MT-350

OPERATOR AND MAINTENANCE MANUAL
SPARE PARTS LISTS INCLUDED

SERIAL NUMBER: 1165071 & 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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- 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

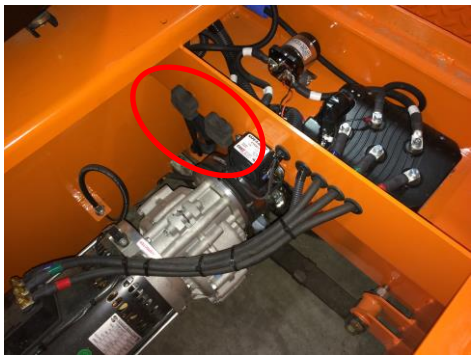
Pull handbrake lever to apply. Never park the vehicle on an incline. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

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.

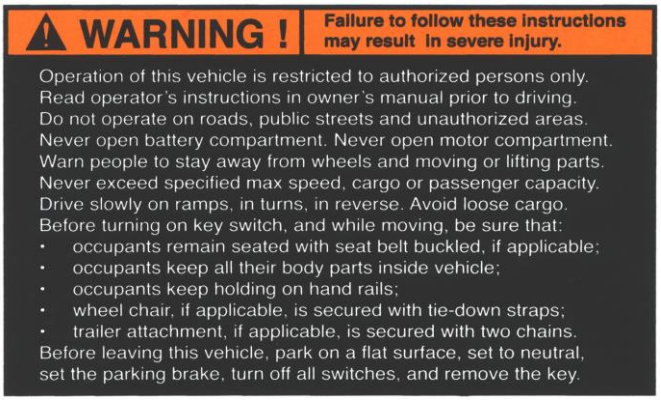
DECALS AND LABELS

! 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

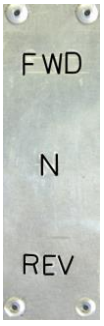


When an emergency push button is installed, this label is required (located under push button): # 3109800006

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



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PREVENTIVE MAINTENANCE SCHEDULE

FOR MODELS WITH AC DIRECT DRIVE

! 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.

	ESTIMATED TIME (MINUTES)						
DESCRIPTION PERIOD	**SHIFT**	**WEEK**	**250H**	**500H**	**1000 H**	**2000 H**	**CHECK**
Check for visible damage	**1**						
Examine floor around and beneath unit for signs of differential and brake fluid leaks.	**1**						
Turn steering, check for hard steering, excessive free play, or unusual sound when turning.	**1**						
Check accelerator for free & smooth movement.	**1**						
Check reverse alarm, horn, strobe light.	**1**						
Check brake pedal travel and parking brake for secure hold. Start slowly and check service brake.		**1**					
Check tire pressure, see pressure rating on tire		**1**					
Check & fill batteries (add distilled water to cover plates. Fill to recommended level after batteries have been fully charged.)		**15**					
Check deadman switch and static strap (min 2`` contact with the floor)			**1**				
Check warning decal & marking			**1**				
Clean battery with water			**1**				
Check master cylinder fluid level (DOT 3)			**1**				
Check brake pedal travel			**1**				
Turn front wheels straight, check steering play			**1**				
Check parking brake, requires 30-40 lbs. force to apply			**1**				
Check brake lines for leaks			**1**				
Check drive for leaks			**1**				
Inspect steering suspension linkages			**1**				
Inspect the frame for damage			**1**				
Check pedal & master cylinder linkages for wear			**1**				

		ESTIMATED TIME (MINUTES)					
DESCRIPTION PERIOD	**SHIFT**	**WEEK**	**250H**	**500H**	**1000 H**	**2000 H**	**CHECK**
Inspect rear wheel bearings for play				**3**			
Inspect front wheel bearings and kingpins for play				**3**			
Inspect rear brake lining for wear 1/16" (2 mm) minimum lining thickness.				**3**			
Check service brake linings and linkages for wear				**12**			
Check parking brake linings and linkages for wear				**5**			
Check power circuit connections				**5**			
Check motor brushes & commutator				**5**			
Check accelerator pot and switch 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.				**10**			
Lubricate the vehicle				**5**			
Change differential oil MOBILUBE 1 SHC 75W-90				**15**			
Check and tighten all electrical connections					**15**		
Lubricate motor spline using Monocal GP 1499 from Lubrication Engineers grease					**15**		
Tighten all nuts and bolts					**15**		
Clean & repack front Wheel Bearing					**15**		
Clean & repack Rear Wheel Bearing					**90**		
Flush the hydraulic brake system (DOT 3), if appl.						**60**	
Replace differential oil seals & wheel bearings.						**90**	
TOTAL TIME (MINUTES)	**5**	**17**	**12**	**66**	**150**	**150**	

Date: _____ Hour Meter Reading: _____

Inspected By: _____ Unit Number: _____

Any deficiencies found during inspection must be corrected before the unit is returned to service.

OIL GRADE CHART

Vehicle system	Oil grade
Differential	MOBILUBE 1 SHC 75W-90
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

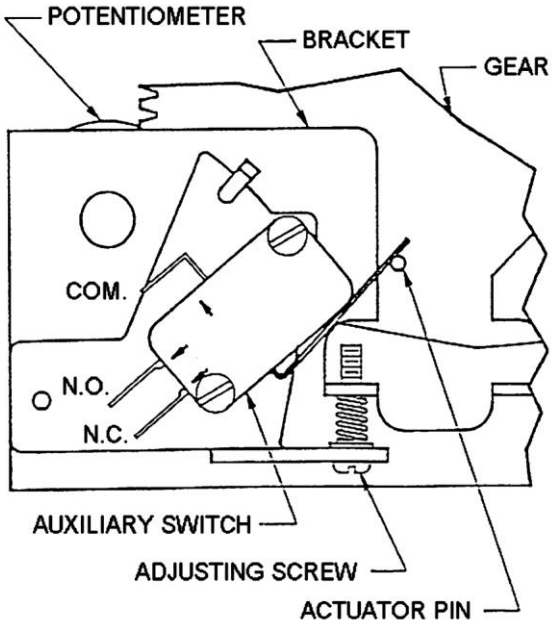
The micro-switch must deactivate the on/off solenoid when the accelerator is released; turn the adjusting screw (shown on figure below) to adjust the micro-switch height.

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.

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.

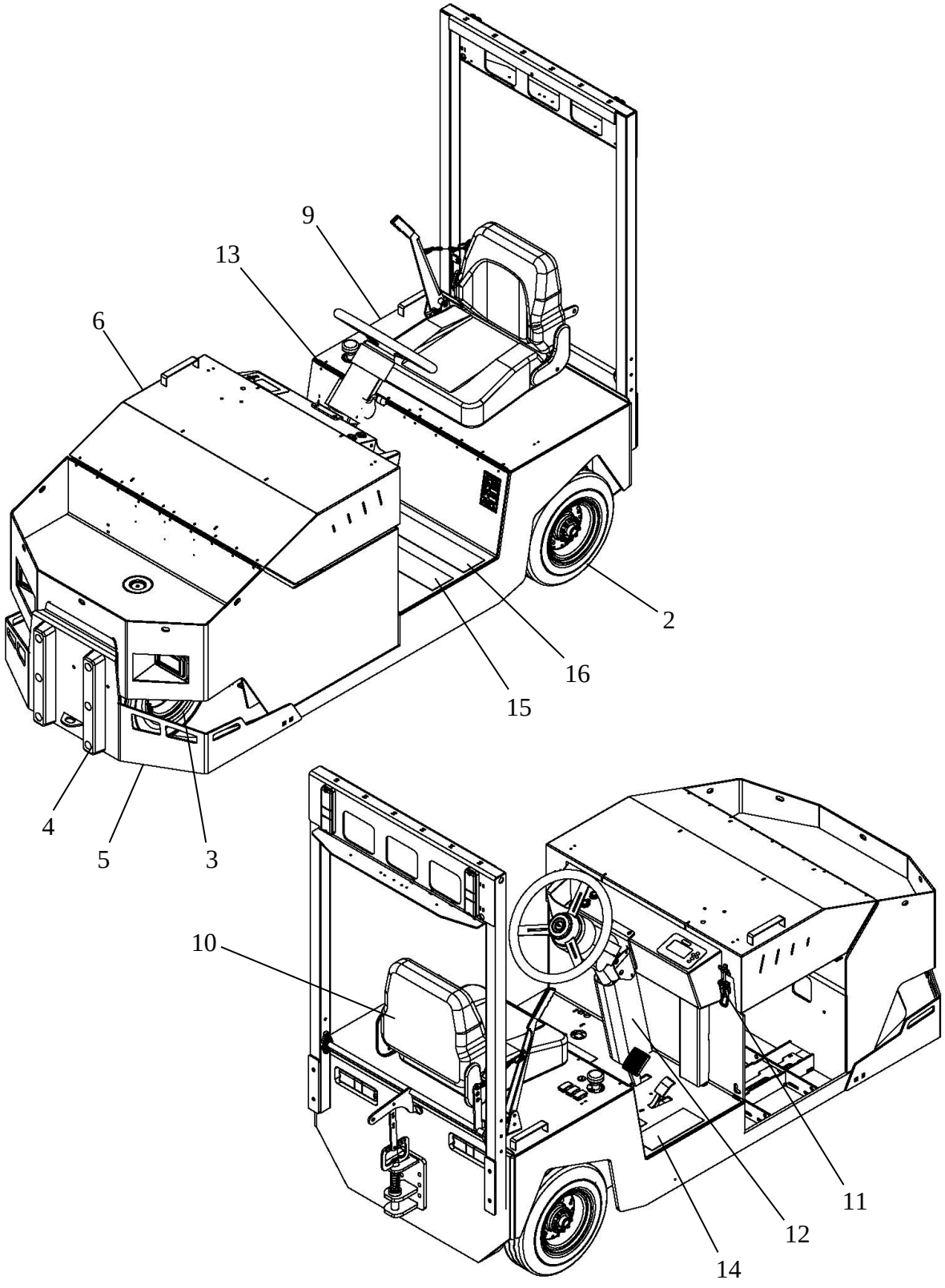
FAULT HISTORY

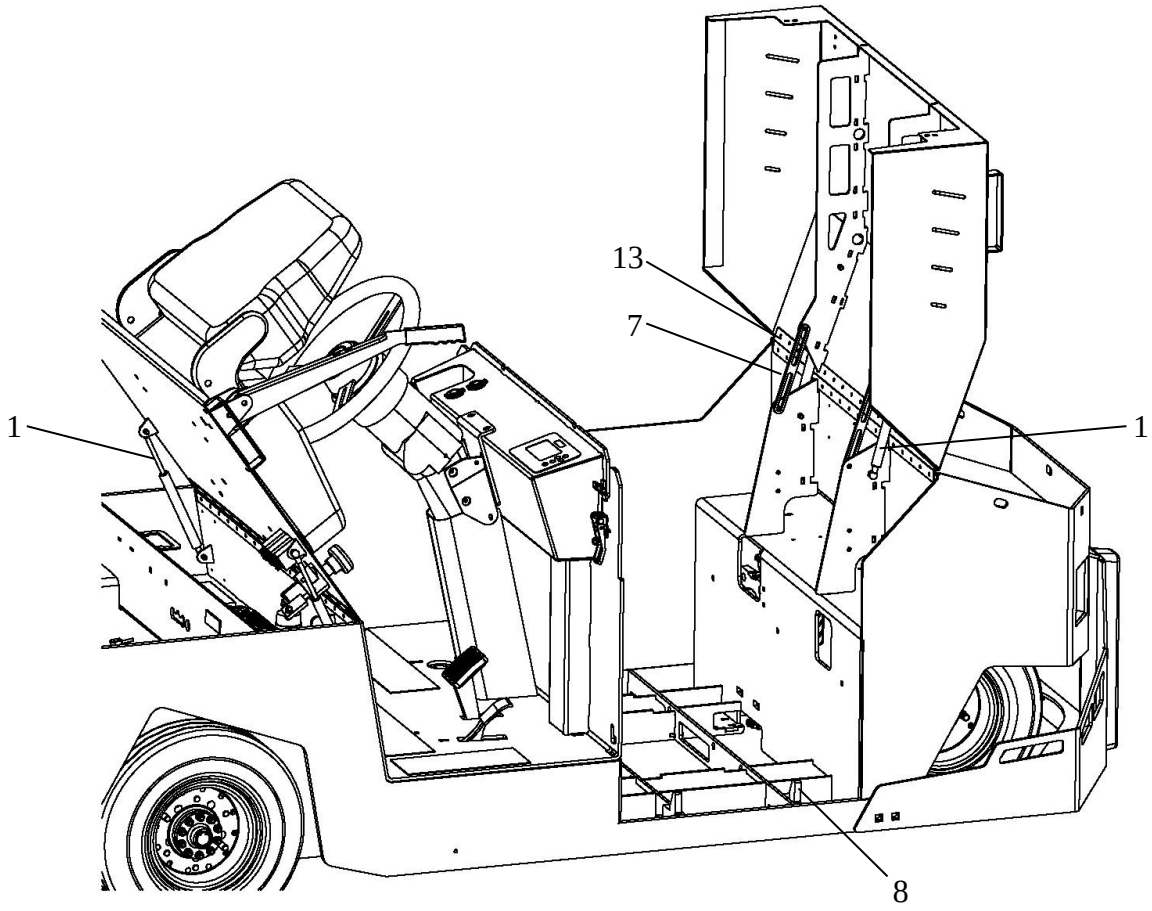
The 1311 programmer can be used to access the controller's fault history file. The programmer will read out all the faults the controller has experienced since the last time the fault history file was cleared. Faults such as contactor faults may be the result of loose wires; contactor wiring should be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

