2013

GEM e2 • GEM e4 • GEM e6® • GEM eS • GEM eL • GEM eLXD

SERVICE MANUAL

FOREWORD

The information printed within this publication includes the latest product information at time of print. The most recent version of this Service Manual is available in electronic format at www.polarisdealers.com.

This Service Manual is designed primarily for use by certified GEM service technicians in a properly equipped shop and should be kept available for reference. All references to left and right side of the vehicle are from the operator's perspective when seated in a normal riding position.

Some procedures outlined in this manual require a sound knowledge of mechanical theory, tool use, and shop procedures in order to perform the work safely and correctly. Technicians should read the text and be familiar with the service procedures before starting any repair. Certain procedures require the use of special tools. Use only the proper tools as specified. If you have any doubt as to your ability to perform any of the procedures outlined in this Service Manual, contact an authorized dealer for service.

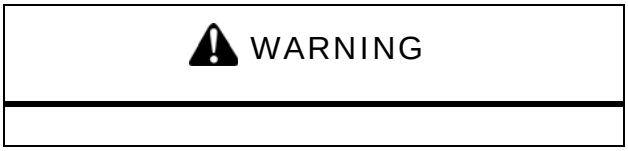
We value your input and appreciate any assistance you can provide in helping make these publications more useful. Please provide any feedback you may have regarding this manual. Authorized dealers can submit feedback using 'Ask Polaris'. Click on 'Ask Polaris', and then click on 'Service Manual/Service Literature Question'.

Consumers, please provide your feedback in writing to: Polaris Industries Inc. ATTN: Service Publications Department, 2100 Hwy 55, Medina, MN 55340.

Publication Printed August 2012 (PN 9924112)

UNDERSTANDING MANUAL SAFETY LABELS AND DIRECTIONS

Throughout this manual, important information is brought to your attention by the following symbols:



SAFETY ALERT WARNING indicates a potential hazard that may result in severe injury or death to the operator, bystander or person(s) inspecting or servicing the vehicle.

SAFETY ALERT CAUTION indicates a potential hazard that may result in minor personal injury or damage to the vehicle.

NOTE:

NOTE provides key information by clarifying instructions.

IMPORTANT:

IMPORTANT provides key reminders during disassembly, assembly and inspection of components.

TRADEMARKS

All brand names and product names used in this guide are trademarks, registered trademarks or trade names of their respective holders.

Polaris Sales Inc. acknowledges the following products mentioned in this manual:

Loctite, Registered Trademark of the Henkel Corporation

Torx, Registered Trademark of Textron

Velcro, Registered Trademark of Velcro Industries, B.V.

Optimol Olistamoly, Trademark of Castrol Limited

CHAPTER 1
Introduction

1

9924112 - 2013 GEM Service Manual

VEHICLE IDENTIFICATION

MODEL NUMBER DESIGNATION

Example: L13G2AGALA

GROUP	MODEL YEAR	MODEL	BODY TYPE (SEATING)	BODY TYPE (CARGO)	ENGINE TYPE	REGION	OPTION
1st digit	2/3rd digit	4th digit*	5th digit*	6th digit*	7th/8th digit*	9th digit**	10th digit
L = LEV	13	G = GEM	2 = Two Pass. 4 = Four Pass.	A = Standard D = Heavy Duty Long Bed L = Long Bed S = Short Bed	GA = DC Electric, 72 Volt	L = North America E = Europe	A
* = digits that would transfer to 17 digit VIN and are used in digits 4-8 respectively ** = 9th digit will be used on color/featured versions of models (not including the base) First 3 digits and 9th digit are used in model number only. They are not used with the 17 digit VIN.							

VEHICLE IDENTIFICATION NUMBER (VIN) DESIGNATION

Example: 52CG2AGA0D3000000

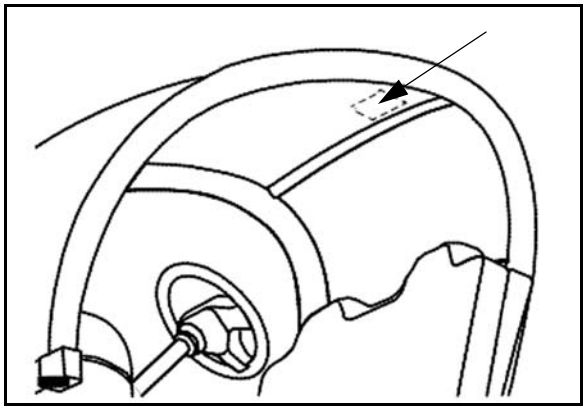
World Mfg. ID			Vehicle Descriptors						Vehicle Identifiers							
			Model	Body Type (Seating)	Body Type (Cargo)	Engine Type		Check Digit	Model Year *	Mfg. Location	Individual Serial No.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
5	2	C	G	2	A	G	A	0	D	3	0	0	0	0	0	0
* Model Year: A = 2010; B = 2011; C = 2012; D = 2013																

VEHICLE IDENTIFICATION NUMBER AND SAFETY CERTIFICATION

A manufacturer's label, containing the Vehicle Identification Number (VIN) and safety certification, is located above the bench seat on underside of the rear roof panel on the driver side. The VIN is also located on the lower-left driver side windshield and under passenger side bench seat.

The information on the label includes:

- Vehicle Identification Number (VIN)
- Month and year of manufacture
- Gross Vehicle Weight Rating (GVWR)
- Gross Front and Rear Axle Ratings (GAWR)
- Wheel size
- Tire size
- Cold tire pressure



GENERAL INFORMATION

INTRODUCTION

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of your vehicles, as well as the safety of the individual doing the work. This service manual provides general directions for accomplishing service and repair work with recommended techniques. Following them will help ensure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing your vehicle, as well as in the skill levels of the individuals doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions for each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that he/she compromises neither their personal safety nor vehicle integrity by their choice of methods, tools, or parts.

GENERAL WARNINGS

Observe the following safety precautions whenever you are working on your vehicle:

⚠ WARNING

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Ensure the key switch is always in the OFF position and that the key is removed.
- Ensure to switch the 72-volt master disconnect to OFF.
- Set the parking brake and place wood blocks (4" x 4" or larger) to the front and rear surfaces of the tires to restrain the vehicle from movement.
- Do not smoke while working on your vehicle.
- Batteries produce hydrogen gas that is extremely flammable and will explode upon exposure to any ignition source.
- Remove rings, watches, loose jewelry, and loose clothing when working on your vehicle to avoid injury.

NOTE: The terms right-hand (RH) and left-hand (LH) are relative to one sitting in the driver's seat. Therefore, right-hand refers to the passenger side, and left-hand refers to the driver's side of the vehicle.

FASTENER USAGE

DESCRIPTION

> **⚠ CAUTION**
>
> Use of an incorrect fastener may result in component damage or personal injury.

Fasteners and torque specifications references in this Service Manual are identified SAE format.

During any maintenance or repair procedure, it is important to salvage all fasteners (nuts, bolts, etc.) for reassembly. If the fastener is not salvageable, a fastener of equivalent specification must be used.

NOTE: Nylon lock nuts must be replaced if removed.

PARTS AND LUBRICANT

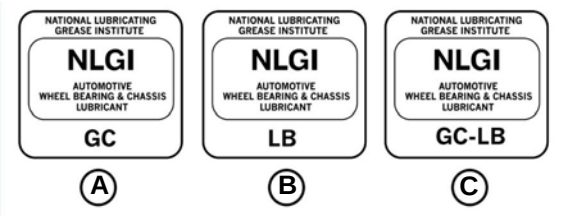
RECOMMENDATION

When service is required, GEM recommends that only GEM replacement parts be used. GEM provides the best-engineered products for servicing GEM vehicles.

LUBRICANTS AND GREASE

Only lubricants bearing designations defined by The Society for Automotive Engineers (SAE) should be used to service a GEM vehicle.

The National Lubricating Grease Institute (NLGI) rates lubricating grease for quality and usage. All approved products have the NLGI symbol (shown below) on the label. At the bottom of the symbol is the usage and quality identification letters. The letter “G” identifies wheel-bearing lubricant. The letter “L” identifies chassis lubricant. The letter following the usage letter indicates the quality of the lubricant. The following symbols indicate the highest quality.



A. Wheel bearing lubrication
B. Chassis lubrication
C. Chassis and wheel bearing lubrication

DIFFERENTIAL

Use Full Synthetic AGL Plus (PN 2878068 - 1 Quart).

BRAKE FLUID

Use only DOT 4 brake fluid from an unopened container when filling the master cylinder to prevent contaminants from entering the brake system.

MAINTENANCE

MAINTENANCE SCHEDULE

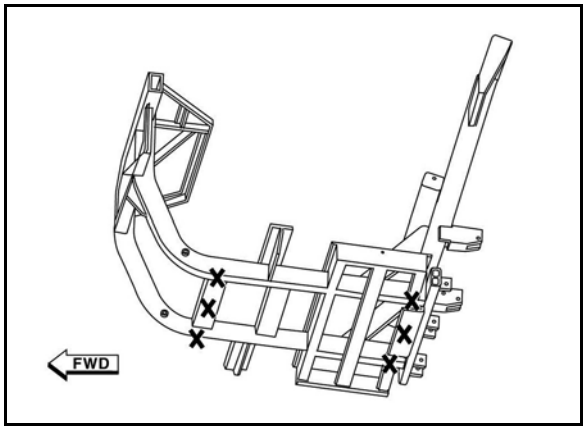
Perform the following inspections and corrections as necessary, on a monthly basis.

Item	Description
1	Check all six batteries for proper water levels (if applicable)
2	Check battery terminals for tight connections
3	Check battery terminals for corrosion
4	Check tires for correct psi and wear
5	Check for proper operation of hand brake
6	Check master cylinder for proper brake fluid levels
7	Check brake lines for leaks
8	Check seat belts for proper operation
9	Check headlights, horn, turn signals, windshield wiper and brake lights for proper operation
10	Check battery hold-downs to ensure batteries are tightly secured
11	Check for worn insulation and frayed wires

HOISTING AND JACKING

⚠ WARNING

Serious injury may result if machine tips or falls. Be sure machine is secure before hoisting or jacking.



A vehicle can be lifted with:

- A single-post frame-contact hoist
- A twin-post, chassis hoist
- A ramp-type drive-on hoist

⚠ WARNING

The hoisting and jack lifting points provided are for a complete vehicle. when a chassis or drivetrain component is removed from a vehicle, the center of gravity is altered making some hoisting conditions unstable. properly support or secure vehicle to hoisting device when these conditions exist.

⚠ CAUTION

Do not attempt to lift a vehicle with a floor jack positioned under an axle tube, body side panel or sill, or front control arm. When properly positioned, a floor jack can be used to lift a GEM vehicle. Support the vehicle in the raised position with jack stands at the locations indicated.

NOTE: When a frame-contact type hoist is used, verify that the lifting pads are positioned properly.

NOTES

9924112 - 2013 GEM Service Manual

CHAPTER 2

Suspension and Steering

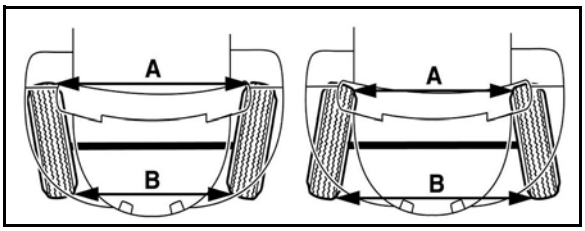
9924112 - 2013 GEM Service Manual

WHEEL ALIGNMENT

INSPECTION - ALIGNMENT

Front wheel alignment is essential for proper vehicle handling and passenger safety. Front-end damage or replacement of any steering or front suspension component will require inspection of the alignment to determine if it is still within specifications.

TOE-IN / TOE-OUT



Toe is the only available adjustment in the front wheel alignment. Toe is the difference between the leading inside edges and trailing inside edges of the front tires. It should be measured at a point above the ground equal to one-half the overall diameter of the wheel/tire assembly. The specification is + 1/16-inch toe-in.

Wheel toe position out of specification causes unstable steering, uneven tire wear and steering wheel off-center.

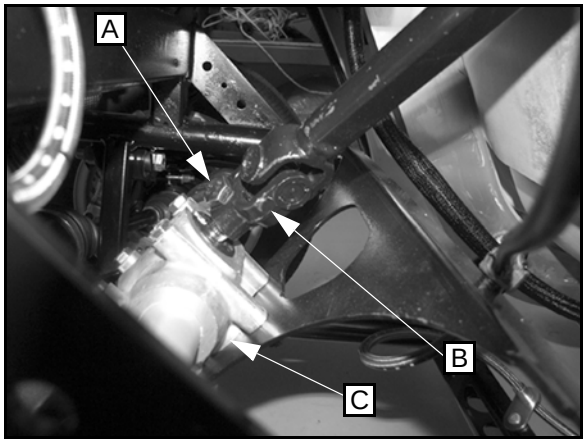
MEASURING FRONT TOE

1. Park vehicle on level, flat surface.
2. Center front wheels.
3. Roll car forward 6-8 feet and apply brake lever.
4. Measure distance from center tread at rear of right front tire to center tread at rear of left front tire.
5. Measure distance from center tread at front of right front tire to the center tread at the front of the left front tire.
6. Subtract front measurement from rear measurement.

