level required for the charge to be started. This may indicate that one or more cells in the battery pack are shorted or damaged.
   [5 FLASH] Over-Temperature: auto-recover. Charger has shutdown due to high internal temperature which typically indicates there is not sufficient airflow for cooling – see Installation Instructions 1). Charger will restart and charge to completion if temperature comes within accepted limits.
   [6 FLASH] QuiQ Fault: an internal fault has been detected. If Fault 6 is again displayed after interrupting AC power for at least 15 seconds, the charger must be brought to a qualified service depot.

Maintenance Instructions

1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the maintenance and safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals are tight and clean.
3. Do not expose charger to oil, dirt, mud or to direct heavy water spraying when cleaning vehicle.

See flip side for **Product Specifications** and **Installation Instructions** for qualified personnel.

Specifications

DC Output – see Operating Instructions

QuiQ Model: 912-	24xx	36xx	48xx	72xx
Voltage-nom (V)	24	36	48	72
Voltage-max (V)	33.6	50.4	67.2	100
Current-max (A)	25	21	18	12
Battery Type	Specific to selected algorithm			
Reverse Polarity	Electronic protection – auto-reset			
Short Circuit	Electronic current limit			

AC Input

All models	
Voltage-max (Vrms)	85 – 265
Frequency (Hz)	45 - 65
Current-max (Arms)	12A @ 104VAC (reduced 20%<104V)
Current – nominal (Arms)	10A @ 120VAC / 5A @ 230VAC
AC Power Factor	>0.98 at nominal input current

Operation

Charger Model: 912-	xx0x (10 LED)	xx1x (1 LED)
AC ON	Solid YELLOW	LED Active
AC LOW	Flash YELLOW	Flash YELLOW
Thermal Cutback	Flash Bargraph	Flash YELLOW
<80% Charge Indicator	-	Short Flash GREEN
>80% Charge Indicator	Solid YELLOW	Long Flash GREEN
100% Charge Indicator	Solid GREEN	Solid GREEN
Fault Indicator	Flash RED	Flash RED
DC Ammeter	LED Bargraph	-
Bat Temp Compensation	Automatic	Optional
Maintenance Mode	Auto-restart if V<2.1Vpc or 30 days elapse	

Mechanical

All models	
Dimensions	28.0 x 24.5 x 11.0 cm (11 x 9.7 x 4.3")
Weight	<5 kg (<11 lbs) w/ standard output cord
Environmental	Enclosure: IP46
Operating Temperature	-30°C to +50°C (-22°F to 122°F), derated above 30°C, below 0°C
Storage Temperature	-40°C to +70°C (-40°F to 158°F)
AC input connector	IEC320/C14 (require ≥1.8m localized cord)
DC output connector	OEM specific w/ 12AWG wire

Regulatory

Safety	
EN 60335-1/2-29	Safety of Appliances/ Battery Chargers
UL2202	EV Charging System Equipment
UL1564 2nd Edition	Industrial Battery Charger
CSA-C22.2 No. 107.2	Battery Chargers- Industrial
Emissions	
FCC Part 15/ICES 003	Unintentional Radiators Class A
EN 55011	Radio disturbance characteristics (Class A)
EN 61000-3-2	Limits for harmonic current emissions
EN 61000-3-3	Limits of voltage fluctuations and flicker
Immunity	
EN 61000-4-2	Electrostatic discharge immunity
EN 61000-4-3	Radiated, radio-frequency, EMF immunity
EN 61000-4-4	Electrical fast transient/burst immunity
EN 61000-4-5	Surge immunity
EN 61000-4-6	Conducted Immunity
EN 61000-4-11	Voltage variations immunity

Installation Instructions

WARNING: The output of chargers with greater than 48V may pose an energy and/or shock hazard under normal use. These units must be installed in the host equipment in such a manner that the output cable and battery connections are only accessible with the use of a tool by qualified personnel.

1) Determine Mounting Location:
While its sealed nature allows the charger to be mounted virtually anywhere, the choice of mounting location and orientation is extremely important. For optimum performance and shortest charge times, mount the charger in an area with adequate ventilation. The charger should also be mounted in an area that will be relatively free of oil, dirt, mud, or dust since accumulations within the fins of the charger will reduce their heat-dissipating qualities. Optimal cooling also occurs when the charger is mounted on a horizontal surface with the fins vertical. More airflow from below the charger will help cool the fins, so mounting above open areas or areas with cut-outs for airflow is desirable. Contact Delta-Q for information on other mounting orientations. As the charger may get hot in operation, the charger must be installed such that risk of contact by people is reduced. The charger's AC plug must be located at least 18" above the floor/ ground surface and the status display must be visible to the user.

2) Mounting Procedure:
Mount the charger by the mounting plate using appropriate fasteners (i.e. 1/4" or M6 with locking hardware). For UL2202 compliance, a 12AWG green bonding wire with ring terminals must be attached from the bonding stud located on the front of the charger (identified by ⏚) to the vehicle frame. The vehicle connection must be made using corrosion resistant hardware (e.g., a #10 stainless steel machine screw with at least two threads of engagement and, if required, a paint piercing washer).

3) DC Battery Connection Procedure:
a) The green wire outputs battery voltage when the charger is not plugged into AC to provide an interlock function – see Fig. 1. **If used, a user-supplied 1A fast-blow external fuse must be installed inline to prevent damage. Shorting or drawing more than 1A may damage charger and void the warranty.**
b) Securely fasten the black ring terminal from the charger to the negative terminal ("-", "NEG", NEGATIVE") of the battery pack.
c) Check that the correct charge algorithm is being used – refer to section 4). Securely fasten the red ring terminal to the positive terminal ("+", "POS", "POSITIVE") of the battery pack.