SPARE PARTS

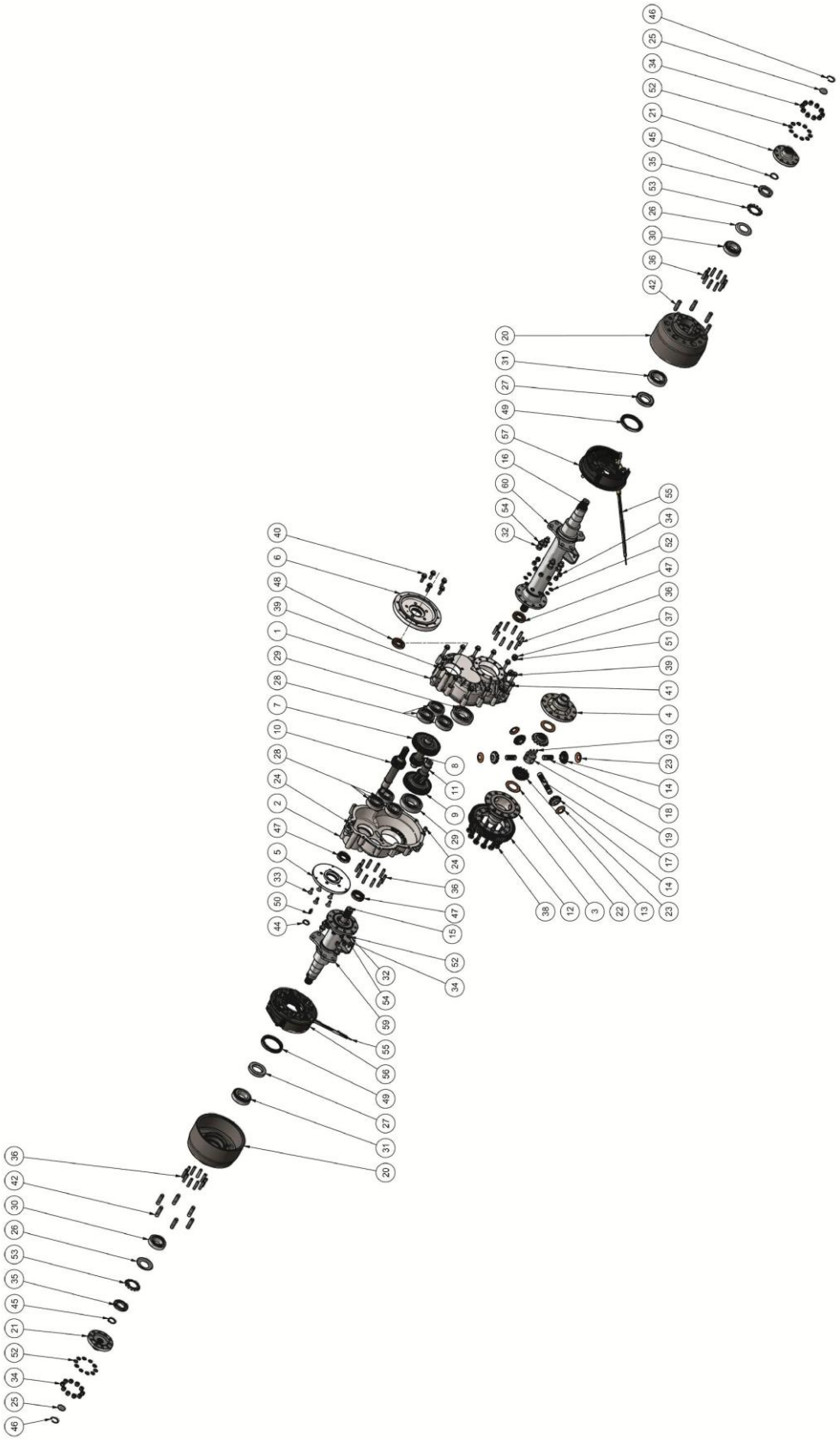
BODY





REF.	*PART NO.*	*DESCRIPTION*
1	2199012060	GAS SPRING
2	2223224010	4.00X8 SOLID SOFTY, 6 HOLES, SPLIT RIM
	2223224012	4.00X8 SOLID SOFTY, 6 HOLES, SPLIT RIM, N-MARKING
3	2223240015HD	4.00X8 HD TIRE, 5 HOLES, BLACK SPLIT RIM
	2223224014HD	4.00X8 WHITE SOFTY, 5HOLES, BLACK SPLIT RIM
4	2311000006	RUBBER BUMPER
5	2314350001	STEEL BUMPER
6	2331351004	BATTERY HOOD 19.5”
	2331351001	BATTERY HOOD 19.5” WITH FAST CHARGE HOLES
7	2339340001	COVER LIMITER
8	2351340001	LIFT-OUT STOPPER
9	2380350001	SEAT PLATE
10	2385224001	SEAT, SEMI-SUSPENSION
11	2803248005	LOCKABLE LATCH
12	2806340002	PROTECTOR DOUGLAS COLUMN
13	2808248012	PIANO HINGE
14	5100280006	SAND STRIP CARPET, 10”
15	5100280007	SAND STRIP CARPET, 16”
16	5100280008	SAND STRIP CARPET, 31.5”

DIFFERENTIAL



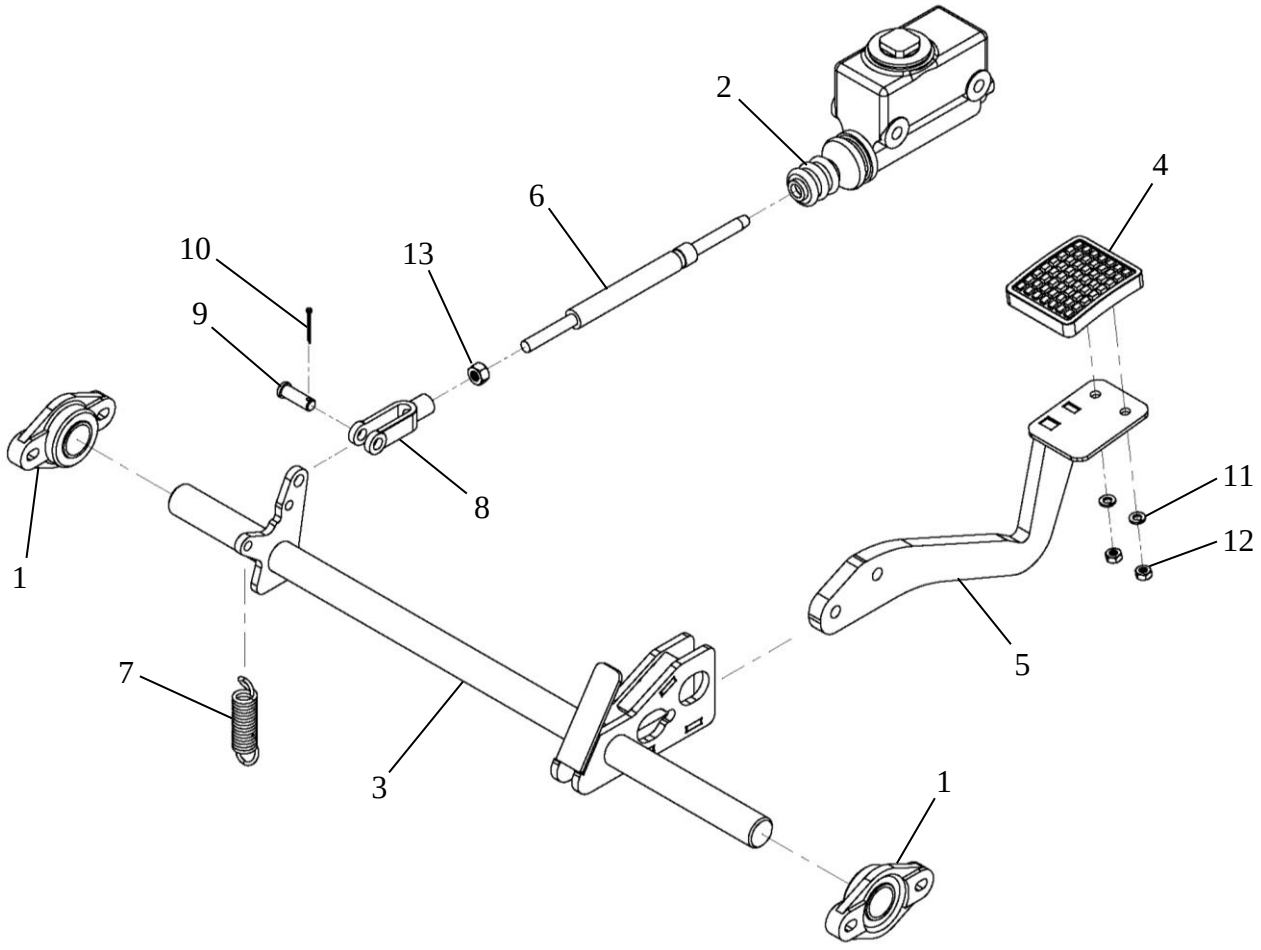
REF.	*PART NO.*	*DESCRIPTION*	*ALL*	*16.1.1*	*22.3.1*	*27.7.1*	*QTY*
1	49.01.3500	GEARBOX	✓				1
2	49.01.35011	GEARBOX COVER	✓				1
3	49.01.3506	DIFFERENTIAL CASE	✓				1
4	49.01.3507	DIFFERENTIAL CASE COVER	✓				1
5	49.03.3505	BRAKE HOUSING	✓				1
6	49.03.3509	BELL HOUSING	✓				1
7	49.05.3511	I REDUCTION DRIVEN GEAR			✓		1
	49.05.3515	I REDUCTION DRIVEN GEAR				✓	1
	49.05.3519	I REDUCTION DRIVEN GEAR		✓			1
8	49.05.3512	II REDUCTION DRIVING GEAR			✓	✓	1
	49.05.3533	II REDUCTION DRIVING GEAR		✓			1
9	49.05.3513	II REDUCTION DRIVEN GEAR			✓	✓	1
10	49.05.3522	INOUT GEAR WITH BRAKE			✓		1
	49.05.3523	INOUT GEAR WITH BRAKE				✓	1
	49.05.3524	INOUT GEAR WITH BRAKE		✓			1
11	49.05.3531	II REDUCTION DRIVING GEAR			✓	✓	1
12	49.05.3532	DIFFERENTIAL GEAR			✓	✓	1
	49.05.3534	DIFFERENTIAL GEAR		✓			1
13	49.05.3539	PLANET GEAR	✓				2
14	49.05.3540	SUN GEAR	✓				4
15	49.06.3579	AXLE SHAFT	✓				1
16	49.06.3592	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	49.08.3622	DRUM BRAKE 170	✓				2
21	49.08.3625	HUB	✓				2
22	49.11.3640	PLANET GEAR WASHER	✓				2
23	49.11.3641	SUN GEAR WASHER	✓				4
24	49.11.3642	PIN	✓				2
25	49.11.3648	PROTECTION	✓				2
26	49.11.3649	RING	✓				2
27	49.11.3650	RING	✓				2
28	50.05.01.08	BALL BEARING	✓				6**
29	50.05.01.17	BALL BEARING	✓				2
30	50.05.07.13	TAPARED ROLLER BEARING	✓				2
31	50.05.07.14	TAPARED ROLLER BEARING	✓				2
32	50.06.01.50	SCREW	✓				10
33	50.06.04.17	FLATHEAD BOLT	✓				5
34	50.06.06.53	LOCKNUT	✓				40
35	50.06.07.35	RING NUT	✓				2
36	50.06.08.18	STUD BOLT	✓				40
37	50.06.10.14	OIL PLUG	✓				2
38	50.06.19.10040	BOLT	✓				12
39	50.06.22.08055	FLANGED BOLT	✓				2
40	50.06.23.08025	FLANGED BOLT	✓				5
41	50.06.23.08050	FLANGED BOLT	✓				11
42	50.06.28.12025	STUD BOLT	✓				12
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