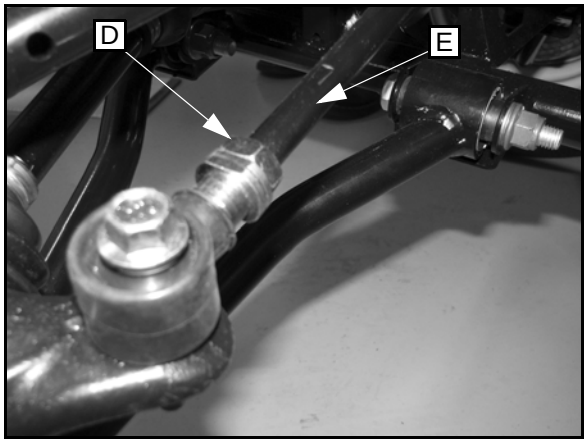
NOTE: If front measurement is less than rear, vehicle has toe-in, and is shown with a plus sign (+1/16 inch). If front measurement is greater than rear, vehicle has toe-out, and difference is shown with a minus sign (-1/16 inch).

ADJUSTING FRONT TOE

1. Center front wheels.
2. Inspect position of pinch bolt (A) joining steering column shaft (B) to steering gear (C). Ensure bolt (A) is horizontal and under shaft. If necessary, turn steering wheel to position bolt. Remove and re-center steering wheel if required. See Steering Wheel in this section.



3. Lash steering wheel in centered position.
4. Loosen both jam nuts (D) on both tie rods (E).



5. Rotate tie rods (E) so front wheels have specified toe-in.
6. Tighten both jam nuts (D).

9924112 - 2013 GEM Service Manual

MEASURING REAR TOE

1. Park vehicle on level, flat surface.
2. Center front wheels forward.
3. Roll car forwards 6-8 feet and apply parking brake lever.
4. Measure distance from center tread at rear of right rear tire to center tread at rear of left rear tire.
5. Measure distance from center tread at front of right rear tire to center tread at front of left rear tire.
6. Subtract front measurement from rear measurement.

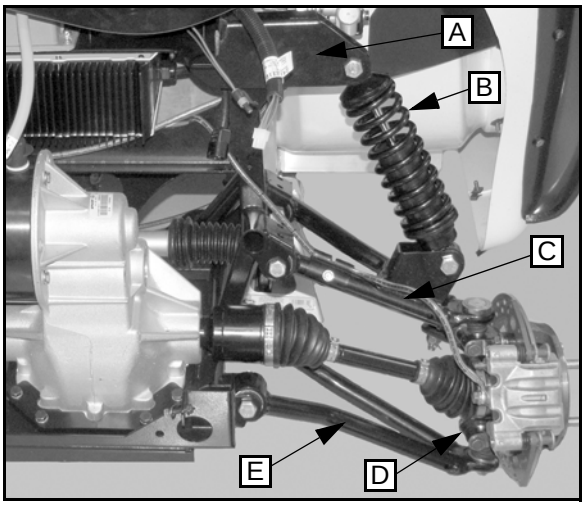
NOTE: If front measurement is less than rear, vehicle has toe-in, and is shown as a plus (+) sign (positive). If front measurement is greater than rear, vehicle has toe-out, and difference is shown as a minus (-) sign (negative).

7. Ensure rear tire/wheel toe measurement is set to 0.

ADJUSTING REAR TOE

There is no adjustment of the rear axle for toe alignment and camber related issues. In the case of a rear axle out of specification, the axle may need to be replaced. Inspect bushing wear in shock assembly and trailing arms. Follow torque specs. See Rear Axle Removal and Installation in this section.

FRONT SUSPENSION



A. Front suspension frame
B. Spring / shock absorber
C. Upper control arm
D. Knuckle
E. Lower control arm

DESCRIPTION

The front suspension is designed to allow each wheel to adapt to different road surfaces independently. The wheels are mounted to rotor assemblies, which in turn are mounted to the steering components attached to control arms that pivot up and down on bushings. Spring and shock absorber assemblies provide cushioning.

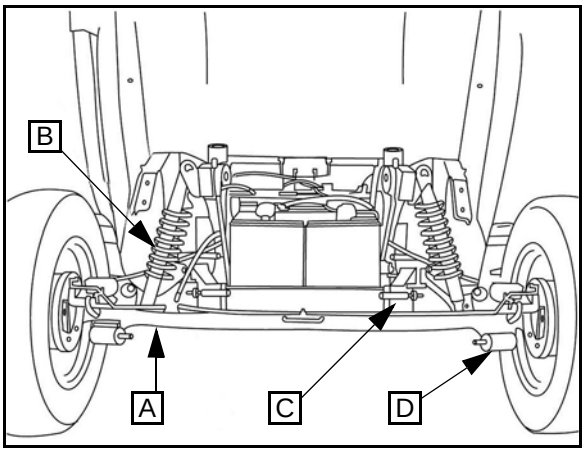
NOTE: Suspension components with rubber/ urethane bushings should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are tightened. This will maintain vehicle ride comfort and prevent premature bushing wear.

OPERATION

The front suspension frame provides a platform for the front shocks, and acts as an axle for the front wheels and brakes.

9924112 - 2013 GEM Service Manual

REAR SUSPENSION



A. Rear suspension frame / axle
B. Spring / shock absorber
C. Upper trailing arms
D. Lower trailing arms

DESCRIPTION

The rear suspension is comprised of the rear axle, spring/shock absorbers, and trailing arms.

OPERATION

The rear suspension travels up and down, pivoting on bushings at the front and rear of each trailing arm. Rear drum brakes and wheels are mounted on flanges at each end of the rear axle. Spring/shock absorber units control the movement, thereby maintaining contact of the tires on the road.

NOTE: Suspension components with rubber/urethane bushings should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. This will maintain vehicle ride comfort and prevent premature bushing wear.

REAR SUSPENSION FRAME / AXLE REMOVAL (e2, e4, eS, eL MODELS)

1. Remove rear tire and wheel assemblies. See Wheel and Tires section.
2. Remove rear drum brake assemblies. See Brakes section.
3. (Vehicles with spat only) Remove spat bracket. See Body section.
4. Ensure rear suspension frame/axle is properly supported.
5. Remove three bolts securing brake lines to rear suspension frame/axle.
6. Remove two lower mounting bolts, two flat washers (nut side), and two nuts from spring/shock absorbers.
7. Remove four bolts, four flat washers (nut side), and four nuts from two upper and two lower trailing arms.
8. Remove rear suspension frame/axle.

REAR SUSPENSION FRAME / AXLE INSPECTION (e2, e4, eS, eL MODELS)

Inspect rear suspension frame/axle for damage and/or worn bushings. Bushings are not serviceable. Replace the bushings if worn or damaged, or replace each individual trailing arm as needed.

REAR SUSPENSION FRAME / AXLE INSTALLATION (e2, e4, eS, eL MODELS)

1. Install rear suspension frame/axle onto vehicle rear frame.
2. Install four nuts, four flat washers (nut side), and four bolts, into two upper and two lower trailing arms.
3. Install two nuts, two flat washers (nut side), and two lower mounting bolts into spring/shock absorbers.
4. Install three bolts to secure brake lines to rear suspension frame/axle.
5. (Vehicles with spat only) Install the spat bracket. See Body section.
6. Install rear drum brake assemblies. See Brakes section.
7. Install rear tire and wheel assemblies. See Wheel and Tires section.

9924112 - 2013 GEM Service Manual

8. Torque two spring/shock absorber mounting bolts to specification.

= T
Lower Spring/Shock Absorber Mounting Bolts: **60 ft-lbs (81 Nm)**

9. Torque two upper and two lower trailing arm bolts to specification.

= T
Upper and Lower Trailing Arms Bolts: **60 ft-lbs (81 Nm)**

REAR SUSPENSION FRAME / AXLE REMOVAL (e6, e6S, eLXD MODELS)

1. Remove both rear tire and wheel assemblies. See Wheel and Tires section.
2. Remove rear drum brake assemblies. See Brakes section.
3. (Vehicles with Spat). Remove spat bracket.
4. Ensure rear suspension frame/axle is properly supported.
5. Remove three bolts securing brake lines to rear suspension frame/axle.
6. Remove rear hub and bearing.
7. Remove rear spindles.

NOTE: Support the backing plate assemblies to protect the brake lines and parking brake cables.

8. Remove two lower mounting bolts, two flat washers (nut side), and two nuts from spring/shock absorbers.
9. Remove four bolts, four flat washers (nut side), and four nuts from trailing arms.
10. Remove rear suspension frame/axle.

REAR SUSPENSION FRAME / AXLE INSPECTION (e6, e6S, eLXD MODELS)

Inspect rear suspension frame/axle assembly for damage and/or worn bushings. Bushings are not serviceable. Replace the bushings if worn or damaged, or replace each individual trailing arm as needed.

REAR SUSPENSION FRAME / AXLE INSTALLATION (e6, e6S, eLXD MODELS)

1. Install rear suspension frame/axle.
2. Install four nuts, four flat washers (nut side), and four bolts, into trailing arms.
3. Install two nuts, two flat washers (nut side), and two lower spring/shock bolts.
4. Install rear spindles and position backing plate assemblies. Apply thread sealer to bolts and torque to specification.
5. Install hub and bearing. Torque to specification.
6. Install three bolts securing brake lines to axle.
7. (Vehicles with Spat). Install spat bracket. See Body section.
8. Install rear drum brake assemblies. See Brakes section.
9. Install tire and wheel assembly. See Wheel and Tires section.
10. Torque two lower spring/shock absorber mounting bolts to specification.

= T
Lower Spring/Shock Absorber Mounting Bolts: **60 ft-lbs (81 Nm)**

11. Torque two upper and two lower trailing arm bolts to specification.

= T
Upper and Lower Trailing Arms Bolts: **60 ft-lbs (81 Nm)**

9924112 - 2013 GEM Service Manual

SHOCK ASSEMBLY

DESCRIPTION

The GEM e-series vehicles combine a spring and shock absorber into a single unit. They are used on both the front and rear suspension. They are not serviceable, but must be replaced.

OPERATION

The shock absorbers dampen bounce and rebound of the vehicle over various road and terrain conditions.

DIAGNOSIS AND TESTING

Movement between mounting bushings, metal brackets and attaching components may cause a knocking or rattling noise from a shock absorber/spring unit. Tightening the attaching nuts can usually stop these noises. If the noise persists, inspect for damaged and worn bushings and/or attaching components. Replace if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

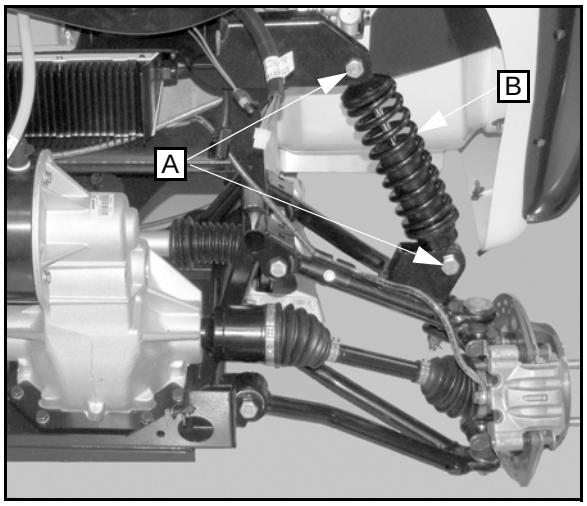
The shock absorbers are not refillable or adjustable. If a malfunction or leak occurs, the shock absorber/spring unit must be replaced.

To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

IMPORTANT: The shock absorber bushings do not require any type of lubrication. Do not attempt to stop bushing noise by lubricating them. Grease and mineral oil-based lubricants will deteriorate the bushing.

REMOVAL - FRONT SHOCK

1. Raise and support vehicle on suitable hoist.
2. Remove two nuts and two mounting bolts (A).



3. Remove front shock (B).

INSPECTION - FRONT SHOCK

Check bolts and nuts for signs of wear and replace if necessary.

INSTALLATION - FRONT SHOCK

1. Install front shock.
2. Install two mounting bolts and two nuts.
3. Lower vehicle to ground.
4. Torque two mounting bolts to specification.

= T
Front Spring/Shock Absorber Mounting Bolts: **70 ft-lbs (95 Nm)**

9924112 - 2013 GEM Service Manual

REMOVAL - REAR SHOCK

1. Raise and support vehicle on suitable hoist.
2. Remove two nuts, two flat washers, and two mounting bolts.
3. Remove rear shock.

INSPECTION - REAR SHOCK

Check bolts and nuts for signs of wear and replace if necessary.

INSTALLATION - REAR SHOCK

1. Install rear shock.
2. Install two mounting bolts, two flat washers (nut side), and two nuts.
3. Torque two mounting bolts to specification.

= **T**
Rear Spring/Shock Absorber Mounting Bolts: **60 ft-lbs (81 Nm)**

4. Lower vehicle to floor.

9924112 - 2013 GEM Service Manual

CONTROL ARM ASSEMBLY

DESCRIPTION

The upper and lower control arms connect the front suspension to the front frame support assembly. They are connected to the front frame support by bolts passing through bushings that allow the control arm to pivot.

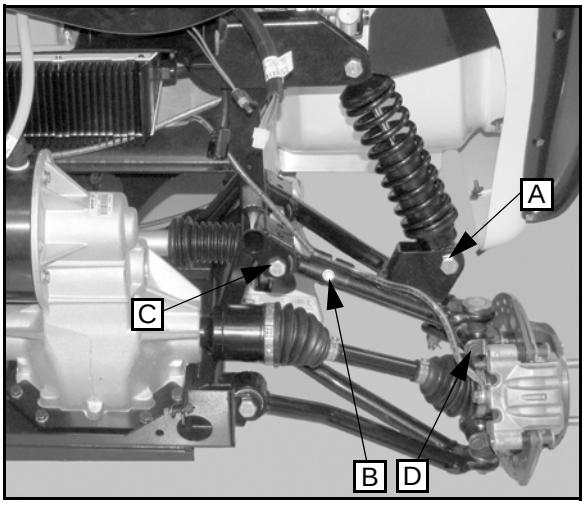
NOTE: The bushings and ball joints are serviceable. The control arm, bushings and ball joint can be replaced separately or as needed. See procedures in this section.