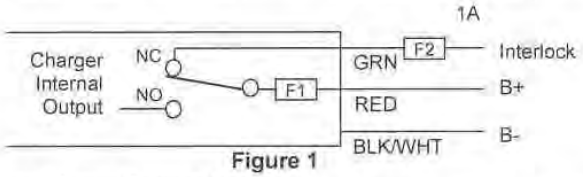


Figure 1

4) Check / Change Charging Algorithm:
The charger comes pre-loaded with algorithms for batteries as detailed in Table 1. If your specific battery model is not listed, please contact Delta-Q.
Each time AC power is applied with the battery pack NOT connected, the charger enters an algorithm select/display mode for approximately 11 seconds. During this time, the current Algorithm # is indicated on the '80%' LED (Models 912-xx0x) or on the single LED (Models 912-xx1x). A single digit Algorithm # is indicated by the number of blinks separated by a pause. A two digit Algorithm # is indicated by the number of blinks for the first digit followed by a short pause, then the number of blinks for the second digit followed by a longer pause.
To check / change the charging algorithm:
a) Disconnect the charger positive connector from battery pack. Apply AC power and after the LED test, the Algorithm # will display for 11 seconds.
b) To change algorithm, touch positive connector during the 11 second display period to the battery pack's positive terminal for 3 seconds and then remove – the Algorithm # will advance after 3 seconds. Repeat until desired Algorithm # is displayed. A 30 second timeout is extended for every increment. Incrementing beyond the last Algorithm moves back to the first Algorithm. After desired Algorithm # is displayed, touch the charger connector to the battery positive until the output relay is heard to click (~10 seconds) – algorithm is now in permanent memory.
c) Remove AC power from the charger and reconnect the charger positive connector to the battery pack. It is highly recommended to check a newly changed algorithm by repeating step 4) above.

Alg #	Battery Type
35	Concorde 2xxAh AGM
27	Crown CR325 dv/dt
26	Deka 8GGC2 Gel
11	generic flooded CP dv/dt
8	Concorde 1xxAh AGM
7	Trojan J305 dV/dt
6	DEKA 8G31 Gel
5	Trojan 30XHS
4	US Battery US2200
1	Trojan T-105

Table 1.

Product warranty is two years - please contact dealer of original equipment for warranty service.

Note: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

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MOTREC ILLUSTRATED ACCESSORIES – AC VEHICLES

Strobe light, pole mount
Amber 12-80V: 3116000002
Red 12-80V: 2469001
Blue 12-80V: 3690008

Strobe light, cab mount
Amber 12-48V: 3116250001
Red 12-48V: 3069026
Blue 12-48V: 3069014
Amber 72-80V:3116720001
Red 72-80V: 3116720002
Blue 72-80V: 3116720003

Amber turn lamp
12V: 3111000022
Bulb 12V: 3069021
Multi-LED amber turn lamp
Round Light: 3111000010
Grommet: 3111000008
Plug: 3111000009

Amber turn lamp 2”
12V : 3111330002

Amber turn lamp 2” LED white background
12V : 3111330003

Red Tail/Turn/Rev light
12V: 3111000002

Red Tail/Brake light
Grommet: 3269001
Plug: 246012A
12V : 2469021
24V : 2469022

Red Tail/Brake light
** Model EE **
Assembly: 3111000030
Housing: 3111000027
Plug: 3111000029
12V : 3111000028

Red Tail/Brake light
Housing: 3111000041
Red Tail/Brake light
Housing LED: 3111000044
Bulb 12V: 3117240001
Bulb 12V LED: 3117000010

Multi-LED Red Tail/Brake
Light: 3111000047
Grommet: 3269001
Plug: 246012A

Red Tail/Brake light
12V: 386002

Red Tail/Turn LED light
12-24V: 3111000037

Red Tail/Turn LED light
12-24V: 3111000038

Clear lamp Incandescent
12V: 3111000039
Clear lamp LED 12V:
3111000042
Bulb incandescent 12V :
1269008
Bulb 12V LED:
3117000001

Oval lamp
12V: 3111330001

LED Headlight
12V: 3111000036

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3111480006
Bulb Turn: 3111480008
Bulb Mark: 3111480007

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3117480001
Bulb Turn: 3117480003
Bulb Mark: 3117480002

Multi-LED Back-up
Light: 3111000007
Strobe light: 3111000013
Grommet: 3111000008
Plug: 3119000009

Back-up lamp
Grommet: 3269001
12V: 3669012
24V: 3669012A

Pedestal head lamp
12V: 3111240001
Bulb 12V: 2569001B
Bulb 24V: 2169001B

Pedestal head lamp - LED
12-48V: 3111000034

Pedestal lamp – 9W LED
12-24V: 3111000045
Support: 2392000009

Headlamp
12V: 3111300001
Bulb 12V: 3111300002

DC-DC Converter, 300W
24V: 3124224001
36-48V: 3124280001
72-80V: 3124880001

CONNECTOR:3124280002

Wiper motor
12V: 3113000001
24V: 486211

Wiper arm 2800000001

Wiper blade
14" Blade: 2800000002
18" Blade: 2800000003

Pantograph wiper arm
246233A

Pantograph wiper blade
246233

Limit switch 3109000029

Cab heater
12V: 3103300001
36V: 3669008
48V: 4869020

12V Dome light 3669006

12V Fan 3669013

Back-up alarm or
Motion beeper
12-48V : 3100000001
72-80V : 3105720001

12-24V Adjustable ECCO:
3100000002

12-48V Adjustable PRECO:
3100000004

Red Pilot light
12V: 246212
Bulb 12V: 246212B

Horn
12V: 246003
24V: 246013

Horn button VIP
2208224002

Horn button, column mount
3109000011

Horn button, dash mount
266210

Horn button 3109250001

Turn signal switch 246050