REF.	*PART NO.*	*DESCRIPTION*	*ALL*	*16.1:1*	*22.3:1*	*27.7:1*	*QTY*
47	50.10.01.02V	OIL SEAL	✓				3
48	50.10.01.27	OIL SEAL	✓				1
49	50.10.01.28	OIL SEAL	✓				2
50	50.11.01.02	KEY	✓				1
51	50.12.01.06	WASHER	✓				2
52	50.12.03.03	WASHER	✓				40
53	50.12.05.35	TAB WASHER	✓				2
54	50.12.09.05	WASHER	✓				10
55	50.14.03.170C2	PARK BRAKE CABLE	✓				2
56	50.14.03.170D	HYDRAULIC DRUM BRAKE ASSEMBLY	✓				1
57	50.14.03.170S	HYDRAULIC DRUM BRAKE ASSEMBLY	✓				1
58	50.26.01.01	OIL	✓				0.500 L
59	71.2.3.0.4.02L	LEFT TUBE		✓			1
	71.2.3.0.4.05L	LEFT TUBE			✓	✓	1
60	71.2.3.0.4.02R	RIGHT TUBE		✓			1
	71.2.4.0.4.05R	RIGHT TUBE			✓	✓	1

** BALL BEARING (**ITEM # 28**) **QTY** : **6** FOR **22.3:1** & **27.7:1** RATIO

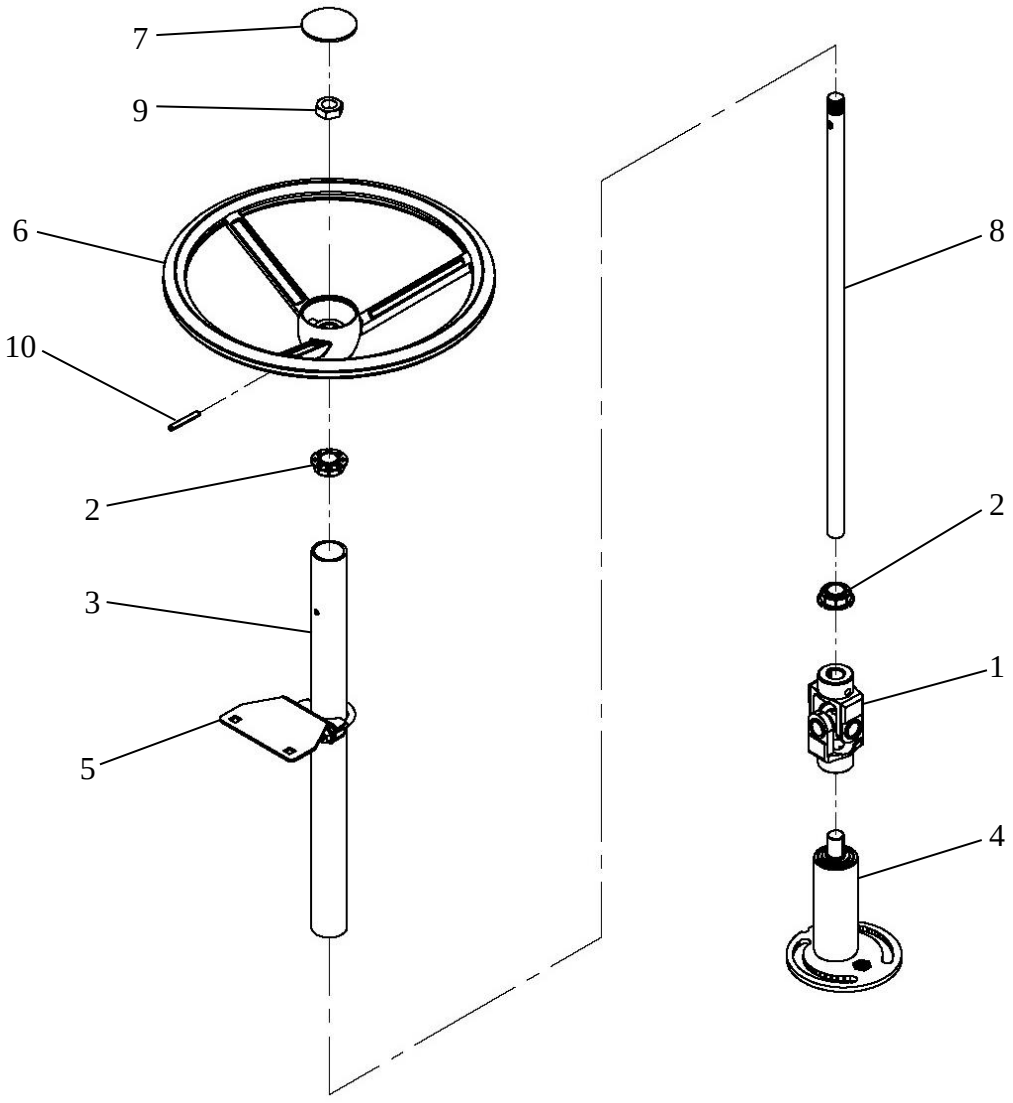
BALL BEARING (**ITEM # 28**) **QTY** : **4** FOR **16.1:1** RATIO

BRAKE CONTROLS



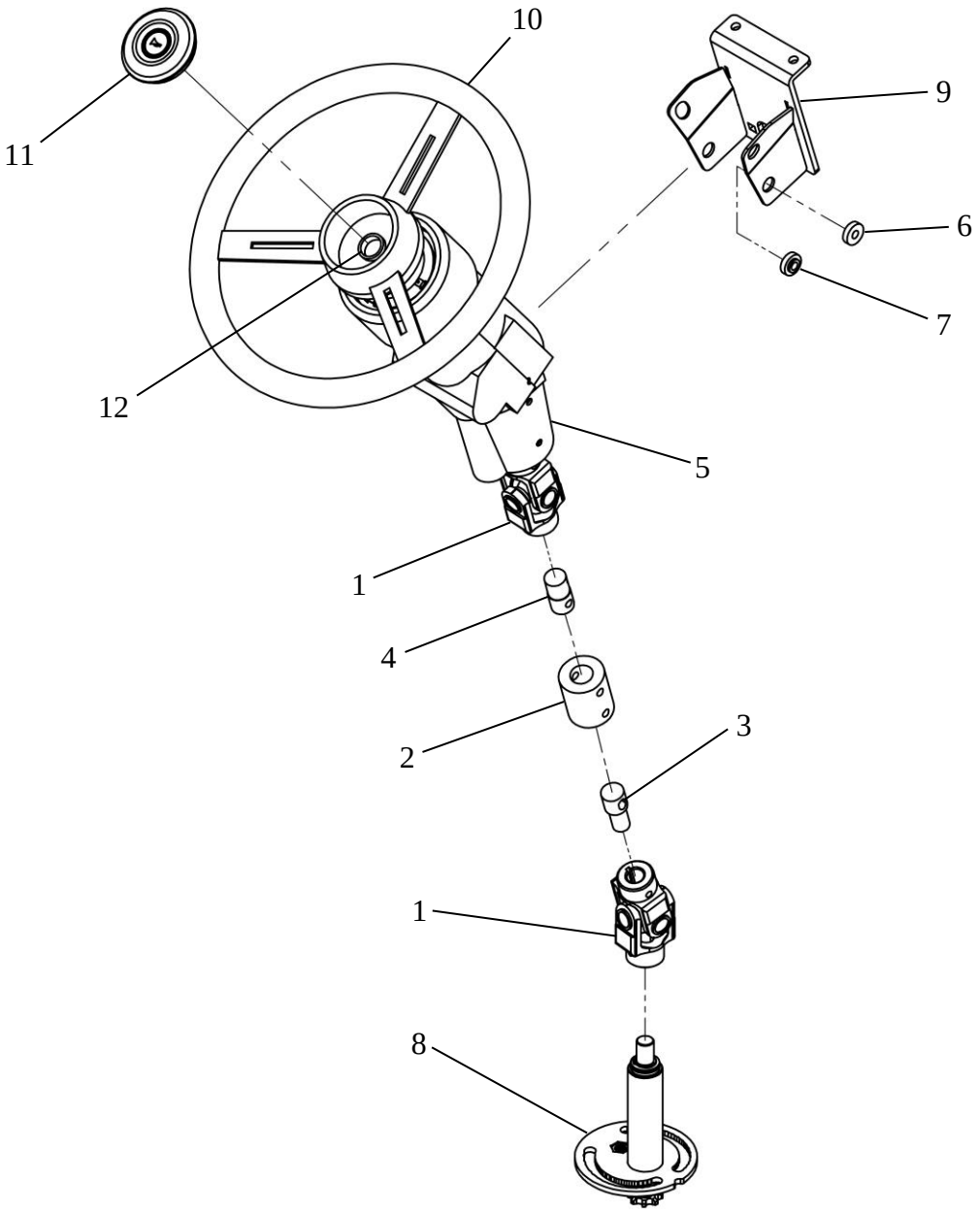
REF.	*PART NO.*	*DESCRIPTION*
1	2106016001	PLASTIC FLANGE BEARING, 1 DIA
2	2125000001	MASTER CYLINDER
3	2131340001	BRAKE PIVOT
4	2131100002	RUBBER FOR BRAKE PEDAL
5	2131340004	BRAKE LEVER
6	2133236001	PUSH ROD, MASTER CYLINDER
7	2190000003	SPRING
8	2910000015	CLEVIS YOKE
9	2910000028	CLEVIS PIN 3/8 X 1 3/32
10	-	COTTER PIN 3/32X 1
11	-	LOCK WASHER 1/4
12	-	NUT 1/4-NC
13	-	NUT 3/8-NF