OPERATION

The upper and lower control arms allow the front suspension to move vertically over various road and terrain conditions.

UPPER CONTROL ARM REMOVAL

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Remove lower shock absorber mounting nut and bolt (A).



3. Remove brake line retaining fastener (B) from upper control arm.
4. Remove two nuts, two flat washers (nut side), and two bolts (C) retaining control arm to frame.
5. Remove nut, flat washer (nut side) and ball joint pinch bolt (D).
6. Remove control arm from vehicle.

UPPER CONTROL ARM INSTALLATION

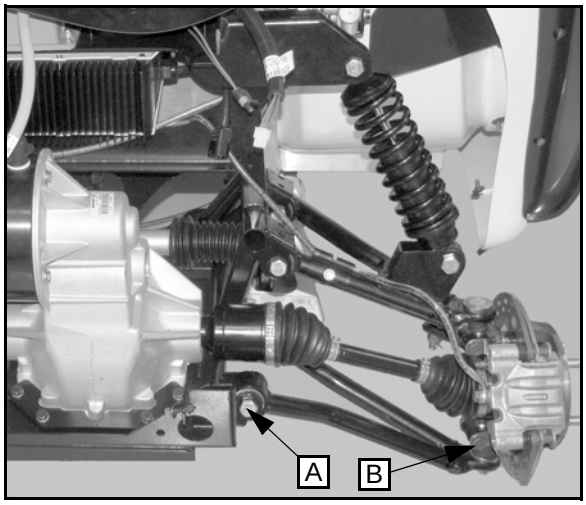
1. Install upper control arm, ball joint pinch bolt**,** flat washer (nut side), and nut.
2. Install two bolts, two flat washers (nut side), and two nuts retaining control arm to frame.
3. Install shock absorber lower mounting nut and bolt.
4. Install front tire and wheel assembly. See Wheel and Tires section.
5. Torque two control arm mounting bolts to specification.
6. Torque shock absorber lower mounting bolt to specification.
7. Torque ball joint pinch bolt to specification.

= T
Control Arm Mounting Bolts: **70 ft-lbs (95 Nm)** Lower Shock Mounting Bolt: **70 ft-lbs (95 Nm)** Ball Joint Pinch Bolt: **45 ft-lbs (61 Nm)**

8. Check front-end alignment toe-in. See Front-End Alignment Toe-In in this section.

LOWER CONTROL ARM REMOVAL

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Remove two nuts, two flat washers (nut side), and two bolts (A) retaining control arm to frame.



3. Remove nut, flat washer (nut side) and ball joint pinch bolt (B).
4. Remove lower control arm.

LOWER CONTROL ARM INSTALLATION

1. Install lower control arm, ball joint pinch bolt, flat washer (nut side), and nut.
2. Install two bolts (E), two flat washers (nut side), and two nuts retaining control arm to frame.
3. Install front tire and wheel assembly. See Wheel and Tires section.
4. Torque two control arm mounting bolts to specification.
5. Torque ball joint pinch bolt to specification.

= T
Control Arm Mounting Bolts: **70 ft-lbs (95 Nm)** Ball Joint Pinch Bolt: **45 ft-lbs (61 Nm)**

6. Check front-end alignment toe-in. See Front-End Alignment Toe-In in this section.

9924112 - 2013 GEM Service Manual

BUSHING

DESCRIPTION

The bushing is a metal sleeve surrounded by a rubber or polyurethane center and a metal collar around its exterior. It is typically fitted in to a machined hole or opening of control arm assembly.

OPERATION

A bushing is used to act as a pivot point and take on minimal wear at that joint. It is primarily used at mounting locations of travel as a bolt pass-through.

MAINTENANCE

The bushing is non-lubricated. Do not attempt to stop bushing noise by applying lubrication. Grease and mineral oil-based lubricants will deteriorate the bushing.

BUSHING REMOVAL

1. Remove applicable control arm assembly. See Control Arm Assembly in this section.
2. Using hydraulic press, remove bushing.

BUSHING INSTALLATION

1. Insert new bushing.
2. Install applicable control arm assembly. See Control Arm Assembly in this section.

BALL JOINT

DESCRIPTION

The ball joint is a spherical bearing that connects the control arm to the steering knuckle. More specifically, a ball joint is a steel bearing stud and socket enclosed in a steel casing. The bearing stud is tapered.

OPERATION

The ball joint assembly fits into a tapered hole in the steering knuckle. A protective encasing prevents dirt from getting into the joint assembly. Ball joints serve as the pivot points between the tires and suspension. Ball joints also support weight.

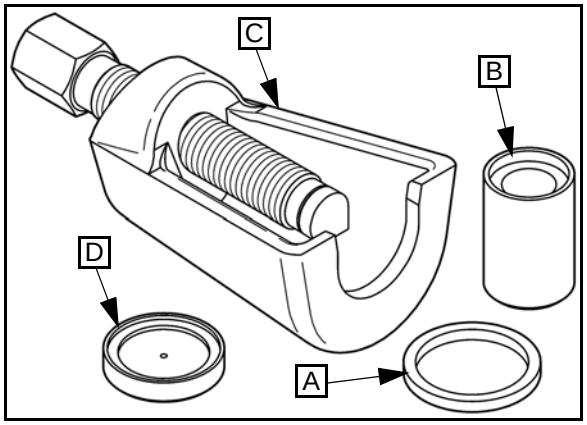
MAINTENANCE

The GEM uses “lubricated for life” ball joints that can't be lubricated. Ball joints, along with other suspension components, should be inspected annually along with a complete wheel alignment. The most common vehicle symptoms associated with worn ball joints are wandering, uneven tire wear, and erratic steering. Ball joint inspection methods and specifications vary, so have your vehicle inspected by a qualified service professional.

BALL JOINT SERVICE

IMPORTANT: Do not reuse a ball joint if it has been removed. If removed, it must be replaced. Use this removal procedure only when replacing the ball joint.

NOTE: Ball joint tool PU-50506 will allow the upper and lower ball joints to be replaced with the A-arm installed on the vehicle.



A. Spacer
B. Removal Adaptor
C. Press Assembly
D. Installation Adaptor

9924112 - 2013 GEM Service Manual

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. To service upper ball joint:

   - Remove and discard two front brake caliper mounting bolts and remove caliper from brake disc (see Brakes section).

   - Remove and discard upper ball joint pinch bolt.

   - If necessary, remove lower front shock fastener from A-arm to gain enough clearance to install ball joint tool (PU-50506) on upper ball joint.

Ball Joint Tool:
PU-50506

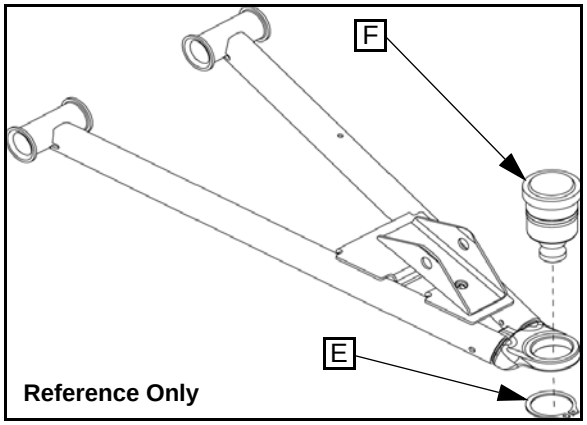
3. To service lower ball joint:

   - Remove and discard lower ball joint pinch bolt.

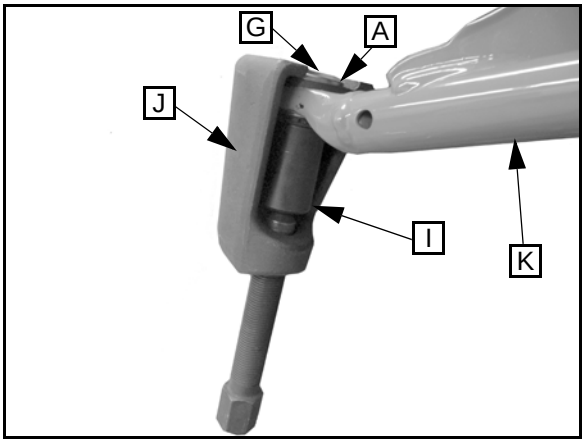
   - If necessary, remove lower front shock fastener from A-arm to gain enough clearance to install ball joint tool (PU-50506) on lower ball joint.

BALL JOINT REMOVAL

1. Remove applicable control arm assembly. See Control Arm Assembly in this section.
2. Remove retaining ring (E) from ball joint (F).



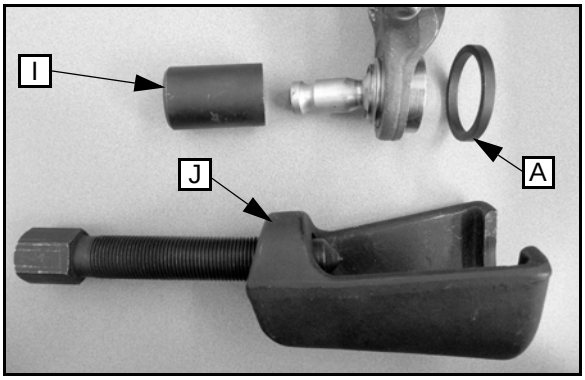
3. Install spacer (A) over top of ball joint face (G).



4. Place removal adaptor (I) over the ball joint shaft.
5. Install press assembly (J) onto A-arm (K) to engage removal adapter (I).

IMPORTANT: Ensure the press assembly (J) opening is only contacting the spacer (A) and not the ball joint face (G).

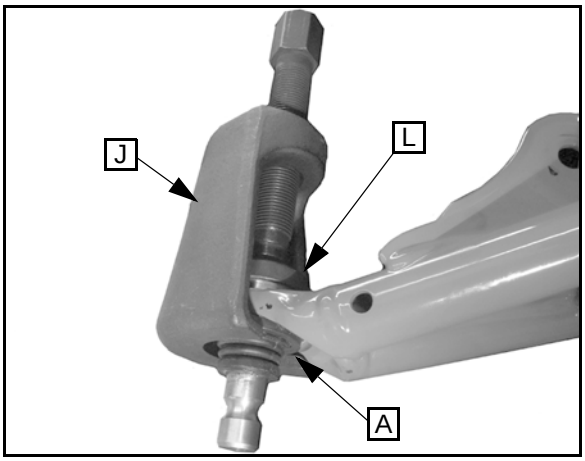
6. Tighten press assembly screw and fully remove ball joint (F) from A-arm (K).



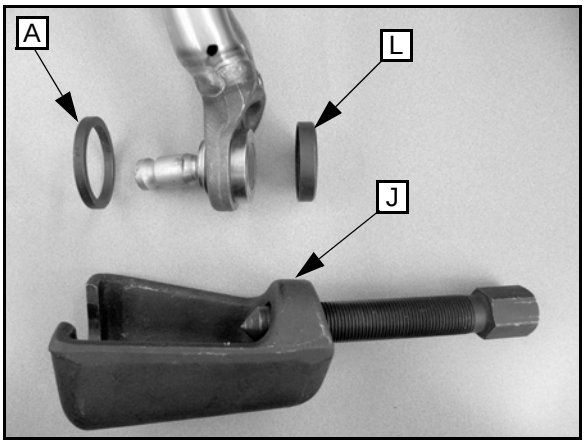
9924112 - 2013 GEM Service Manual

BALL JOINT INSTALLATION

1. By hand, install new ball joint (F) into A-arm (K).
2. Position installation adapter (L) over face of ball joint (F).



3. Position spacer (A) over shaft of ball joint (F) so it is against A-arm (K).
4. Install press assembly (C) onto A-arm (K) to engage installation adapter (D) and spacer (A).
5. Tighten press assembly screw and fully install ball joint (F) into A-arm (K).



6. After new ball joint is fully installed into A-arm (K), install a new retaining ring (E).
7. Repeat ball joint service procedure for any additional A-arm ball joint (F) replacements.
8. Insert upper or lower A-arm ball joint end into bearing carrier. Install new pinch bolts and nuts. Torque to specification.

= **T**
Front Ball Joint Pinch Bolts: **45 ft-lbs (61 Nm)**

9. If needed, install new brake caliper mounting bolts and torque to specification.

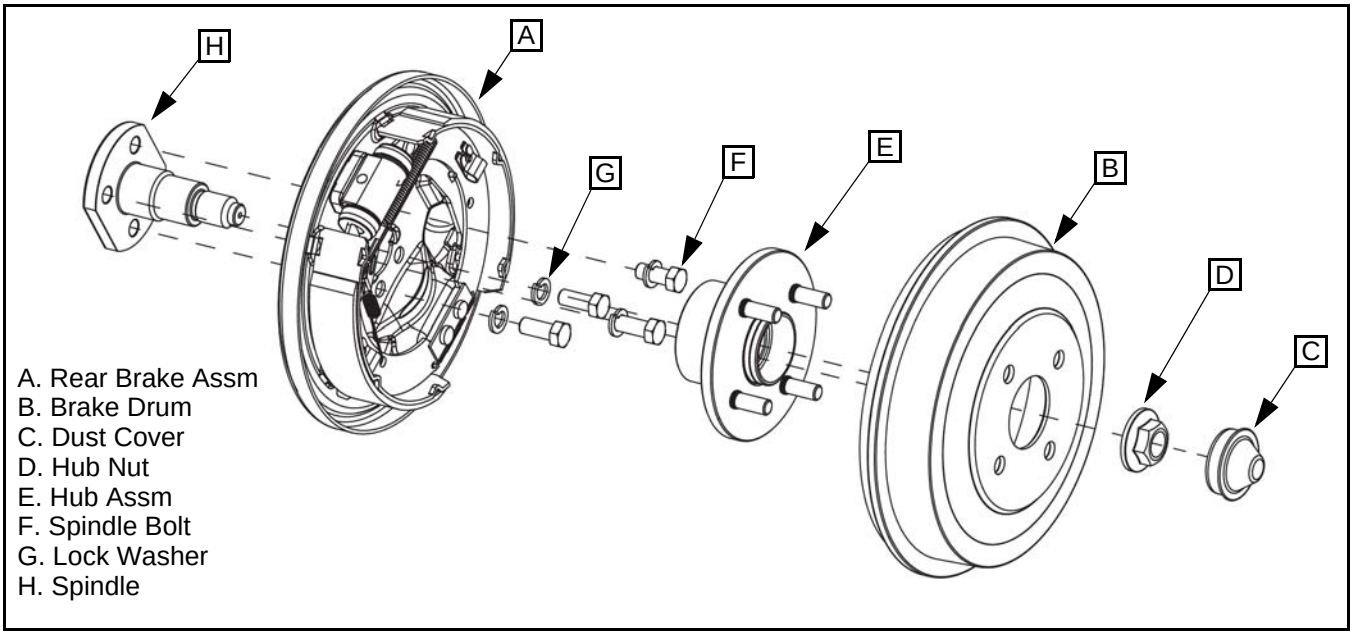
CAUTION
New bolts have a pre-applied locking agent which is destroyed upon removal. Always use new brake caliper mounting bolts upon assembly.