STEERING WHEEL



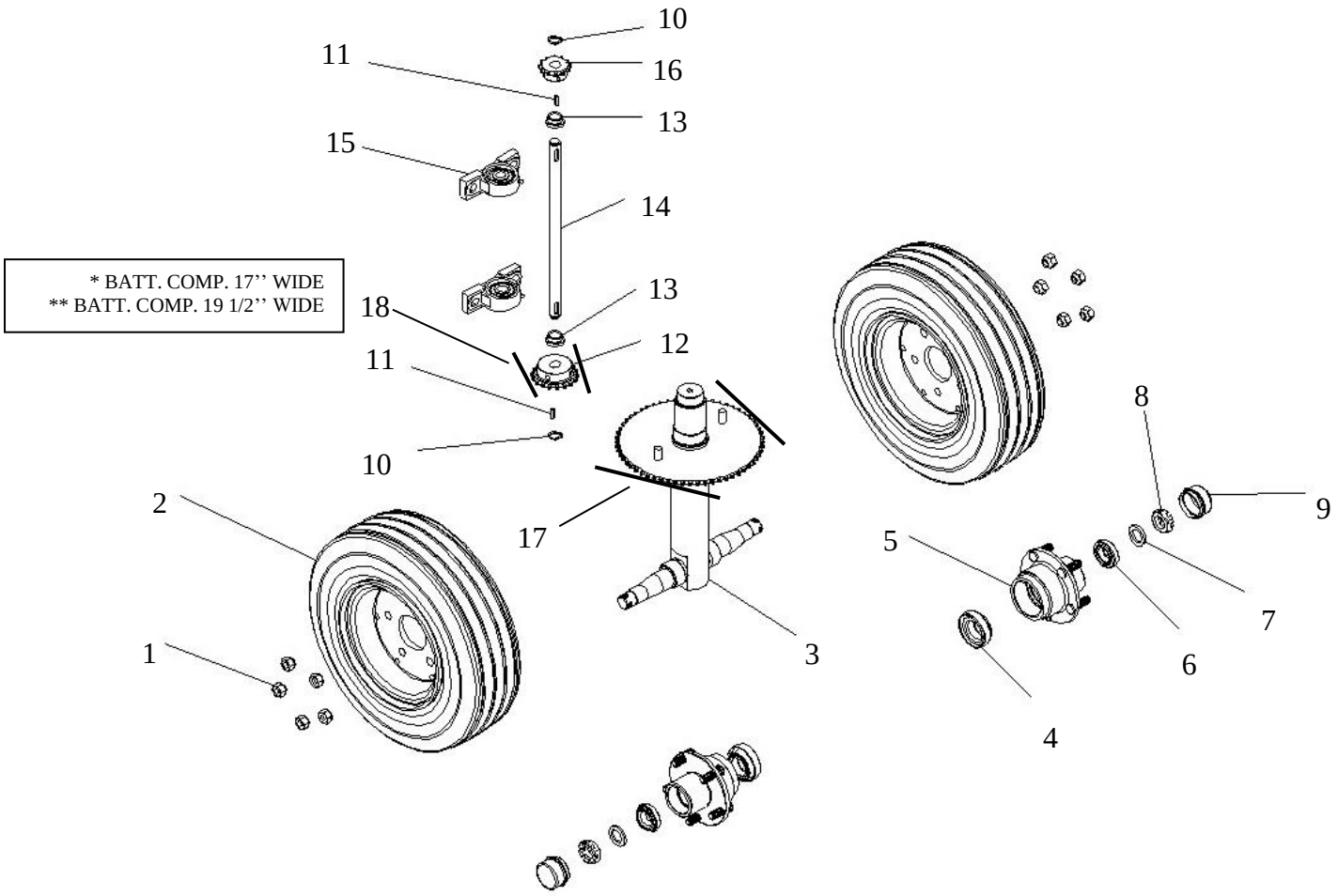
REF.	*PART NO.*	*DESCRIPTION*
1	2104000001	UNIVERSAL JOINT
2	2109012001	PLASTIC BEARING, 3/4 DIA
3	2200224021	TUBE
4	2205340001	PIVOT
5	2206224010	STEERING ASSEMBLY
6	2208240001	STEERING WHEEL
7	2208240002	COVER
8	2209248003	SHAFT
9	2910000022	NUT 3/4-NF
10	2910000023	PIN

TILT STEERING WHEEL



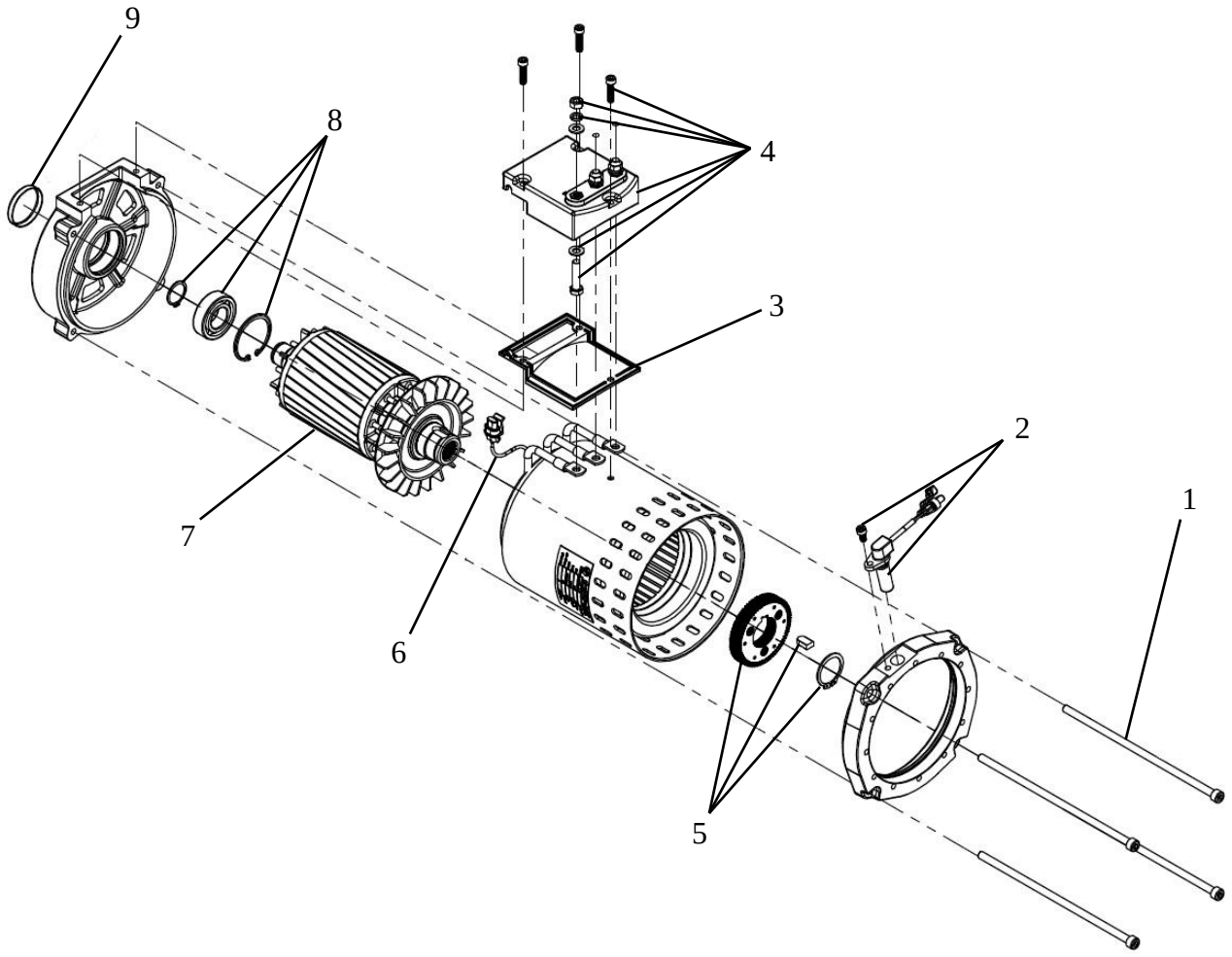
REF.	*PART NO.*	*DESCRIPTION*	*REF.*	*PART NO.*	*DESCRIPTION*
1	2104000001	UNIVERSAL JOINT	**7**	2200224007	BUSHING
2	2200224001	NYLON COUPLER	**8**	2205350002	CHAIN TENSIONER
3	2200224002	STEEL SHAFT	**9**	2206224001	SUPPORT
4	2200224003	ALUMINIUM SHAFT	**10**	2208224001	STEERING WHEEL
5	2200224004	TILT/TEL COLUMN	**11**	2208224002	HORN BUTTON
6	2200224006	WASHER	**12**	2219224002	HORN BRUSH KIT

FRONT WHEEL



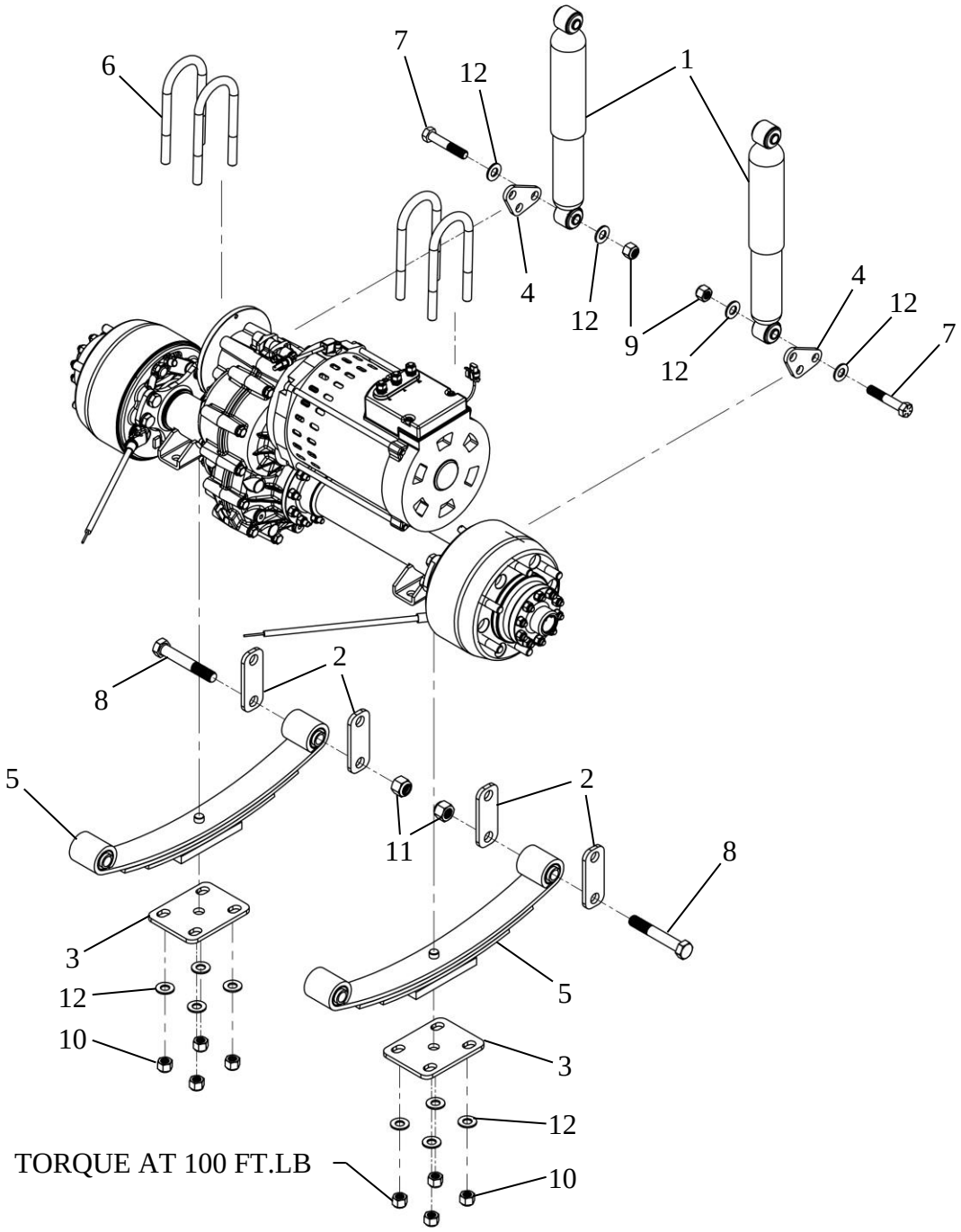
REF.	*PART NO.*	*DESCRIPTION*	*REF.*	*PART NO.*	*DESCRIPTION*
1	2910000019	WHEEL NUT	**8**	2910300002	CASTELLATED NUT
2	2223240015	SOLID SOFTY TYRE	**9**	2229300001	DUST CAP
	2223224002	SPLIT RIM	**10**	2910224002	RETAINING RING
			11	2118360001	SQUARE KEY
3	2203340020	RIGID FORK	**12**	2111012001	SPROCKET, 18 TEETH
4	2103300003	CONE TAPER.ROLLER	**13**	2100121608-RF	PLASTIC BUSHING
5	2224300006	SPINDLE HUB	**14**	2209350001	INTERMEDIATE SHAFT
	2229300002	OIL SEAL	**15**	2105000001	PILLOW BLOCK
			16	2111012002	SPROCKET, 12 TEETH
6	2103300005	CONE TAPER BEARING	**17**	2110350002	FORK CHAIN (44 ½")
7	2229300003	SPINDLE WASHER	**18**	*2110350003	STEERING CHAIN (52 LINKS)
				**2110350001	STEERING CHAIN (57 LINKS)