10. Install front tire and wheel assembly. See Wheel and Tires section.

9924112 - 2013 GEM Service Manual

REAR HUB AND BEARING / SPINDLE (E6, E6S, ELXD)

REAR HUB AND BEARING / SPINDLE ASSEMBLY VIEW (E6, E6S, ELXD)



REAR HUB REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.
2. Remove brake drum.
3. Remove bearing dust cover.
4. Remove hub nut.
5. Remove rear hub assembly.
6. Remove four bolts, four lock washers, and rear brake assembly.
7. Remove rear spindle.

NOTE: Support the backing plate assemblies to protect the brake lines and parking brake cables.

REAR HUB INSTALLATION

1. Apply thread sealer to four spindle retaining bolts.
2. Install rear spindle, rear brake assembly, four lock washers, and four spindle retaining bolts. Torque to specification.

= T
Spindle Retaining Bolts: **65 ft-lbs (88 Nm)**

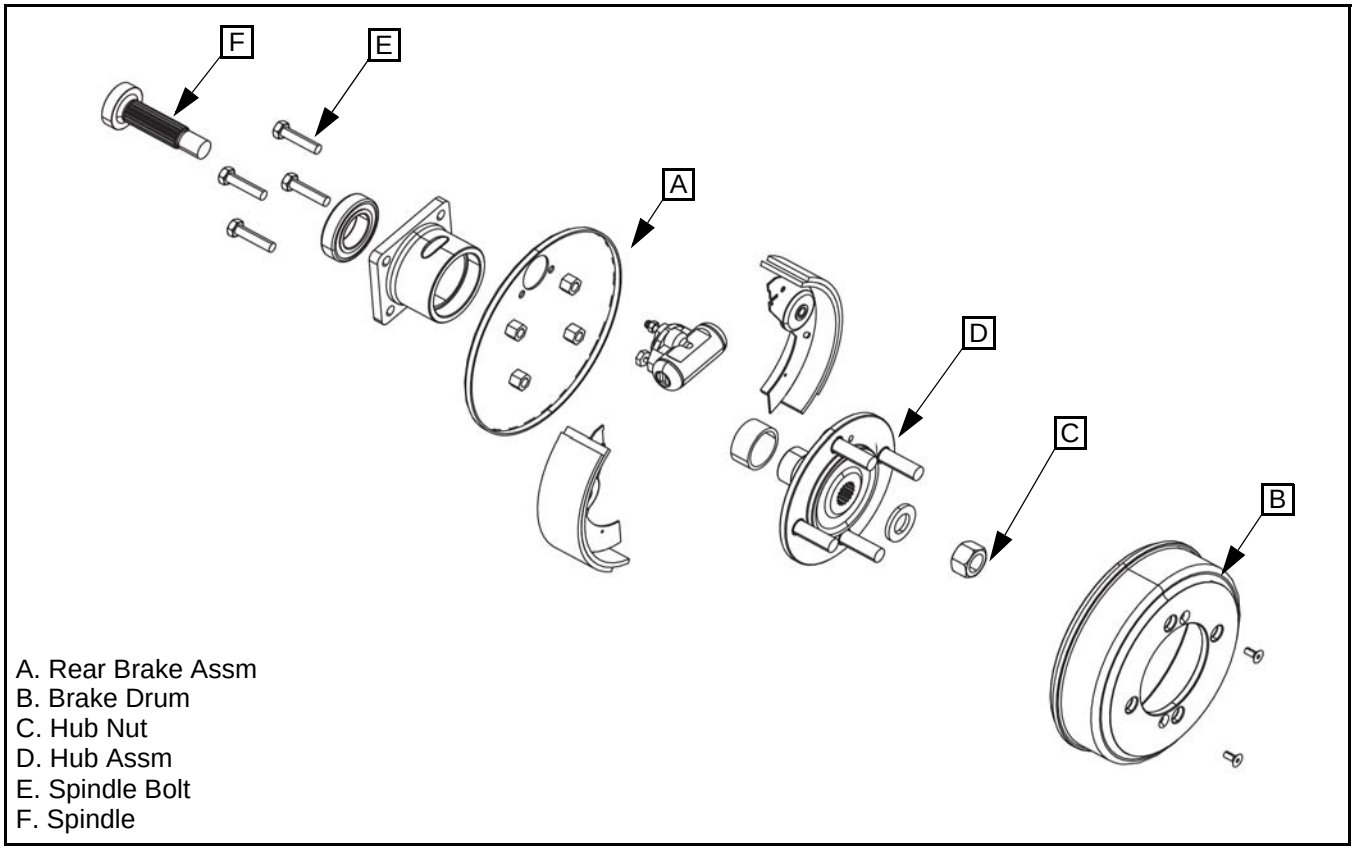
3. Install rear hub assembly.
4. Install hub retaining nut. Torque to specification.

= T
Hub Bearing Retainer: **165 ft-lbs (224 Nm)**

5. Install bearing dust cover.
6. Install brake drum.
7. Install rear tire and wheel assembly. See Wheel and Tires section.

REAR HUB AND BEARING / SPINDLE (E2, E4, ES, EL)

REAR HUB AND BEARING / SPINDLE ASSEMBLY VIEW (E2, E4, ES, EL)



A. Rear Brake Assm
B. Brake Drum
C. Hub Nut
D. Hub Assm
E. Spindle Bolt
F. Spindle

REAR HUB REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.
2. Remove two screws and brake drum.
3. Remove hub nut and washer.
4. Remove rear hub assembly.
5. Remove four bolts, rear brake assembly and rear spindle.

NOTE: Support the backing plate assemblies to protect the brake lines and parking brake cables.

REAR HUB INSTALLATION

1. Apply thread sealer to four bolts.
2. Install rear spindle, rear brake assembly, and four bolts. Torque to specification.

= T
Spindle Retaining Bolts: **75 ft-lbs (88 Nm)**

3. Install rear hub assembly.
4. Install hub nut and washer. Torque to specification.

= T
Hub Bearing Retainer: **165 ft-lbs (224 Nm)**

5. Install brake drum and two retaining screws.
6. Install rear tire and wheel assembly. See Wheel and Tires section.

STEERING WHEEL

DESCRIPTION

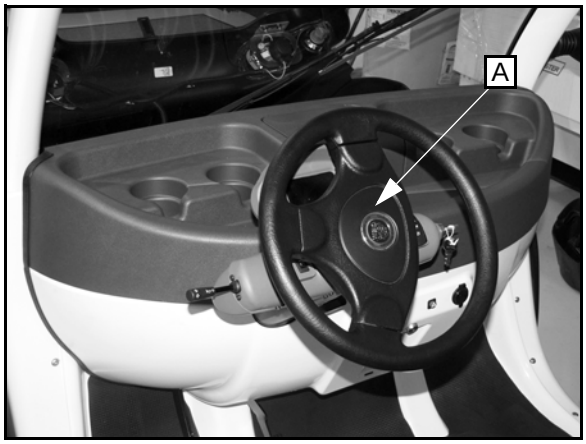
The steering wheel assembly consists of two parts, the steering wheel and the steering wheel cover.

OPERATION

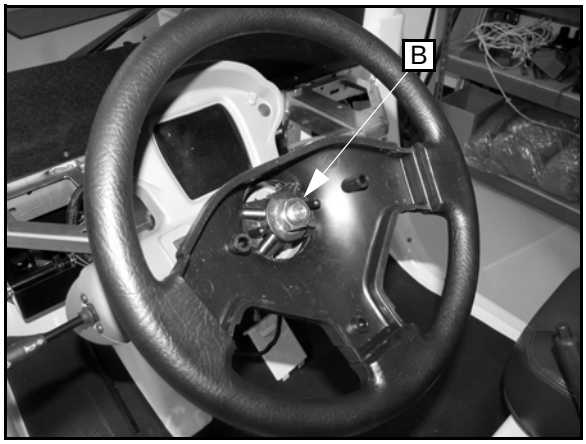
Splines on the steering wheel mounting hole match to splines on the steering shaft. These splines force the wheel and shaft to turn as a unit, thereby transmitting turning force to the steering gear.

STEERING WHEEL REMOVAL

1. Remove two mounting screws located on underside of steering wheel and remove steering wheel cover (A).



2. Loosen the wheel retaining nut (B) and back it half way off the steering shaft.



3. Mark steering wheel and steering shaft end for reference when re-installing.
4. With a glove on your hand, place it under the steering wheel. Lift upward on the inner portion of the steering wheel while using a hammer to strike the steering shaft nut.

IMPORTANT: If the steering wheel will not pop loose, proceed to Steering Column Removal in this section.

5. Once the steeing column pops loose, completely remove the nut and lift the steering wheel off the shaft.

STEERING WHEEL INSTALLATION

1. Using reference marks, align steering wheel to steering shaft and install.
2. Install washer and nut on steering shaft and tighten to press wheel completely on splines. Back off nut and torque to specification.

= T
Steering Wheel Retaining Nut: **20 ft-lbs (27 Nm)**

3. Install steering wheel cover and two mounting screws.

9924112 - 2013 GEM Service Manual

STEERING COLUMN ASSEMBLY

DESCRIPTION

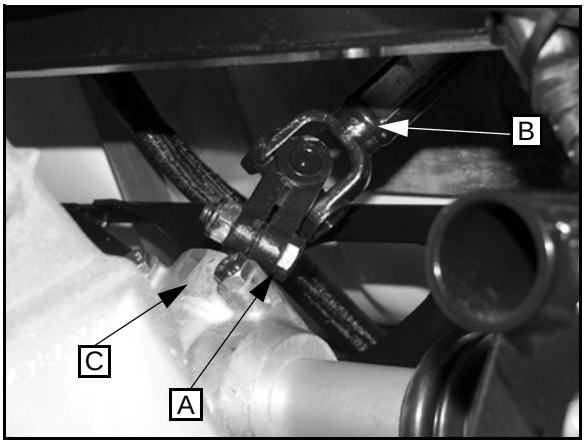
The steering column consists of the steering column and steering shaft. It is bolted to the dash frame and supports the upper end of the steering shaft and steering wheel. The steering shaft is connected to the steering gear by a pinch bolt.

OPERATION

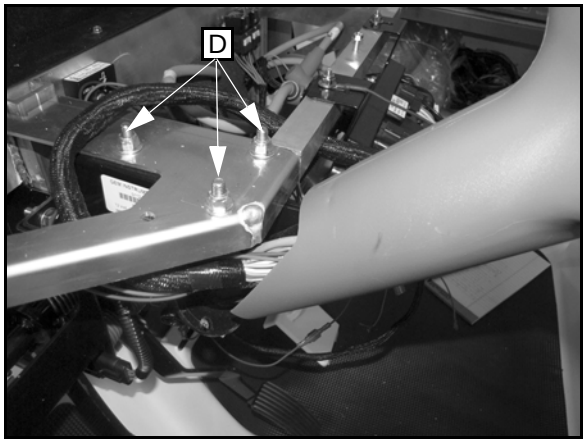
The steering column assembly receives turning inputs from the steering wheel and transmits these inputs to the steering gear to direct the tie rods to their proper positions.

STEERING COLUMN REMOVAL

1. Ensure front wheels are in the straight-ahead position and steering wheel is centered.
2. Remove upper dash assembly. See Upper Dash in Body section.
3. Remove lower dash assembly. See Lower Dash in Body section.
4. Remove pod covers. See Pod Covers in Body section.
5. Remove instrument pod. See Accessory System Component Replacement section.
6. Remove steering wheel. See Steering Wheel in this section.
7. Remove pinch bolt (A) and nut from steering shaft (B).



8. Remove steering shaft (B) from steering gear (C).
9. Remove three bolts (D) and steering column from dash support frame.



STEERING COLUMN INSPECTION

Rotate steering shaft in bearing, feeling for roughness of action. If roughness is detected, replace steering shaft. Inspect steering shaft u-joints and pinion mating surface for wear or damage. Replace shaft if necessary.

STEERING COLUMN INSTALLATION

1. Install steering column and three mounting bolts. Torque mounting bolts to specification.

= T
Steering Column Mounting Bolts: **20 ft-lbs (27 Nm)**

2. Ensure front wheels are straight and steering wheel is centered.
3. Install steering shaft onto steering gear.
4. Install nut and pinch bolt onto steering shaft. Torque pinch bolt to specification.

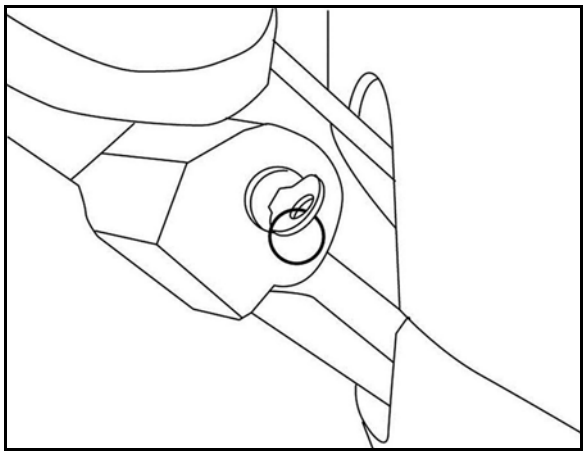
= T
Steering Column Pinch Bolt: **30 ft-lbs (40 Nm)**

5. Install instrument pod. See Accessory System Component Replacement section.
6. Install steering wheel. See Steering Wheel in this section.
7. Install pod covers. See Pod Covers in Body section.
8. Install the lower dash panel. See Lower Dash Panel in Body section.
9. Install the upper dash panel. See Upper Dash Panel in Body section.

LOCKING STEERING COLUMN

DESCRIPTION

The steering wheel lock, if equipped, prevents the steering wheel from being turned for added security against theft. It is assembled to the steering column of the vehicle. The locking mechanism consists of a key, lock, latch rod and latch.



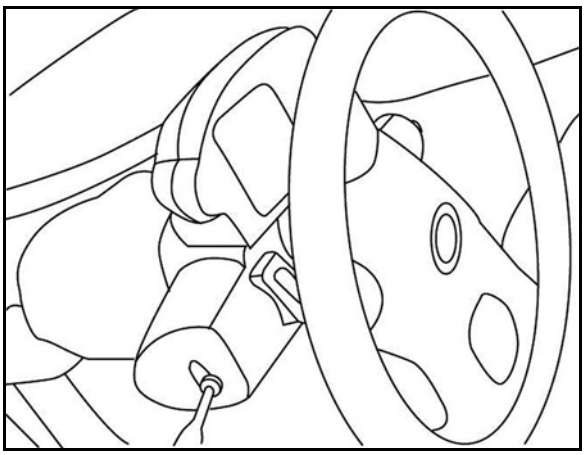
OPERATION

Insert the key into the lock of the column. Turn the key forward while turning the steering wheel until the latch rod internally catches the latch. Once set in to place remove the key, the steering column is now locked.

STEERING WHEEL TILT

DESCRIPTION

The infinite position tilt steering, if equipped, accommodates different driver heights for improved comfort. It is a part of the steering column assembly. The adjustable column consists of a pivoting spring loaded tilt mechanism and an adjustable height position locking lever.



OPERATION

Using your left hand release the lever on the driver's side of the column, pull toward driver. Adjust the steering wheel to the desired ride height. To set desired height, push lever forward away from the driver to lock in to position. The adjustable column can be selected to any degree of tilt to fit your needs.

9924112 - 2013 GEM Service Manual

STEERING GEAR

DESCRIPTION

The GEM uses a rack and pinion steering gear with integral tie rods.

OPERATION

Teeth on the pinion gear engage teeth on the rack. Turning motion of pinion gear causes rack to move either right or left.

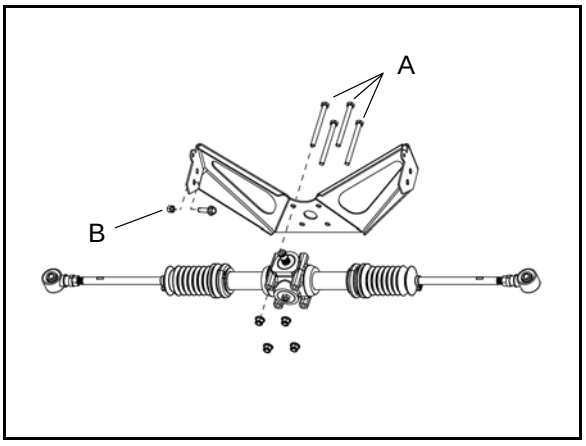
DIAGNOSIS AND TESTING

If excessive play was detected during the driving test outlined in Front Wheel Alignment in this section, raise vehicle off ground and support safely with jack stands. Grasp the lower half of steering shaft and rotate to determine if play is in the steering gear. Also check steering gear for loose mounting bolts.

- If the steering gear mounting bolts are loose, tighten to specification.
- If excessive play is found within the steering gear, it must be replaced.

STEERING GEAR REMOVAL

1. Remove front tire and wheel assemblies. See Wheel and Tires section.
2. Remove both tie rod ends. See Outer Tie Rod End in this section.
3. Remove nut and pinch bolt from steering shaft.
4. Remove steering shaft from steering gear.
5. Remove four steering gear retaining bolts (A).



6. Loosen but do not remove bolts (B) retaining steering bracket.
7. Remove steering gear from vehicle.

STEERING GEAR INSTALLATION

1. Install steering gear and four retaining bolts, through steering bracket. Torque to specification.

= T
Steering Gear Retaining Bolts: **18 ft-lbs (24 Nm)** Steering Bracket Retaining Bolts: **18 ft-lbs (24 Nm)**

2. Ensure front wheels are straight and steering wheel is centered to equalize tie rod lengths.
3. Install steering shaft onto steering gear.
4. Install nut and pinch bolt onto steering shaft. Torque pinch bolt to specification.

= T
Steering Column Pinch Bolt: **30 ft-lbs (40 Nm)**

5. Install both tie rod ends. See Outer Tie Rod End in this section.
6. Install front tire and wheel assemblies. See Wheel and Tires section.
7. Check front-end alignment toe-in. See Front-End Alignment Toe-In in this section.

9924112 - 2013 GEM Service Manual

STEERING KNUCKLE

DESCRIPTION

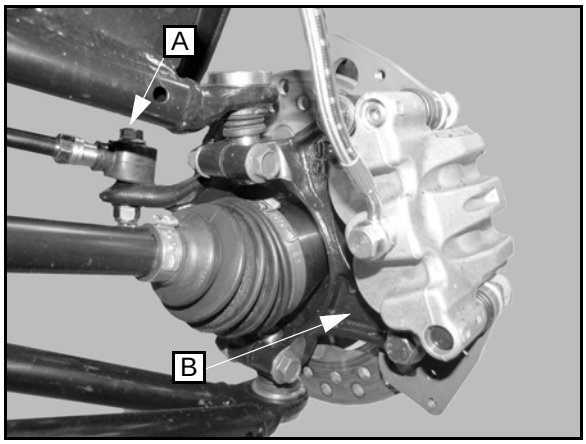
The knuckle is a single casting with legs machined for the upper and lower ball joints. It also has a machined surface for mounting the front brake assembly.

OPERATION

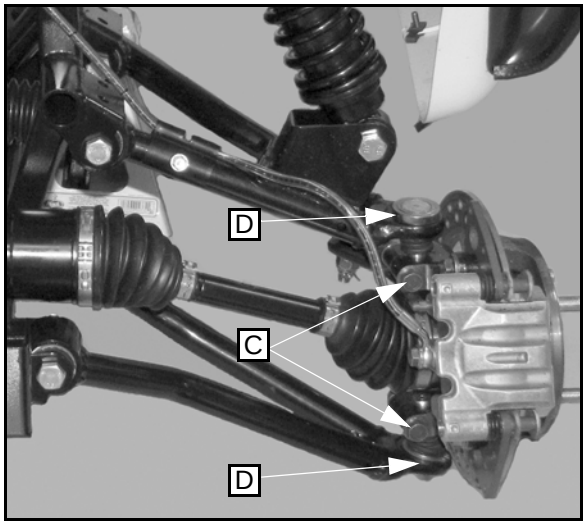
The steering knuckle pivots between the upper and lower control arms on the ball joints. Tie rods attached to the knuckle allow the vehicle to be steered.

STEERING KNUCKLE REMOVAL

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Remove front brake assembly. See Front Brake Assembly in Brake section.
3. Remove cotter pin and nut from stud (A).



4. Remove two nuts, two ball joint pinch bolts (C), two ball joints (D), and steering knuckle (B).



5. Separate stud (A) from steering knuckle (B).

STEERING KNUCKLE INSTALLATION

1. Install steering knuckle, two ball joints and two ball joint pinch bolts.
2. Install (2) new ball joint pinch bolt nuts and torque to specification.

= T
Ball Joint Pinch Bolt: **45 ft-lbs (61 Nm)**

3. Insert stud into steering knuckle.
4. Install new nut onto stud. Torque nut to specification and install new cotter pin.

= T
Tie Rod Stud Nut: **45 ft-lbs (61 Nm)**

5. Install front brake assembly. See Front Brake Assembly in Brake section.
6. Install tire and wheel assembly. See Wheel and Tires section.
7. Check front-end alignment toe-in. See Front-End Alignment Toe-In in this section.

OUTER TIE ROD END

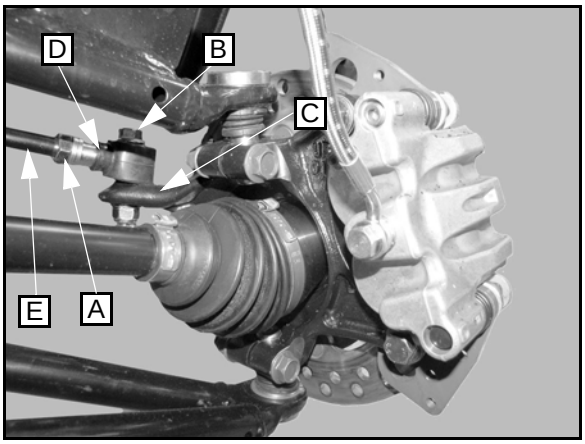
DESCRIPTION

The tie rod end provides the connection between the steering gear rack (tie rod) and the knuckle on the front wheel. Threads on the tie rod end allow adjustment of overall length and control toe-in. A jam nut maintains the tie rod end position relative to the tie rod.

NOTE: Tie rod ends are a serviceable replacement item as needed.

TIE ROD END REMOVAL

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Loosen tie rod jam nut (A).



3. Remove cotter pin and nut from stud (B).
4. Separate stud (B) from steering knuckle (C).
5. Remove outer tie rod end (D) from tie rod (E).

TIE ROD END INSTALLATION

1. Install outer tie rod end onto tie rod.
2. Insert stud into steering knuckle.
3. Install nut onto stud. Torque nut to specification and install new cotter pin.

= T
Tie Rod Stud Nut: **45 ft-lbs (61 Nm)**

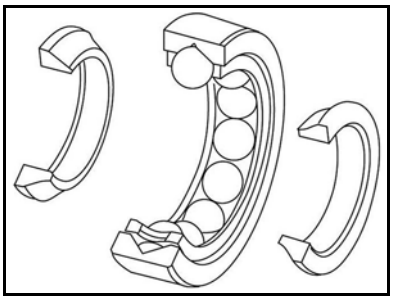
4. Install front tire and wheel assemblies. See Wheel and Tires section.
5. Check front-end alignment toe-in. See Front-End Alignment Toe-In in this section.

BEARING AND RETAINING RING

DESCRIPTION

A bearing is a mechanical component that separates moving parts that spin and take on a load. A device that permits constrained relative motion between two moving parts, typically rotating or having linear movement.

A retaining ring is a mechanical device that helps to join systems or mechanisms together by preventing leakage, containing pressure, and/or excluding contamination.



OPERATION

The bearing rotates in a circular pattern around its axis or device it is mounted/mated with. It provides relative motion where its inner race will spin with its mating surface and the outer race remaining idle.

The retaining ring seats against the device and bearing and prevents penetration of fluid, dirt, and debris from entering the product it surrounds and keeps internal fluids and grease from escaping.

BEARING AND RETAINING RING REMOVAL

1. Remove applicable steering knuckle. See Steering Knuckle in this section.
2. Remove retaining ring.
3. Using hydraulic press, remove old bearing from knuckle housing.

BEARING AND RETAINING RING INSTALLATION

1. Apply Loctite® 603 to outer surface of new bearing.
2. Insert new bearing into knuckle housing.
3. Install retaining ring.
4. Install re-assembled steering knuckle. See Steering Knuckle in this section.