AC MOTOR FAN COOLED



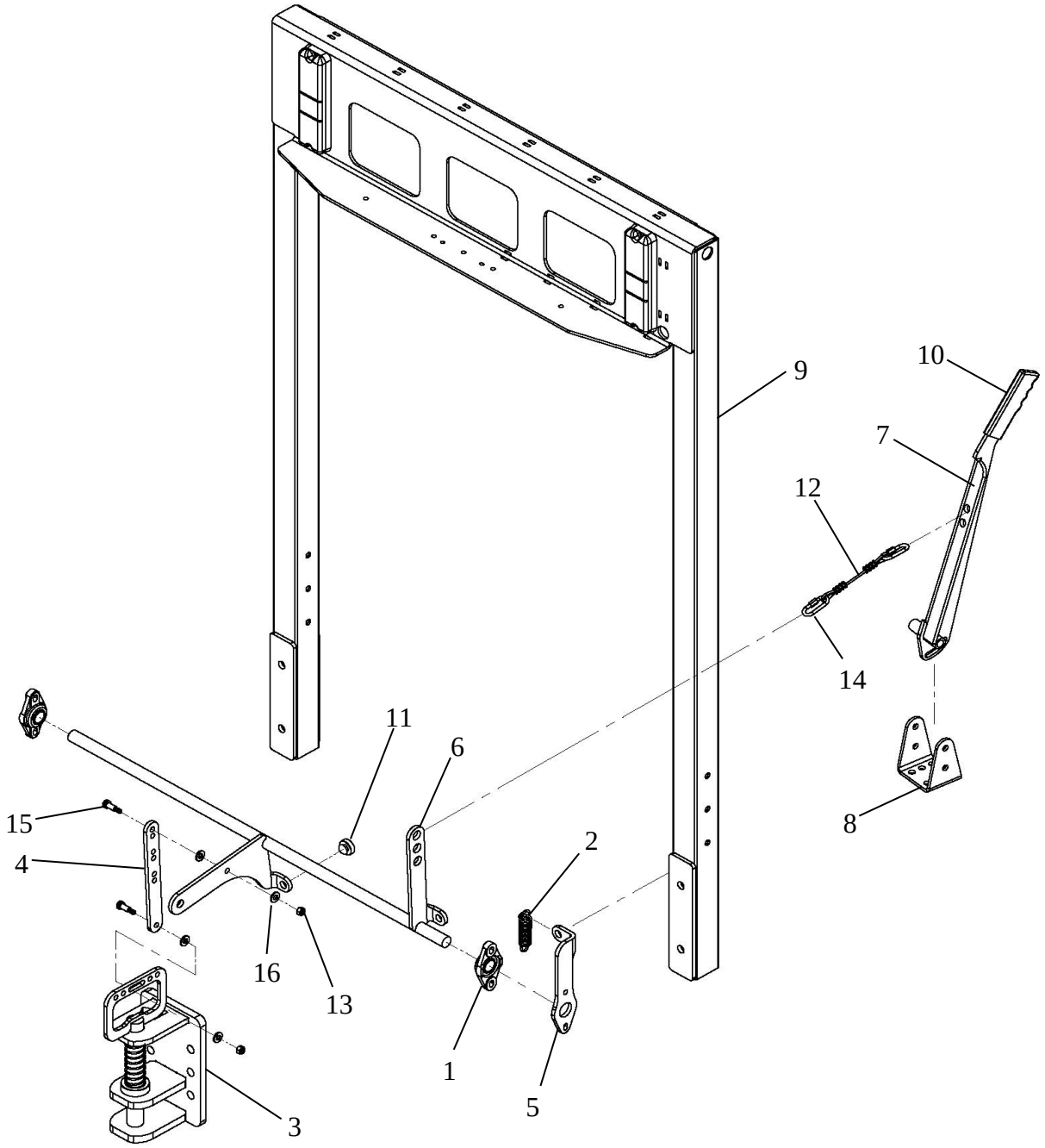
REF.	*PART NO.*	**DESCRIPTION**
1	8SD.909.020S	BOLT SERVICE KIT
2	3113248002	SPEED SENSOR SERVICE KIT
3	8SD.371.226	TERMINAL GASKET
4	3112248005SP	TERMINAL BLOCK SERVICE KIT
5	5SD.676.502S	PULSE WHEEL SERVICE KIT
6	H-303S	THERMAL SENSOR SERVICE KIT
7	3112248008	ROTOR
8	100218AS	REAR BEARING SERVICE KIT
9	8SD.310.310	REAR END SHAFT COVER

RIGID AXLE



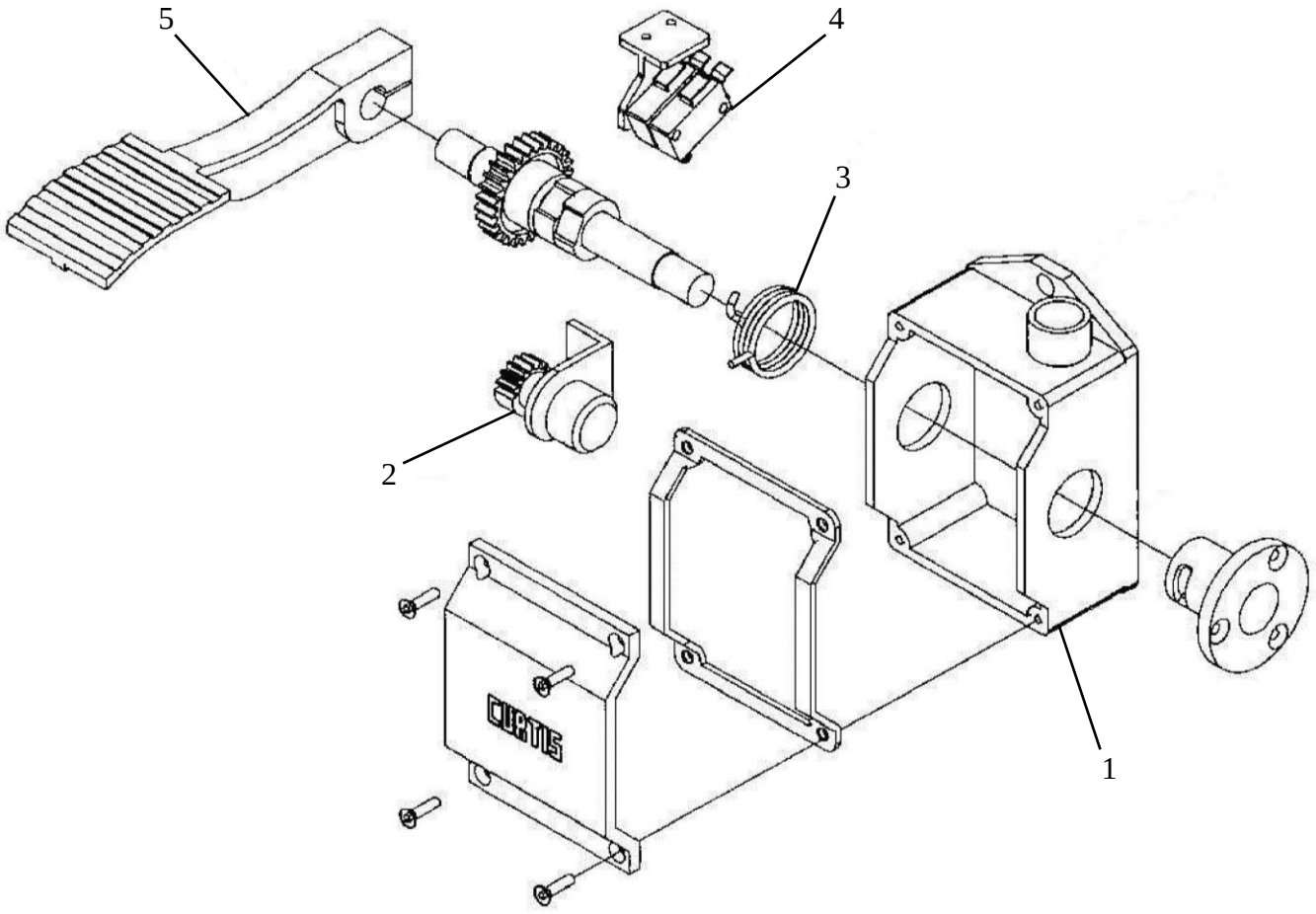
REF.	*PART NO.*	*DESCRIPTION*	*REF.*	*PART NO.*	*DESCRIPTION*
1	2180240002	SHOCK	**7**	-	BOLT 1/2-NC X 2 3/4, GRD 8
2	2182320002	SHACKLE LINK	**8**	-	BOLT 5/8-NC X 4, GRD 8
3	2185280002	PLATE	**9**	-	NYLON NUT 1/2-NC, GRD 8
4	2189340001	SHOCK SUPPORT	**10**	-	NYLON NUT 1/2-NF, GRD 8
5	2192210001	LEAF SPRING	**11**	-	NYLON NUT 5/8-NC, GRD 8
6	2916280001	U-BOLT	**12**	-	WASHER 1/2, GRD 8