9924112 - 2013 GEM Service Manual

TROUBLESHOOTING

SUSPENSION AND STEERING TROUBLESHOOTING

Condition	Possible Causes	Correction
Front end noise	• Loose or worn wheel bearing • Loose or worn steering or suspension components	• Replace front knuckle assembly • Tighten or replace components as necessary
Excessive play in steering	• Loose or worn wheel bearing • Loose or worn steering or suspension components • Loose or worn steering gear	• Replace front knuckle assembly • Tighten or replace components as necessary • Tighten or replace steering gear
Front wheels shimmy	• Loose or worn wheel bearing • Loose or worn steering or suspension components • Tires worn or out of balance	• Replace front knuckle assembly • Tighten or replace components as necessary • Replace or balance tires
Vehicle instability	• Loose or worn wheel bearing • Loose or worn steering or suspension components • Tire pressure • Alignment	• Replace front knuckle assembly or rear drum brake assembly • Tighten or replace components as necessary. • Adjust tire pressure • Align vehicle to specifications
Excessive steering effort	• Loose or worn steering gear • Steering column u-joints binding • Tire pressure • Alignment	• Replace steering gear • Replace steering column • Adjust tire pressure • Align vehicle to specifications
Vehicle pulls to one side	• Tire pressure • Tire • Worn wheel bearings • Loose or worn ball joints • Weak or broken spring/shock absorber assembly	• Adjust tire pressure • Rotate front tires side to side • Replace front knuckle assembly • Replace ball joints as necessary • Replace spring/shock/absorber • Check for proper front end alignment
Vehicle pulls to one side when braking	• Brakes worn or out of adjustment • Air in brake lines • Loose or worn steering or suspension components • Worn wheel bearings • Wheel cylinder leaking (rear only)	• Adjust or replace brake components • Bleed brakes • Tighten or replace components as necessary • Replace front knuckle assembly • Replace wheel cylinder
Excessive tire wear at center of tire	• Toe out of specification • Tires over-inflated	• Reset toe to proper specification • Release park brake or adjust park brake cable tension • Repair or replace brakes
Vehicle will not coast	• Toe out of specification • Park brake on or cables tensioned too tight • Brakes binding	• Reset toe to proper specification • Release park brake or adjust park brake cable tension • Repair or replace brakes
Vehicle makes thumping sound on tight turns	• Toe out of specification. • CV boot cut or torn.	• Reset toe to proper specification • Replace CV boot

9924112 - 2013 GEM Service Manual

NOTES

9924112 - 2013 GEM Service Manual

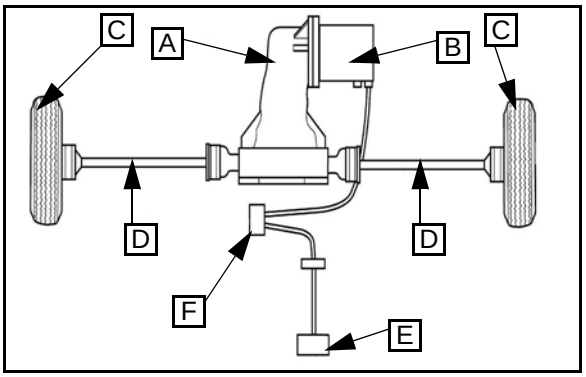
CHAPTER 3
Drivetrain

9924112 - 2013 GEM Service Manual

DRIVETRAIN

DESCRIPTION

The drivetrain consists of a 72-volt motor, a gearbox/ differential and two constant velocity drive shafts called half shafts.



A. Differential
B. Motor
C. Wheel
D. Half Shaft
E. Accelerator
F. Controller

OPERATION

Batteries power the motor. The accelerator pedal (potentiometer) controls the motor speed. The motor is connected to a differential. The power is transferred from the differential through two constant velocity (CV) drive shafts (half shaft) to the wheel hubs.

NOTE: For instructions on motor and accelerator replacement/repair, see Electrical section.

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears.

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds.

HALF SHAFT

DESCRIPTION

The half shaft assembly consists of a shaft with rubber boots at each end for protection from dirt, etc. A splined socket on the inboard end of the shaft mates with a splined shaft on the differential. The splines on the outboard end of the half shaft mate with the splines in the front wheel spindle assembly.

OPERATION

Rotating motion of differential side gear is transferred to front wheel spindle by the half shaft.

HALF SHAFT DIAGNOSIS

Half shafts must be replaced if they exhibit any of the following symptoms.

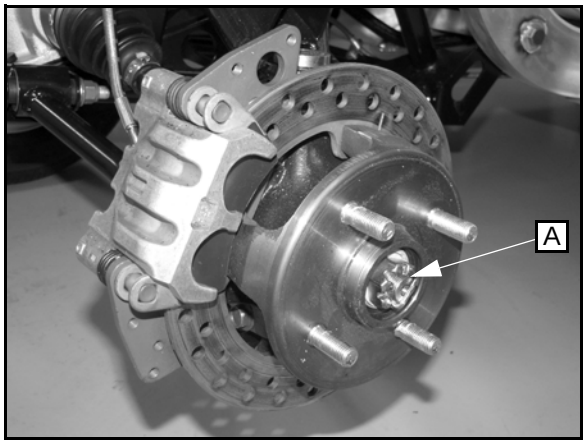
- A clicking noise in turns, which indicates that the outboard joint is damaged.
- A thump or clunk when accelerating from coasting, which points to a faulty inboard joint.
- Vibration or shuddering during acceleration, which may be caused by a damaged inboard or outboard joint, a sticking inboard joint, or an excessive operating angle.

The half shaft must be replaced as an assembly if the CV boots exhibit grease accumulating around the outside of the boot. This is caused either by a small hole or a tear in the boot.

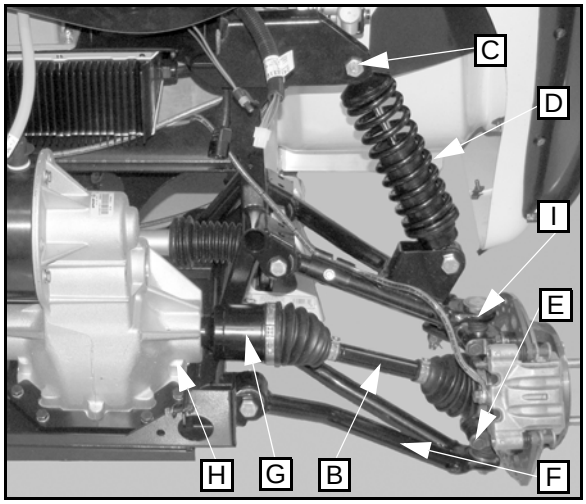
9924112 - 2013 GEM Service Manual

HALF SHAFT REMOVAL

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Remove cotter pin and retaining nut (A) and washer from outboard end of half shaft (B).



3. Remove upper shock absorber bolt (C) and nut from front shock (D).



4. Remove nut, washer (nut side), and ball joint pinch bolt (E), and separate lower control arm (F).

⚠ CAUTION

Exercise caution to not damage the splined shaft during this procedure.

5. Using pair of short pry bars, gently pry inner end (G) from differential (H).
6. Remove outer end of half-shaft (B) from steering knuckle (I).

HALF SHAFT INSPECTION

Inspect the half shaft spline and boot for wear or damage. If worn or damaged, replace the half shaft as an assembly.

HALF SHAFT INSTALLATION

1. Apply Optimol® Olistamoly 2 LN 584 LO grease or equivalent to splines at inner and outer end of half shaft prior to installation.

Grease:
Optimol® Olistamoly 2 LN 584 LO

2. Install outer end of half-shaft onto steering knuckle.
3. Ensure spring clip is still on splined shaft of differential and is not damaged. If damaged, replace.
4. Install inner end onto differential. Press inward, toward differential, until spring clip snaps into place.
5. Apply Loctite® 242 to ball joint pinch bolt.
6. Attach lower control arm and install ball joint pinch bolt, washer (nut side), and nut. Torque to specification.

= T
Ball Joint Pinch Bolt: **45 ft-lbs (61 Nm)**

7. Install and hand tighten upper shock absorber bolt and nut onto front shock.
8. Install washer and hub bearing retaining nut. Torque to specification and install new cotter pin.

= T
Hub Bearing Retainer: **75 ft-lbs (102 Nm)**

9. Install front tire and wheel assembly. See Wheel and Tires section.
10. Torque upper spring/shock absorber bolt to specification.

= T
Spring/Shock Absorber Mounting Bolt: **70 ft-lbs (95 Nm)**

9924112 - 2013 GEM Service Manual

DIFFERENTIAL

DESCRIPTION

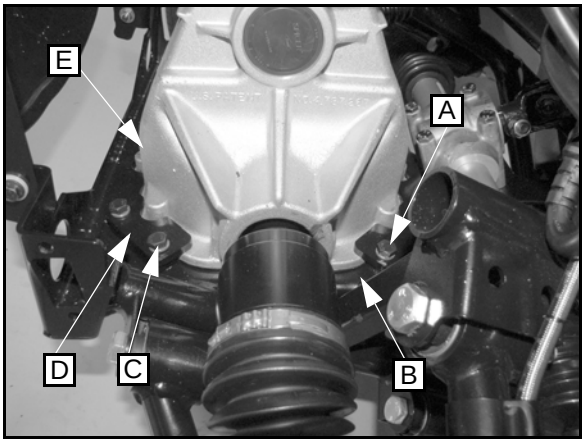
The differential consists of a pinion gear and two side gears in a cast aluminum case. The drive motor is attached to the pinion gear. The side gears are each attached to half shafts

OPERATION

Rotation of the motor spindle is transferred to the pinion gear. The pinion gear contacts the side gears, forcing them to rotate, transferring power to the half shafts.

DIFFERENTIAL REMOVAL

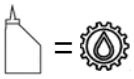
1. Unlatch and open hood.
2. Remove half shafts. See Half Shaft in this section.
3. Remove motor. See Motor in Electrical section.
4. Remove four bolts (A), four lock washers, and upper mounting bracket (B).



5. Remove four bolts (C), four lock washers, and lower mounting bracket (D).
6. Remove differential (E).

DIFFERENTIAL INSTALLATION

1. Add oil to new differential.



Recommended Differential Lubricant:
Full Synthetic AGL Plus (PN 2878068 - 1 Quart)

2. Ensure spring clips are on splined differential shafts.
3. Position differential between front suspension frame and mounting plate.
4. Install lower mounting bracket, four lock washers, and hand tighten four bolts.
5. Install upper mounting bracket, four lock washers, and hand tighten four bolts.
6. Torque eight mounting bolts to specification.

Differential Mounting Bracket Bolts:
20 ft-lbs (27 Nm)

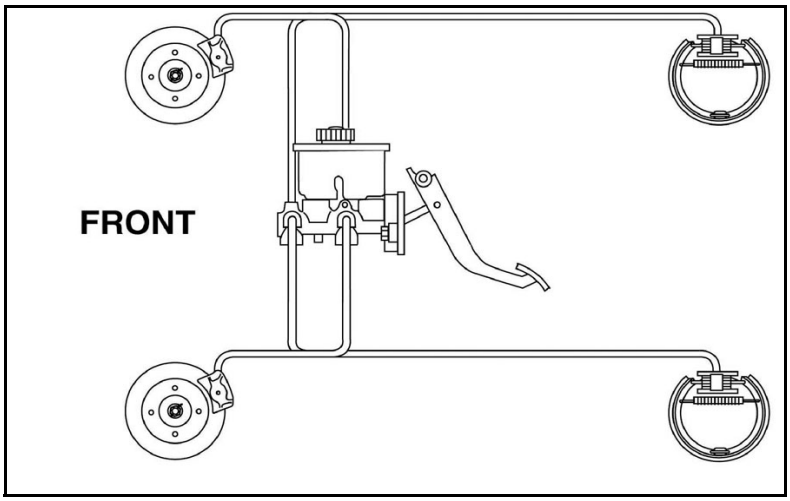
7. Install motor. See Motor in Electrical section.
8. Install half shafts. See Half Shaft in this section.
9. Close and latch hood.

9924112 - 2013 GEM Service Manual

CHAPTER 4
Brakes

9924112 - 2013 GEM Service Manual

BRAKE SYSTEM



DESCRIPTION

The GEM car uses a hydraulic brake system with front disc and rear drum brakes. There is also a mechanical parking brake that activates the rear brakes only.

OPERATION

The Polaris front brakes consist of the following: brake pedal, master cylinder, hydraulic brake lines, brake calipers, brake pads, and brake discs which are secured to the drive line. The rear brakes consist of the following: spindle, wheel cylinder, parking brake actuator lever, drum and shoes. It is mounted on flanges at each end of the rear axle. The parking brake actuator lever is connected by cables to the parking brake lever. When the parking brake lever is engaged, it pulls on the cables to the parking brake actuator lever, which engages the two brake shoes. Movement of the parking brake actuator forces the brake shoes to press against the brake drum.

When the foot activated brake lever is applied it applies pressure on the piston within the master cylinder. As the master cylinder piston moves inward it closes a small opening (compensating port) within the cylinder and starts to build pressure within the brake system. As the pressure within the system is increased, the pistons located in the brake calipers move outward and apply pressure to the moveable brake pads. These pads contact the brake discs and move the calipers in their floating bracket, pulling the stationary side pads into the brake discs. The resulting friction reduces brake disc and vehicle speed. For the rear brakes, The wheel cylinder has two pistons, each of which engage a brake shoe. Fluid pressure pushes the pistons out, causing the brake shoes to press against the brake drum.

The friction applied to the brake pads will cause the pads to wear. As these pads wear, the piston within the caliper moves further outward and becomes self adjusting. Fluid from the reservoir fills the additional area created when the caliper piston moves outward. The friction of the rear brake shoes against the drum causes the drum and wheel to stop turning.

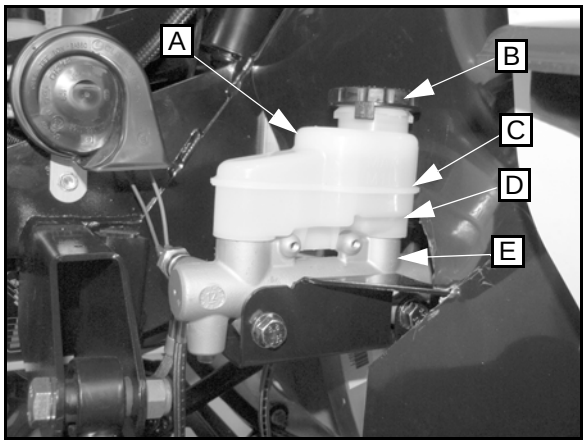
Located within the master cylinder is the compensating port which is opened and closed by the master cylinder piston assembly. As the temperature within the hydraulic system changes, this port compensates for fluid expansion or contraction. Due to the high temperatures created within the system during heavy braking, it is very important that the master cylinder reservoir have adequate space to allow for fluid expansion. Never overfill the reservoir! Do not fill the reservoir beyond the MAX LEVEL line! Brake fluid level is critical to proper system operation. Too little fluid will allow air to enter the system and cause the brakes to feel spongy. Too much fluid could cause brakes to drag due to fluid expansion. When servicing Polaris brake systems use only Polaris DOT 4 Brake Fluid (PN 2872189).