HAND RELEASE FOR CLEVIS HITCH



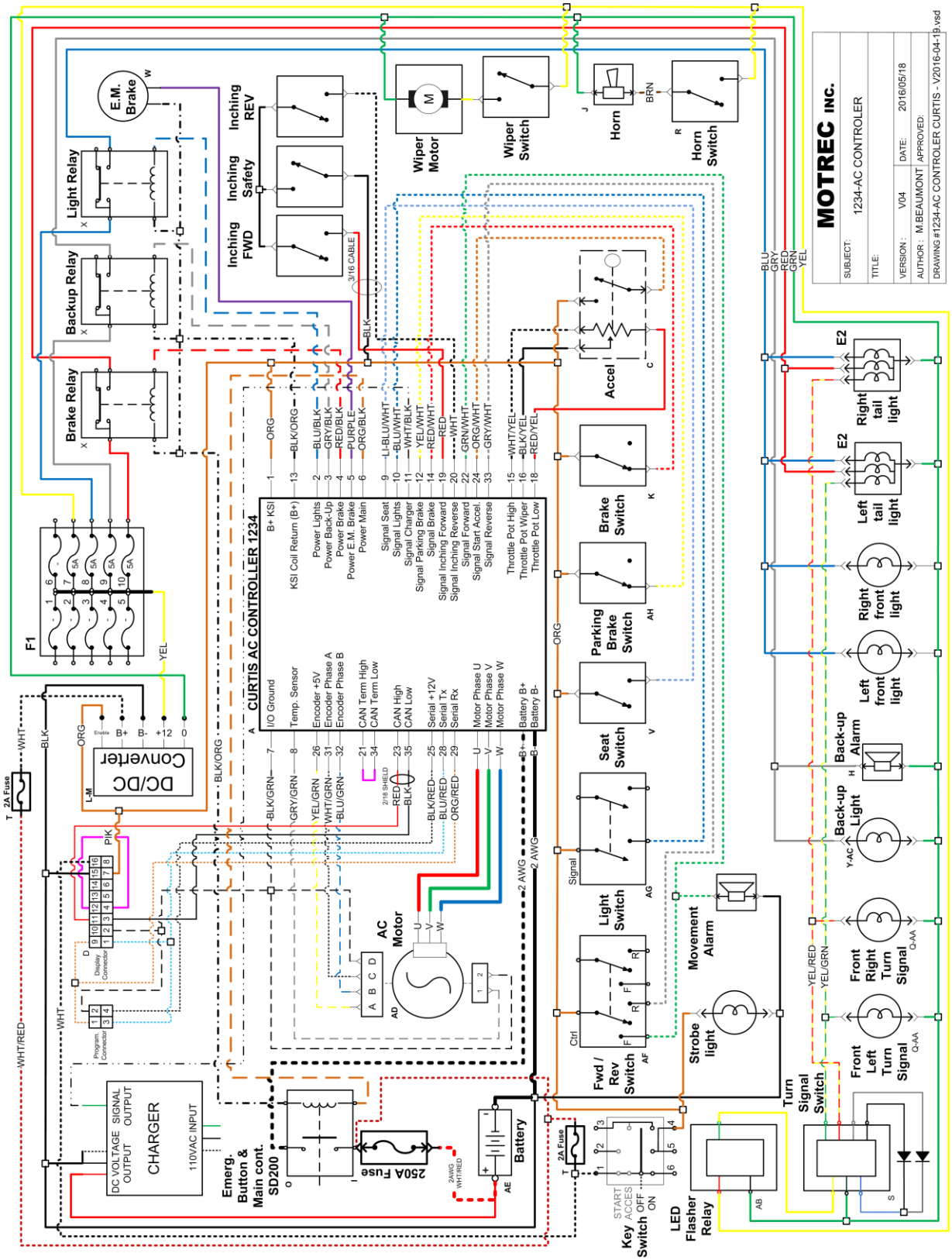
REF.	*PART NO.*	*DESCRIPTION*
1	2106012001	PLASTIC FLANGE BEARING
2	2190000003	SPRING
3	2320000010	CLEVIS HITCH
4	2322248056	ADJUSTABLE DRAW BAR
5	2322248077	SPRING SUPPORT
6	2322248082	REAR PIVOT
7	2322340001	RELEASE HANDLE
8	2322440009	LEVER SUPPORT
9	2342340005	LIGHT BAR, 56”
10	2803000020	HAND GRIP
11	2930000032	PUSH-IN BUMPER
12	2930350001	WIRE ROPE
13	-	NYLON NUT 1/4-NC, GRD 8
14	-	QUICK LINK 3/16”
15	-	SHOULDER BOLT 5/16”
16	-	WASHER 5/16”, GRD 8

CURTIS FOOT PEDAL

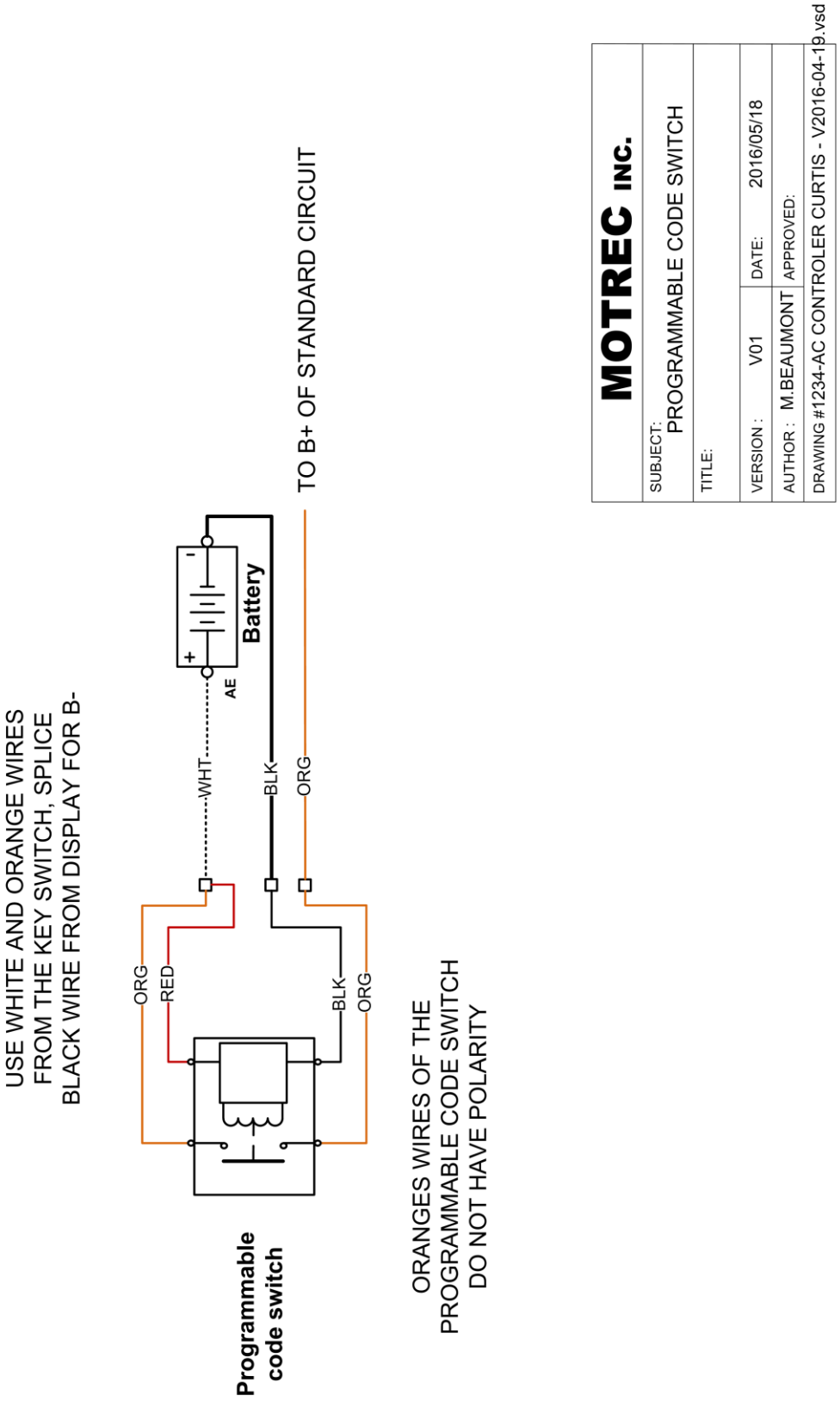


REF.	*PART NO.*	*DESCRIPTION*
1	3062001C	ACCELERATOR CURTIS
2	367008	POTENTIOMETER
3	2262004C	SPRING
4	2262001C	MICRO-SWITCH
5	2262003C	LEVER

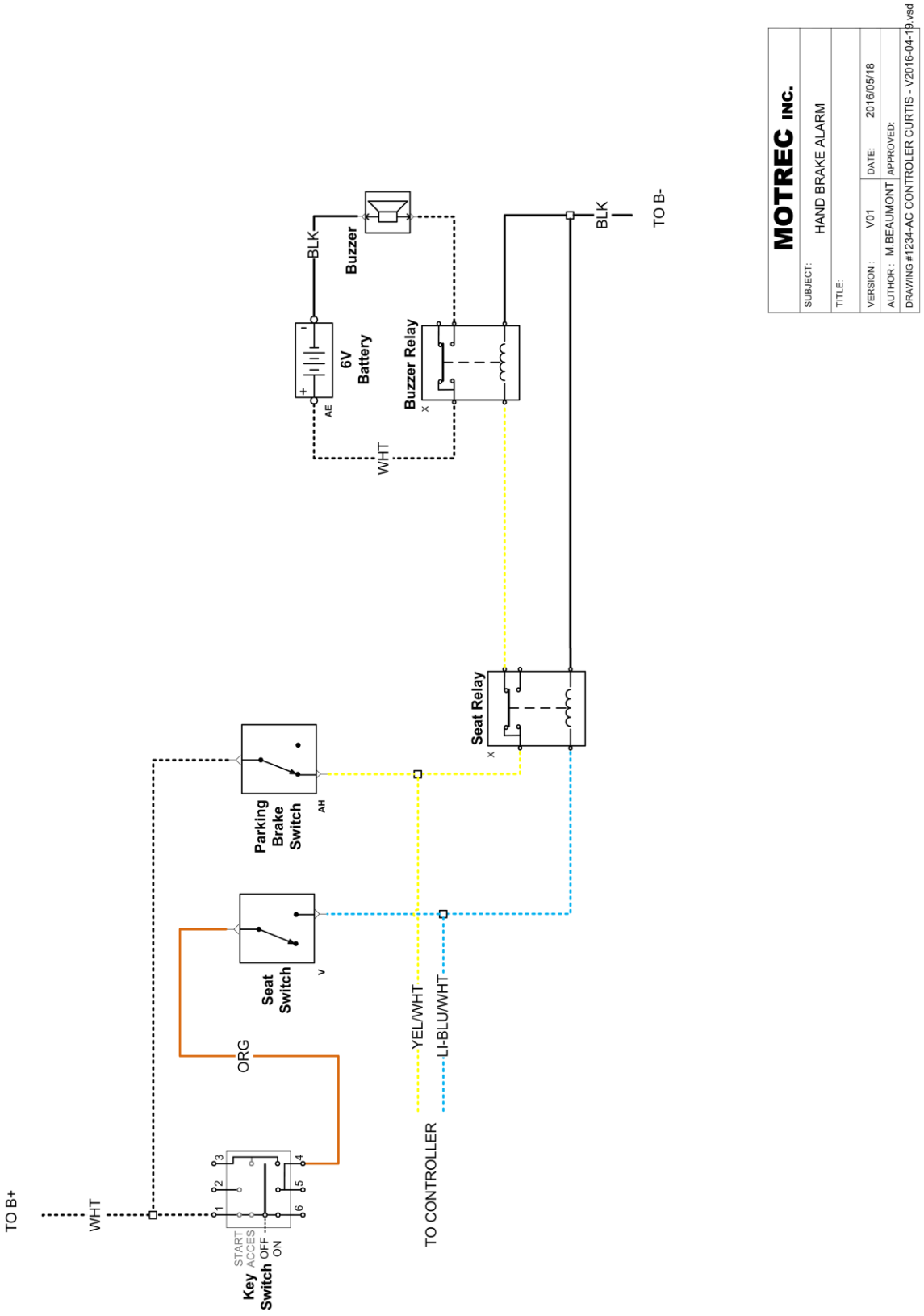
ELECTRICAL DIAGRAM – MAIN CIRCUIT



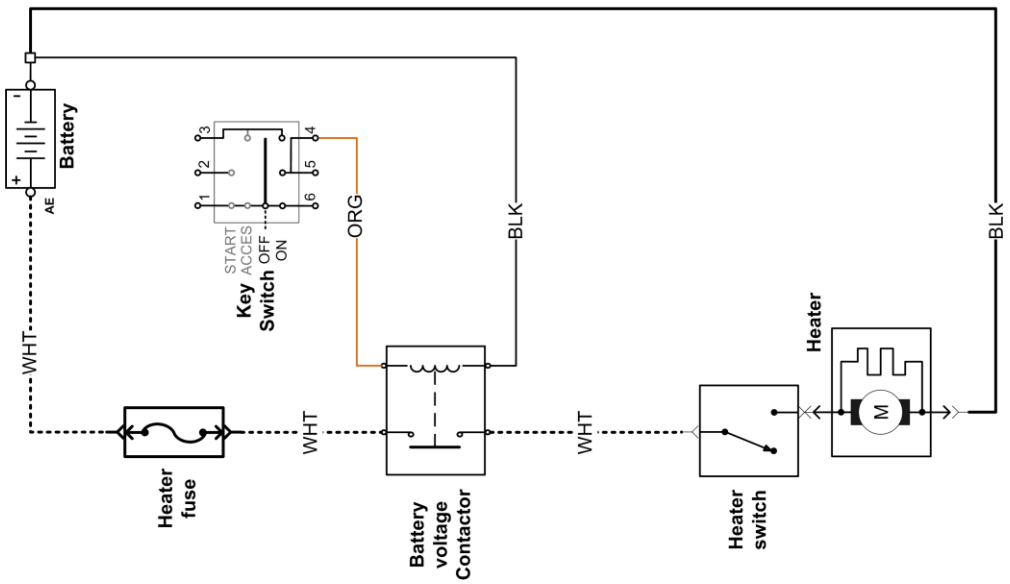
PROGRAMMABLE CODE SWITCH



HAND BRAKE ALARM



HEATER WIRING DIAGRAM



MOTREC INC.			
SUBJECT:	HEATER WIRING DIAGRAM		
TITLE:			
VERSION :	V01	DATE:	2016/05/18
AUTHOR :	M.BEAUMONT	APPROVED:	
DRAWING #1234-AC CONTROLER CURTIS - V2016-04-19.vsd			