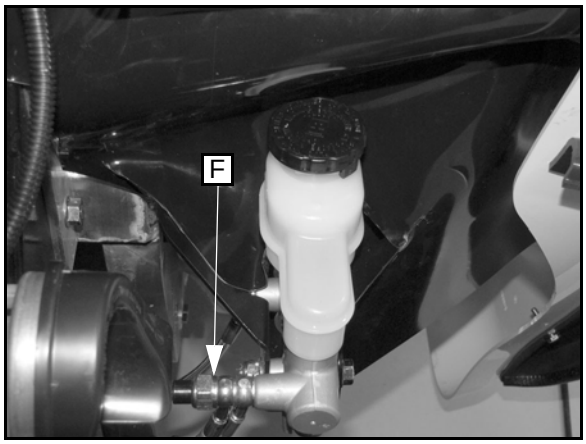
WARNING: Once a bottle of brake fluid is opened, use what is necessary and discard the rest in accordance with local laws. Do not store or use a partial bottle of brake fluid. Brake fluid is hygroscopic, meaning it rapidly absorbs moisture. This causes the boiling temperature of the brake fluid to drop, which can lead to early brake fade and the possibility of serious injury.

MASTER CYLINDER ASSEMBLY

OPERATION

Pressure from the brake pedal is transmitted by a push rod to a piston in the master cylinder, causing the piston to move forward. Movement of piston forces brake fluid out of master cylinder into brake lines leading to the four brake assemblies.





A. Reservoir

B. Cap

C. Maximum fluid level line

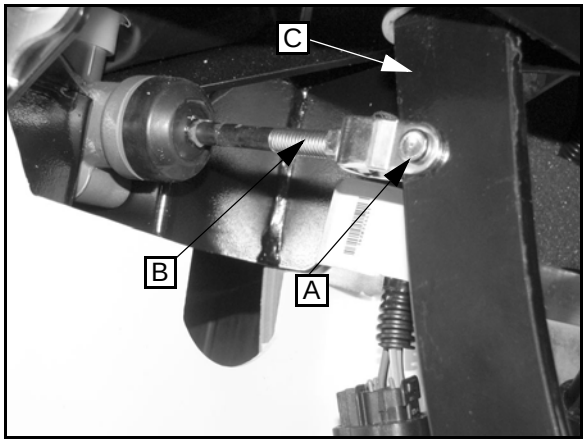
D. Minimum fluid level line

E. Master Cylinder

F. Brake pressure switch

MASTER CYLINDER REMOVAL

1. Remove upper dash panel. See Dash Panel Upper in Body section.
2. Remove lower dash panel. See Dash Panel Lower in Body section.
3. Remove pin (A) and locking clip to separate push rod (B) from brake pedal (C).



4. Place a container to catch brake fluid under the master cylinder brake line banjo bolts.

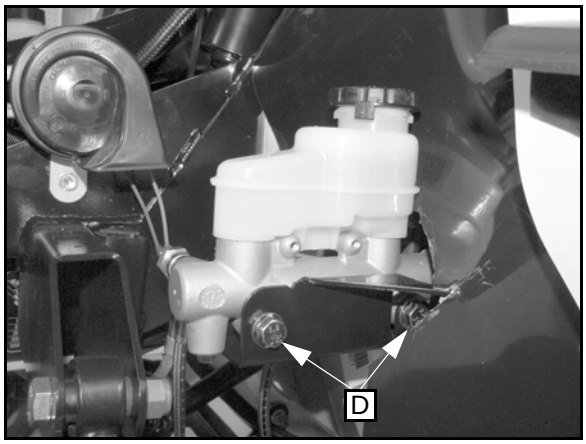
> **CAUTION**
>
> Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces.

NOTE: Make note of front and rear brake line orientations to master cylinder.

5. Loosen and remove the brake line banjo bolts and allow fluid to drain.

NOTE: Dispose of fluid properly. Do not re-use.

6. Remove (2) mounting fasteners (D) that secure the master cylinder to the frame..



9924112 - 2013 GEM Service Manual

MASTER CYLINDER INSTALLATION

CAUTION

Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces.

1. Install master cylinder and (2) mounting fasteners. Torque to specification.
2. Install brake lines and brake line banjo bolts being sure to match brake line orientation noted during removal. Torque to specification.

= T

Master Cylinder Mounting Bolts: **20 ft-lbs (27 Nm)**
Brake Line Banjo Bolts: **20 ft-lbs (27 Nm)**

3. Install pin and locking clip to attach master cylinder to brake pedal.
4. Remove master cylinder cap and add DOT 4 brake fluid to master cylinder reservoir until MAX line on side of reservoir is reached. Install cap.

Polaris DOT 4 Brake Fluid:
P/N 2872189

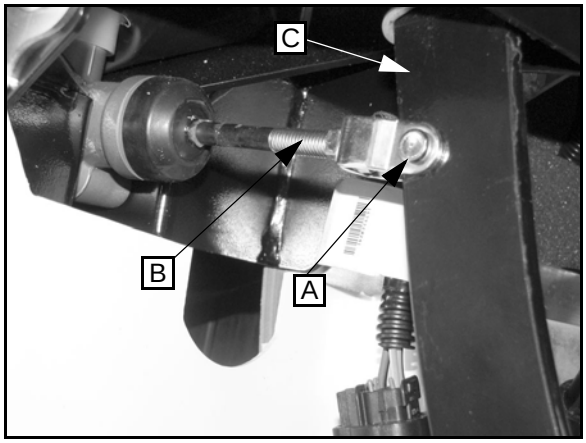
5. Bleed brakes. See Brake Bleeding in this section.
6. Install lower dash panel. See Dash Panel Lower in Body section.
7. Install upper dash panel. See Dash Panel Upper in Body section.

9924112 - 2013 GEM Service Manual

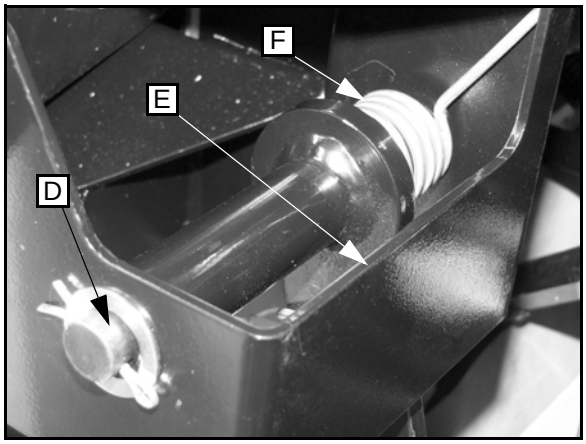
BRAKE PEDAL ASSEMBLY

BRAKE PEDAL REMOVAL

1. Remove upper dash panel. See Dash Upper Panel in Body section.
2. Remove lower dash panel. See Dash Lower Panel in Body section.
3. Remove accelerator pedal. See Accelerator Pedal in Electrical section.
4. Remove locking clip and pin (A) to separate push rod (B) from brake pedal (C).



5. Remove cotter pin and washer from brake pedal shaft (D).

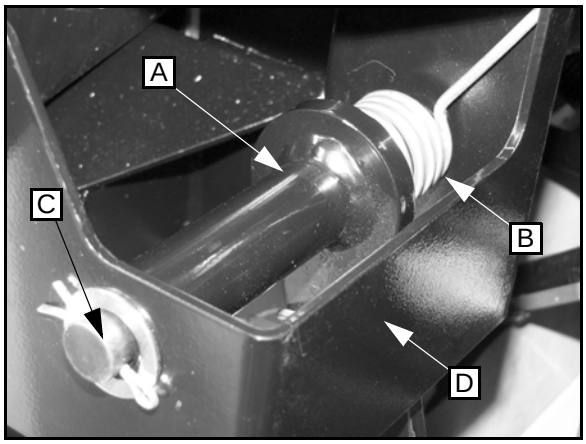


6. Slide brake pedal shaft (D) toward passenger side of brake pedal bracket (E) and remove brake pedal shaft, spring (F), and brake pedal.

BRAKE PEDAL INSTALLATION

IMPORTANT: Spring must be installed with long end positioned into notch in brake pedal bracket.

1. Holding brake pedal (A) and spring (B) in place, slide brake pedal shaft (C) into place from passenger side of brake pedal bracket (D).



2. Install washer and cotter pin onto brake pedal shaft (C).
3. Install pin and clip to attach push rod to brake pedal.
4. Install accelerator pedal. See Accelerator Pedal in Electrical section.
5. Install lower dash panel. See Dash Lower Panel in Body section.
6. Install upper dash panel. See Dash Upper Panel in Body section.

9924112 - 2013 GEM Service Manual

BRAKE BLEEDING

Brakes must be bled to remove air from the system whenever the brake hoses or brake lines are disconnected.

PRESSURE BLEEDING

⚠ WARNING

Brake fluid is toxic and must be disposed of properly. Follow instructions on brake fluid container in the event of accidental contact or ingestion.

⚠ CAUTION

Use only DOT 4 brake fluid from an unopened container.

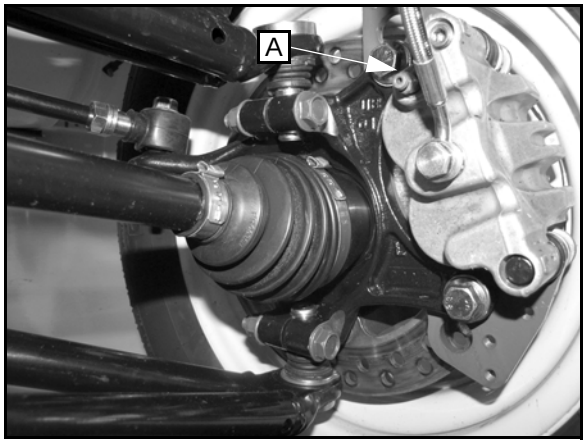
⚠ CAUTION

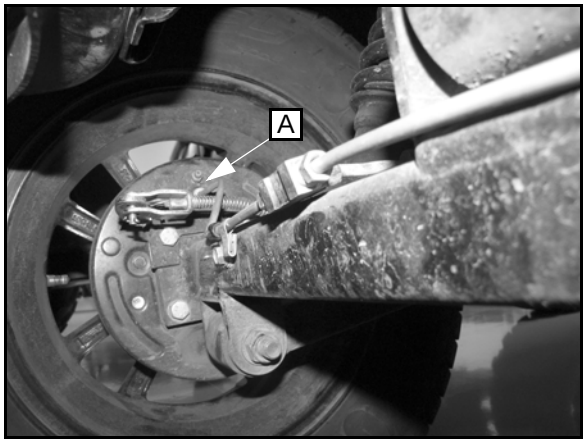
Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces.

NOTE: Proper brake bleeding requires an automotive type pressure bleeder or vacuum bleeder. Good quality units are available from reputable automotive tool companies.

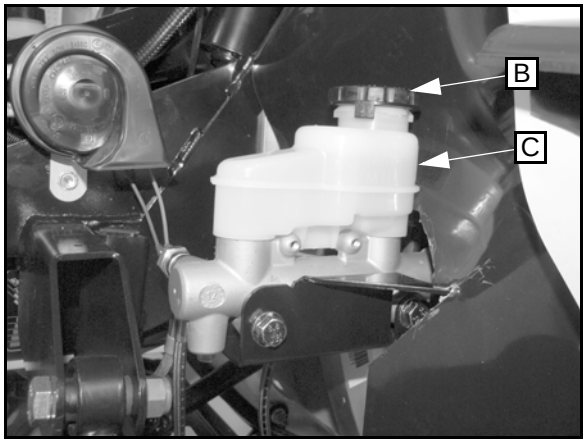
NOTE: Always ensure that the brake fluid reservoir in the master cylinder is kept at the MAX fill line while bleeding.

1. Follow bleeder unit instructions for attachment and usage.
2. Bleed system at all four wheels, starting at right rear, then continue to left rear, right front, and left front.
3. After bleeding all four wheels, apply pressure to brake pedal ensuring firm feel and no floor contact with maximum effort. If pedal feels mushy or makes contact with floor, repeat Steps 1-3.
4. Check bleeder screw (A) and hose/line connections for leaks.





5. Check brake fluid level.
6. If necessary, remove reservoir filler cap (B) and fill master cylinder reservoir (C) with DOT 4 brake fluid.



Polaris DOT 4 Brake Fluid:
P/N 2872189

7. Test drive vehicle to ensure brakes work properly and vehicle does not pull during braking.

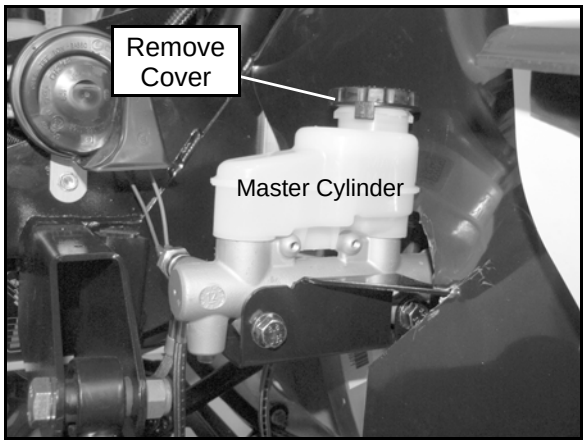
MANUAL BLEEDING - STANDARD

NOTE: When bleeding the brakes or replacing the fluid always start with the furthest caliper or cylinder from the master cylinder. This procedure should be used to change fluid or bleed brakes during regular maintenance.

> **⚠ CAUTION**
>
> Always wear safety glasses.

> **⚠ CAUTION**
>
> Brake fluid will damage finished surfaces. Do not allow brake fluid to come in contact with finished surfaces.