PARTS LIST

NO	DESIGNATION	REF	QTY
A1	SEPEX SPEED CONTROL, 24-36V, 300A	1243-4320	
A2	SEPEX SPEED CONTROL, 24-36V, 400A	1244-4451	
	SEPEX SPEED CONTROL, 36-48V, 400A	1244-5461	
	SEPEX SPEED CONTROL, 36-48V, 600A	1244-5651	
	SEPEX SPEED CONTROL, 36-80V, 600A	1244-6651	
A3	SERIES SPEED CONTROL, 24-36V, 400A	367013	
	SERIES SPEED CONTROL, 36-48V, 350A	487013	
	SERIES SPEED CONTROL, 24-36V, 275A	367010	
A4	SERIES SPEED CONTROL, 24-36V, 350A	1205X-4401	
	SERIES SPEED CONTROL, 36-48V, 350A	1205X-5301	
A5	CURTIS AC CONTROL. 36-48V, 350A	3105236001	
	CURTIS AC CONTROL. CONNECTOR	3105800001-C	
	CURTIS AC CONTROL. CONNECTOR PINS	3105800001-P	
B1	STROBELIGHT	*	
B2	HORN	*	
B3	REVERSE ALARM	*	
B4	MOTION BEEPER	*	
B5	BRAKING BRAKE ALARM	3100000001	
B6	WARNING BUZZER	3100480001	
B7	WARNING BUZZER	3100000007	
B8	RADIO JVC KD-40 WITH 2 AUX INPUT + USB	3114000002	
B9	SPEAKER OMAGE INT-EXT BLACK 5-1/4	3114000005	
E1	HEADLIGHT	*	
E2	TAIL/BRAKE LIGHT	*	
E3	AMBER FRONT LIGHT	*	
E4	BACKUP LIGHT	*	
E5	TAIL/BRAKE/TURN LIGHT - RIGHT	3111800001	
E6	TAIL/BRAKE/TURN LIGHT - LEFT	3111800002	
E7	DOME LIGHT	3669006	
E8	LOW BRAKE OIL LIGHT	3126000001	
F1	FUSE, 15A	246108K	
F2	CIRCUIT BREAKER, 50A	3107000001	
F3	CIRCUIT BREAKER, 150A	3107000002	
F4	DIODE	367012	
F5	DIODE BRIDGE	3669027	
F6	FUSE, 30A	4890028	
F7	FUSE, 300A	3118224003	
	FUSE BASE	3118224002	
F8	8 FUSES BASE	3118000005	
F9	FUSE, 10A	3069019F	
	FUSE HOLDER	246108	
F10	MAXI BLADE FUSE 30A	3118501005	
F11	FUSE, 1A		
F12	FUSE, 20A	3118000006	
F13	FUSE, 6A	3118000004	
F14	FUSE, ANN 250A	3118224001	
	FUSE HOLDER BUSS 4164	3118224002	
G1	BATTERY		
G2	BATTERY CHARGER		
G3	BATTERY (OPTIONAL)		
H1	PILOT LIGHT	*	

K1	FLASHER RELAY (INCANDESCENT)	3069004	
K2	110 VAC RELAY	366213	
	RELAY BASE	246216	
	RELAY RETAINING CLIP	246216C	
K3	FLASHER RELAY	3127000002	
K4	12V MULTIFUNCTION TIMER RELAY 11 PIN	3127662001	
	11 PIN RELAY BASE	3128662001	
K5	RELAY 24VDC SPDT 20A/10A	3127240001	
M1 (E-12)	PERMANENT MAGNET MOTOR, 1/3HP	112406	
(E-100)	PERMANENT MAGNET MOTOR, 1/2HP	124002	
M2	SEPEX MOTOR		
M3	SERIES MOTOR		
M4	WIPER MOTOR	*	
M5	WIPER MOTOR (ADJUSTABLE SPEED)	3113880001	
M6	24 VDC MOTOR – PUMP	204050	
M7	CAB HEATER	*	
M8	48 VDC MOTOR – PUMP	4160266001	
M9	IN-LINE BLOWER	3129480004	
M10	COOLING FAN CONTROL – 12V	3129224001	
M11	COOLING FAN CONTROL – 24V	3129224003	
M12	COOLING FAN MOTOR – 12V	3129224004	
M13	FAN	Call factory	
M14	CAB FAN	*	
M15	COOLING FAN MOTOR	3129124002	
M16	AC MOTOR 36-48VAC FAN COOLED	3112248005	
P1	INDICATOR (BDI), HOUR METER	*	
P2	INDACATOR, HOUR METER 72-80V	802RB7280	
P3	LCD DISPLAY CURTIS	3108000006	
	DISPLAY CONNECTOR	3119000062	
	DISPLAY CONNECTOR PINS	3130000019	
R1	HANDLE ACCELERATOR	3125012001	
	ACCELERATOR (STANDING DRIVER)	367004	
	MICROSWITCH	367005	
	POTENTIOMETER	367008	
	SPRING	2662001	
	ACCELERATOR (SITTING DRIVER)	2142100001	
	MICROSWITCH	3109100001	
	POTENTIOMETER	367003	
	PLASTIC GEAR	367015	
	SPRING	2462008	
	ACCELERATOR, VERTICAL MOUNT	3062001C	
	POTENTIOMETER	367008	
	SPRING	2262004C	
	MICROSWITCH	2262001C	
	LEVER	2262003C	
R4	RESISTANCE, 250 OHMS	367014	
R5	RESISTANCE, 5 KOHMS	2869003	
S1	KEY SWITCH	246205	
	SEALED KEY SWITCH 2 POSITION	3109000046	
	SEALED IGNITION SWITCH WITHOUT KEY 2 POS	3109000047	
	KEY ONLY FOR SEALED KEY SWITCH	3109000046K	
	AUTOMOTIVE CONNECTOR 6 PIN PLUD WEDGE	ASCAW6S	
	AUTOMOTIVE CONNECTOR PLUG 6 WAYS	AT06-6S	
	AUTOMOTIVE CONNECTOR TERMINAL 16-18	AT62-16-0122-L	
S2	DPDT KEY SWITCH	3109000023	

	DPDT KEY SWITCH BASE	3109000017	
	N.O. CONTACT	3109000016	
	N.F. CONTACT	3109000018	
S3	SEAT SWITCH, KIT	2392240003	
	SEAT SWITCH, MICRO-SWITCH	3109100002	
	SEAT SWITCH, SEAT MOUNTED (MICHIGAN)	3109000003	
	CONNECTOR	3109000004	
	SEAT SWITCH, SEAT MOUNTED (GRAMMER)	2205002SW	
S6	FOOT SWITCH	1269003	
S7	FOWARD/REVERSE SELECTOR, ROCKER TYPE	266211	
	FOWARD/REVERSE SELECTOR, COLUMN	436212	
	FORWARD/REVERSE SELECTOR, TILT/TEL COLUMN	366212	
S8	LIGHT SWITCH, ROCKER TYPE	1269004	
	LIGHT SWITCH, PUSH/PULL	486002	
S9	HIGH/LOW HEADLIGHT SWITCH	3109300002	
S10	HORN BUTTON	*	
	HORN BUTTON, COLUMN MOUNT	*	
	HORN BUTTON, TILT/TEL COLUMN	*	
	HORN BUTTON, FLOOR MOUNT	246220	
S11	BRAKE LIGHT SWITCH (STANDING DRIVER)	3109100002	
S12	SEAL BRAKE LIGHT SWITCH (SITTING DRIVER)	3109000043	
	HYDRAULIC BRAKE LIGHT SWITCH	2374001	
S13	FLASHER SWITCH	*	
S14	PARKING BRAKE SWITCH	3109100002	
S15	EMERGENCY PUSH BUTTON	3109800012	
	EMERGENCY PUSH BUTTON, LABEL	3109800006	
S16	UP/DOWN SWITCH	3109266001	
S17	HYDRAULIC PRESSURE SWITCH	3674005	
S18	STAB LOCK SWITCH	3109000029	
S19	EMERGENCY PUSH BUTTON, 250A	3109000005	
	MAINTENANCE SWITCH	3109000022	
	LOCK-OUT MAINTENANCE SWITCH	3109000030	
S20	EMERGENCY PUSH BUTTON	4869012	
S21	EMERGENCY PUSH BUTTON W CASE	3109000008	
S22	TOGGLE SWITCH 2P2T	3109000013	
S23	PRESSURE SWITCH NC	4874001	
S24	HIGH/LOW SELECTOR	55017	
S25	WIPERSWITCH, ADJUST SPEED	3109300005	
S26	HEATER SWITCH	3109300003	
S27	GREEN SWITCH (FORWARD)	3109124005	
S28	GREEN SWITCH (FAST)	3109124005	
S29	GREEN SWITCH (REVERSE)	3109124005	
S30	RED SWITCH (BRAKE)	3109124007	
S31	BLACK SWITCH (HORN)	3109124006	
S32	SIREN/RADIO	3114000001	
S33	SIREN (SPEAKER)	3115000001	
S34	LOW BRAKE OIL SWITCH	2125300003	
S35	TOGGLE SWITCH, ON/OFF	55017	
	ON/OFF PLATE, TOGGLE SWITCH	2469011	
S36	LEG LOCK SWITCH	3109000014	
S37	BATTERY DISCONNECT SWITCH	3109000022	
	LOCK-OUT LEVER	3109000030	
S38	PROGRAMMABLE KEY PAD	3129000003	
S39	PUSH BUTTON WARNING BUZZER	3109000036	

S40	SEALED PUSH BUTTON	3109000024	
	GREEN CAP FOR PUSH BUTTON	3109000025	
	RED CAP FOR PUSH BUTTON	3109000035	
	YELLOW CAP FOR PUSH BUTTON	3109000026	
	SPLASH GUARD FOR PUSH BUTTON	3109000027	
S41	ROTARY SELECTOR 3 POS	3109800015	
S42	LIMIT SWITCH DPDT NO W ADJ ROLLER	3109000038	
S43	SWITCH MAT	3109662003	
S44	MAGNETIC SWITCH FOR PARKING BRAKE LEVER	3109000037	
S45	SINGLE POLE ON/OFF MANUAL DISCONNECT 200A	3104224001	
U1	DC-DC CONVERTER	*	
V1	INVERTER/CHARGER 110VAC, 2400W	**	
X1	HOUR METER CONNECTOR		
X2	SPEED CONTROL CONNECTOR – 1244-XXXX		
X3	SPEED CONTROL CONNECTOR – 1243-XXXX		
X4	SPEED CONTROL CONNECTOR – 1205X-XXXX		
X5	BATTERY CHARGER CONNECTOR		
X6	BLUE CONNECTOR SB-50	SB-50B	
X7	GRAY CONNECTOR SB-50	SB-50G	
X8	RED CONNECTOR SB-50	SB-50R	
X9	YELLOW CONNECTOR SB-50	SB-50Y	
X10	BLUE CONNECTOR SB-175	SB-175B	
X11	GRAY CONNECTOR SB-175	SB-175G	
X12	RED CONNECTOR SB-175	SB-175R	
X13	YELLOW CONNECTOR SB-175	SB-175Y	
X14	BLUE CONNECTOR SBX-175	SBX-175B	
X15	GRAY CONNECTOR SBX-175	SBX-175G	
X16	RED CONNECTOR SBX-175	SBX-175R	
X17	YELLOW CONNECTOR SBX-175	SBX-175Y	
X18	BLUE CONNECTOR SB-350	SB-175B	
X19	GRAY CONNECTOR SB-350	SB-175G	
X20	RED CONNECTOR SB-350	SB-175R	
X21	YELLOW CONNECTOR SB-350	SB-175Y	
X22	BLUE CONNECTOR SBX-350	SBX-350B	
X23	GRAY CONNECTOR SBX-350	SBX-350G	
X24	RED CONNECTOR SBX-350	SBX-350R	
X25	YELLOW CONNECTOR SBX-350	SBX-350Y	
X26	CONNECTOR – 6 POSITIONS – MALE	4869038	
X27	CONNECTOR – 6 POSITIONS – FEMALE	4869039	
X28	MOUNT RECEPTACLE, 125V – 20A	3119480008	
	WEATHERPROOF BOX	3119480006	
	CONNECTOR BOX	3119480007	
	WEATHERPROOF COVER	3119480005	
X29	PVC GROUNDING PLUG, YELLOW	80003	
X30	TRAILER CONNECTOR – 7 POLE - MALE	3119480009	
X31	TRAILER CONNECTOR – 7 POLE - FEMALE	3119480010	
X32	TRAILER CONNECTOR – 9 POLE - FEMALE	3119480035	
X33	TRAILER CONNECTOR – 9 POLE - MALE	3119480036	
	MOUNTING BRACKET – TRAILER CONNECTOR	3119480003B	
X34	PROGRAMMATION CONNECTOR	3119000063	
	PROGRAMMATION CONNECTOR PINS	3130800001	
X35	ENCODER CONNECTOR – VEHICLE PART	3119000048	
	ENCODER CONNECTOR PINS – VEHICLE PART	3119000052	
	ENCODER CONNECTOR – MOTOR PART	3119000049	
	ENCODER CONNECTOR PINS – MOTOR PART	3119000053	

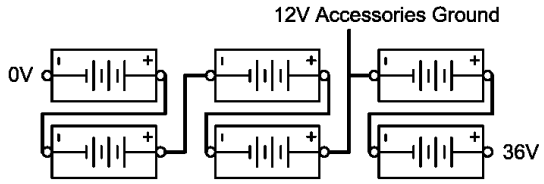
	ENCODER CONNECTOR SEAL	3119000051	
	ENCODER CONNECTOR LOCK	3119000050	
X36	THERMAL SENSOR CONNECTOR – VEHICLE PART	3119000045	
	THERMAL SENSOR CONNECTOR PINS – VEHICLE PART	3119000052	
	THERMAL SENSOR CONNECTOR – MOTOR PART	3119000049	
	THERMAL SENSOR CONNECTOR PINS – MOTOR PART	3119000053	
	THERMAL SENSOR CONNECTOR SEAL	3119000051	
	THERMAL SENSOR CONNECTOR LOCK	3119000047	
Y1	MAIN CONTACTOR – 24V	246111	
	HEAVY DUTY MAIN CONTACTOR – 24V	246112	
	HEAVY DUTY MAIN CONTACTOR – 24V	GE800AH205X0	
	MAIN CONTACTOR – 36V	3104236001	
	MAIN CONTACTOR – 48V	486222	
	HEAVY DUTY MAIN CONTACTOR – 48V	GE800AH208X0	
Y2	F/R CONTACTOR – 24V	246230	
	F/R CONTACTOR – 36V	366217	
	F/R CONTACTOR – 48V	486217	
Y3	ELECTROMAGNETIC BRAKE	3129000023	
Y4	ACCESSORIES SOLENOID – 36V	366215	
Y7	HYDROSTATIC MANIFOLD		
Y8	REVERSE CONTACTOR , 36-48V, 150A	436217	
Y9	FORWARD CONTACTOR , 36-48V, 150A	436218	
Y10	HEATER SOLENOID	246101	
Y11	ELECTROMAGNTIC BRAKE	Call Factory	
Y12	PUMP H.D. SOLENOID	486222	
Y13	DOWN VALVE	4170266001	
Y14	CONTACTOR – 24V	2469010	
Y15	PUMP CONTACTOR – 24V	246112	
Y16	STAB/UNSTAB SOLENOID	4874015	
Y17	DOWN VALVE SOLENOID	4874003	
Y18	UP VALVE SOLENOID	4874002	
Y19	LEVEL INTERLOCK SOLENOID	246230	
Y20	LEVEL SENSOR	3129480001	
Y21	INVERTER SOLENOID	486222	
Y22	RELAY 48V DPDT 10A	3127248002	
Y23	HYDRAULIC VALVE SOLENOID	*	
	F/R BUSSBARS	3119000008	
	STATIC STRAP	2450001	
Y24	POWER STEERING VALVE 48V	4170000003	
Y25	12V SOLENOID	4170480004	
Y26	HYDRAULIC VALVE SOLENOID 2W3P	4170480007	
Y27	RELAY 24V DPDT 10A	3127224001	
Y28	RELAY 12V	3069010	
Y29	RELAY 24V SPDT 40A	3127224002	
Y30	LEVEL SENSOR ELECTRONIC		

* Consult Motrec Illustrated parts

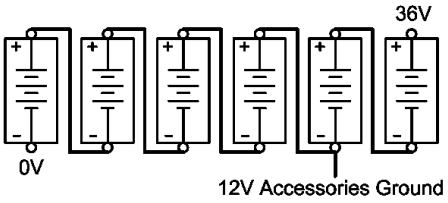
** Consult Motrec chargers

BATTERY CONFIGURATIONS - 36V

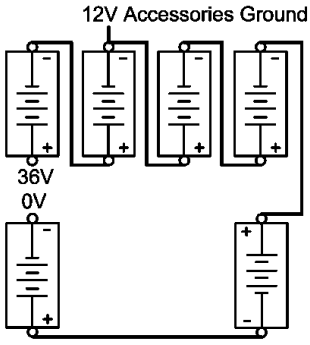
E-280B LIFT-OUT
E-320
E-330
E-360



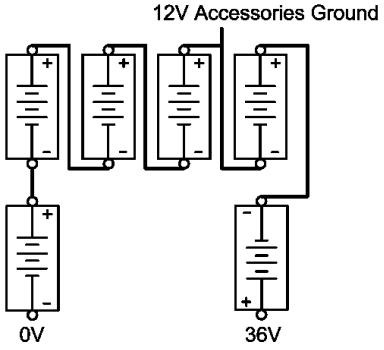
E-300
E-302
E-322



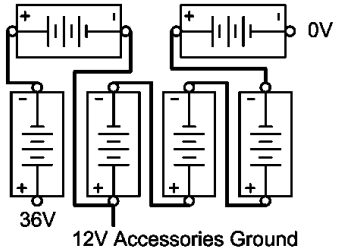
E-276



E-266

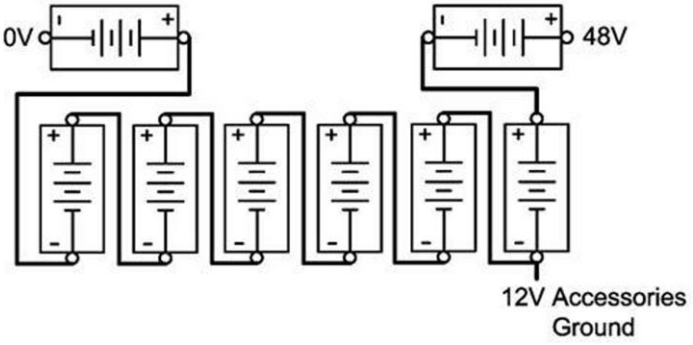


E-266 ROLL-OUT

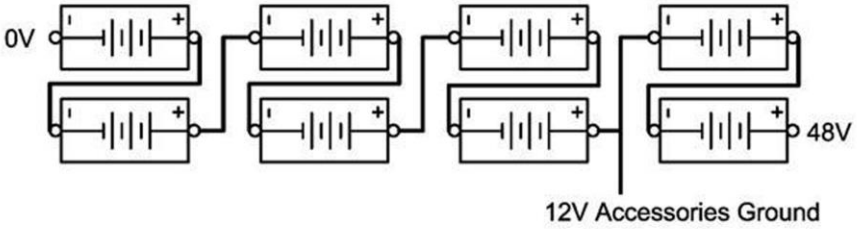


BATTERY CONFIGURATIONS - 48V

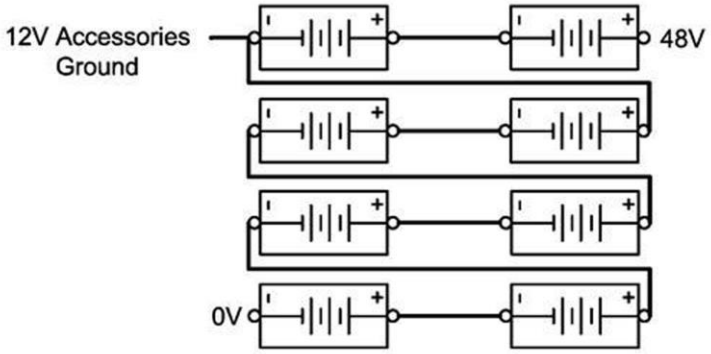
E-348



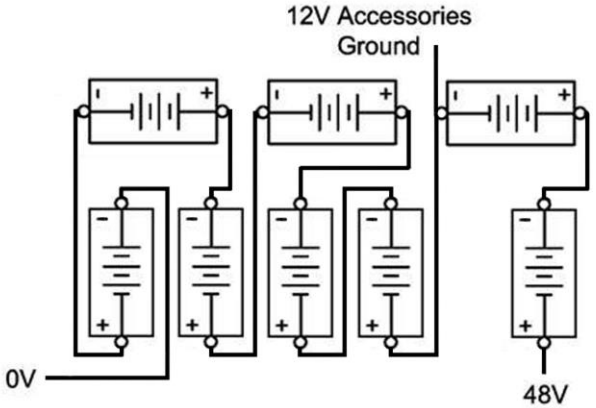
E-480
E-480TT
E-500



E-660



E-660



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: 3119000009

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

Pedestal head lamp - LED
12-48V: 3111000034

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/Turn LED light
12-24V: 3111000037

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

Tail/Brake/Turn/Back up light LED:
3111000055
Kit Connector:
3119000071K

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

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

12-24V LED Headlight:
3111000064

Front Headlight/Turn signal LED 12/48V :
3111000061
Connector : 3119000071K
Rear light/Turn signal/Back up LED 12/48V:
3111000062
Connector: 3119000071K

LED Headlight
12V: 3111000036

Dome light LED:
3111000066

12V Dome light 3669006

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

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

Horn button VIP:
2208224002

Horn button, column mount:
3109000011

Horn button, dash mount:
266210

Horn button: 3109250001

Oval lamp
12V: 3111330001

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

Wiper motor
12V: 3113000001
24V: 486211

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

12-24V Adjustable ECCO: 3100000002

DC-DC Converter, 300W
24-80V: 3124000005
Connector : 3119000074
3119000075

CONNECTOR:3119000084

Horn
12V: 246003
24V: 246013

Turn signal switch: 246050

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

12-48V Adjustable PRECO: 3100000004

Brake switch : 3109000043

Brake switch DC : 246207

Rocker switch Headlight: 3109922020
Replace 1269004

Rocker switch Dome light: 3109922022

Rocker switch Wiper: 3109922031

Rocker switch On/Off: 3109922040

Rocker switch Horn: 3109922130

Rocker switch
Forward/Reverse: 3109923010
Replace 266211

Rocker switch Heater: 3109923032

Rocker switch Inching: 3109923111

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3117480001
Bulb Turn: 3111480003
Bulb Mark: 3111480002

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

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

Red Tail/Turn/Rev light
12V: 3111000002

Amber turn lamp 2”
12V : 3111330002

Red Tail/Brake light
12V: 386002

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

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

Headlamp
12V: 3111300001
Bulb 12V: 3111300002

12V Fan 3113000018