1. Clean master cylinder reservoir cover thoroughly and remove the cover.



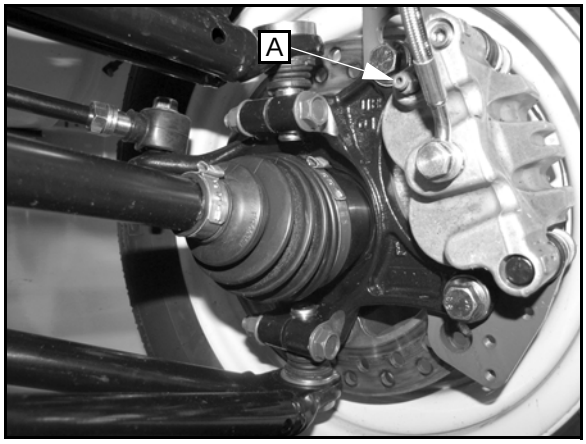
2. If changing fluid, remove old fluid from reservoir with a Mity Vac™ pump or similar tool.

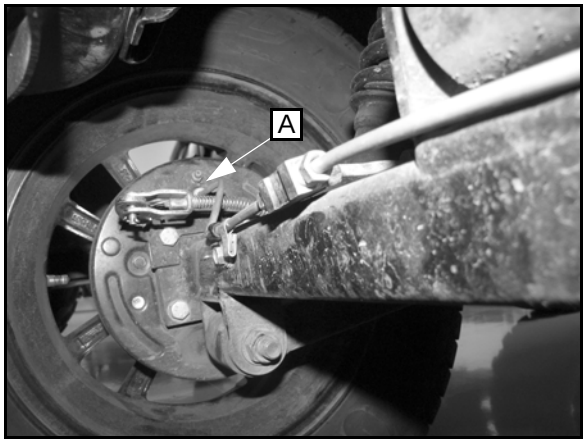
Mity Vac™: PN 2870975

3. Add brake fluid to the indicated MAX level of reservoir.

Polaris DOT 4 Brake Fluid (PN 2872189)

4. Begin bleeding procedure with the caliper or cylinder that is farthest from the master cylinder. Install a box end wrench on bleeder screw (A). Attach a clean, clear hose to fitting and place the other end in a clean container. Be sure the hose fits tightly on fitting.





5. Have an assistant slowly pump foot pedal until pressure builds and holds.
6. Hold brake pedal down to maintain pedal pressure, and open bleeder screw. Close bleeder screw and release pedal.

NOTE: Do not release foot pedal before bleeder screw is tight or air may be drawn into master cylinder.

7. Repeat procedure until clean fluid appears in bleeder hose and all air has been purged. Add fluid as necessary to maintain level in reservoir.

> **⚠ CAUTION**
>
> Maintain at least 1/2"(1.27 cm) of brake fluid in the reservoir to prevent air from entering the master cylinder.

9924112 - 2013 GEM Service Manual

8. Tighten bleeder screw securely and remove bleeder hose. Torque bleeder screw to specification.

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Caliper and Cylinder Bleeder Screw: **47 in-lbs (5.3 Nm)**

9. Repeat steps 5 - 8 for the remaining calipers.
10. Add brake fluid to MAX level inside reservoir.

Master Cylinder Fluid Level

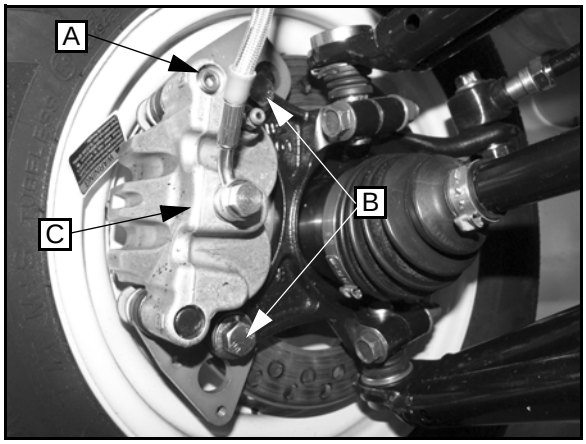
Between MIN and MAX lines on reservoir.

11. Install master cylinder reservoir cover.
12. Field test machine at low speed before putting into service. Check for proper braking action.
13. Check brake system for fluid leaks.

FRONT BRAKE PADS

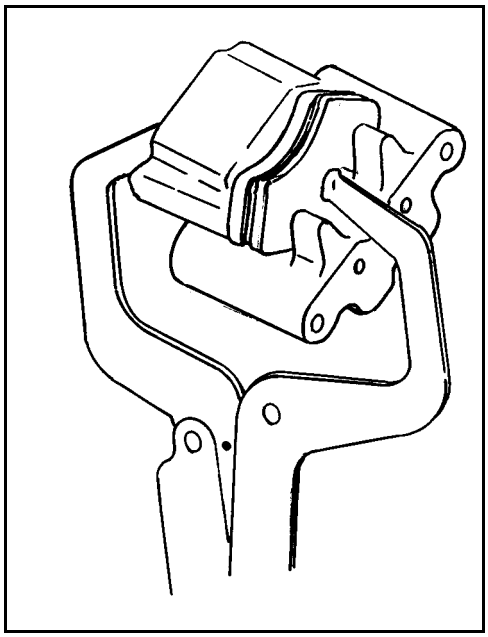
Brake Pad Removal

1. Remove front tire and wheel assembly. See Wheel and Tires section.
2. Loosen pad adjuster screw (A) 2-3 turns.



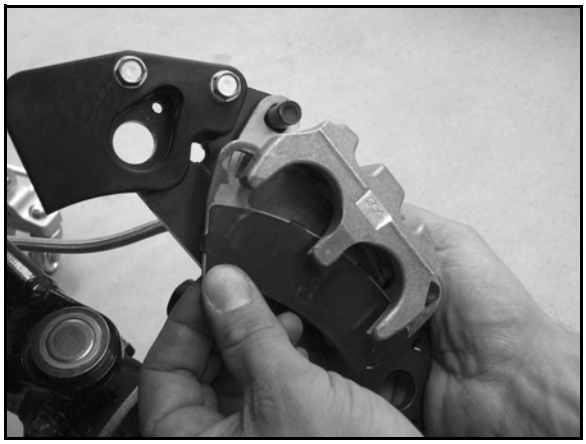
CAUTION
When removing caliper, use care not to damage brake line. Support caliper to avoid kinking or bending brake line.

3. Remove the upper and lower caliper mounting bolts (B) and brake caliper (C).
4. Push caliper piston into caliper bore slowly using a C-clamp or locking pliers with pads installed.



NOTE: Brake fluid will be forced through compensating port into master cylinder fluid reservoir when piston is pushed back into caliper. Remove excess fluid from reservoir as required.

5. Push mounting bracket inward and slip outer brake pad out between bracket and caliper.

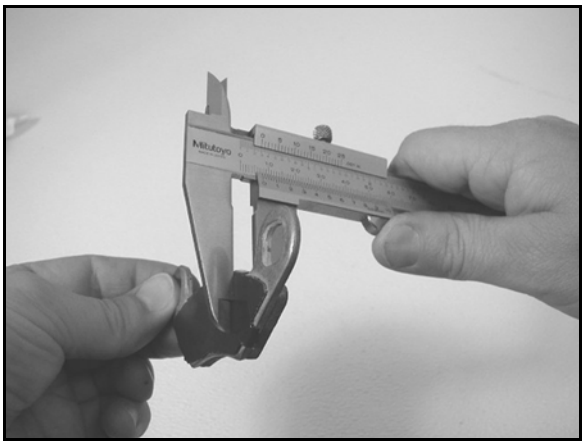


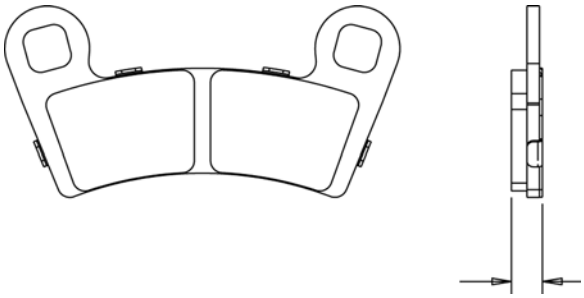
6. Remove inner pad from bracket and caliper.

9924112 - 2013 GEM Service Manual

Pad Inspection

1. Using caliper, measure thickness of pad. Replace pads if worn beyond service limit

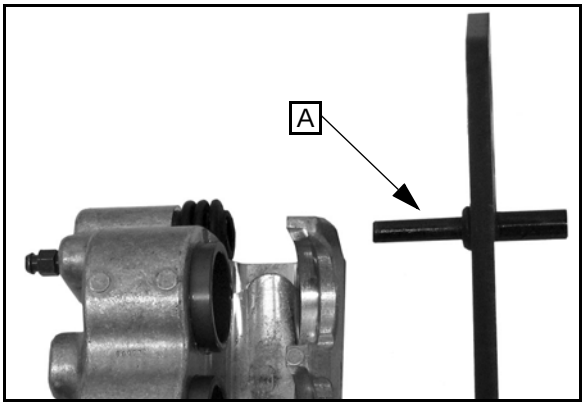




Front Brake Pad Thickness
New: .297 ± .007" (7.56 ± .178 mm)
Service Limit: .180" (4.6 mm)

Brake Pad Assembly / Installation

1. Lubricate mounting bracket pins (A) with a light film of silicone grease and install dust boots.



2. Compress mounting bracket and make sure dust boots are fully seated. Install pads with friction material facing each other.

⚠ WARNING

If brake pads are contaminated with grease, oil, or liquid soaked do not use the pads.
Use only new, clean pads.

3. Install caliper onto front hub and torque mounting bolts to specification.

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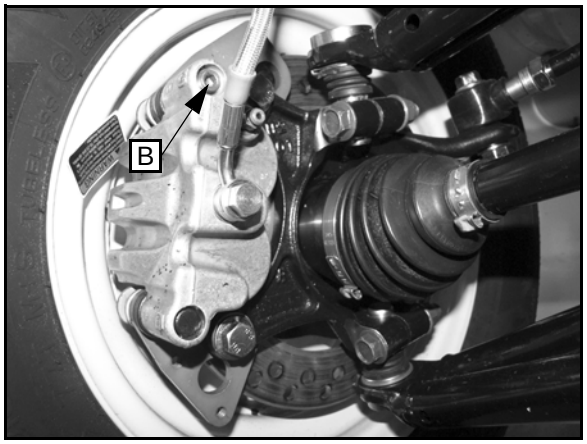
Front Caliper Mounting Bolts:
28 ft-lbs (38 Nm)

4. Slowly pump brake pedal until pressure has been built up. Maintain at least 1/2 in. (12.7 mm) of brake fluid in reservoir to prevent air from entering brake system.
5. Install pad adjuster screw (B) and turn clockwise until stationary pad contacts disc, then back off 1/2 turn (counterclockwise).



6. Verify fluid level in reservoir is up to MAX line inside reservoir and install reservoir cap.

Master Cylinder Fluid:
Up to MAX line inside reservoir

7. Install rear tire and wheel assembly. See Wheel and Tires section.

IMPORTANT: It is required that a burnishing procedure be performed after installation of new brake pads to extend service life and reduce noise.

Brake Burnishing Procedure

> **CAUTION**
>
> Allow pads and disc to cool sufficiently during the procedure. Do not allow pads or disc to become hot or warping may result. Do not make more than 3 stops per 1 mile (1.6 km)

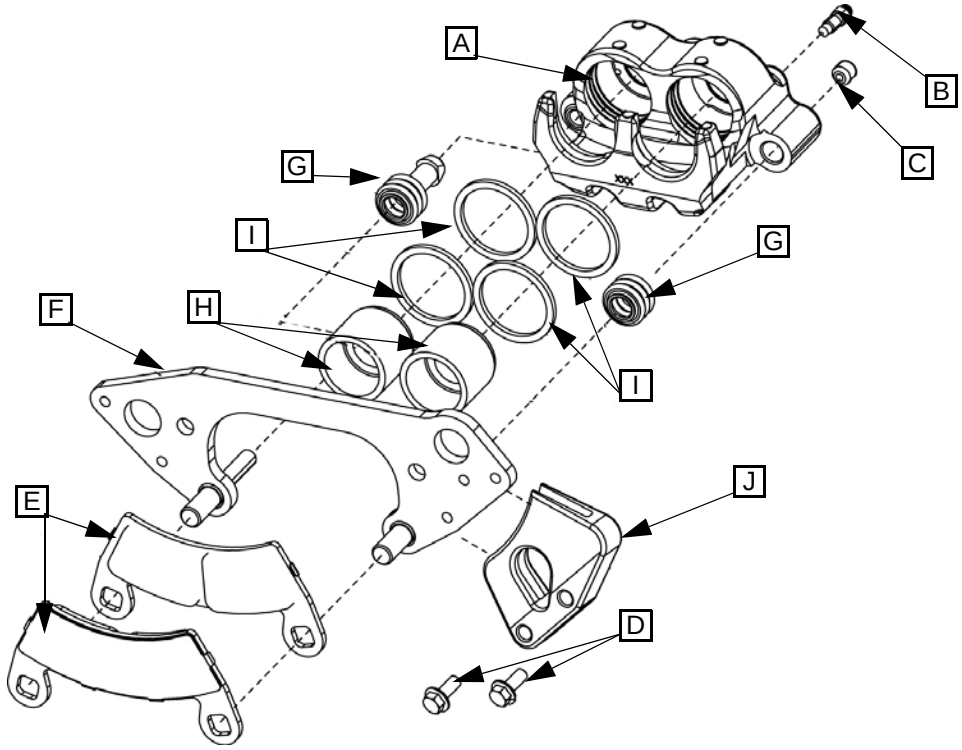
NOTE: It is required that a burnishing procedure be performed after installation of new brake pads to extend service life and reduce noise.

1. Start machine and slowly increase speed to 25 mph. Gradually apply brakes to stop machine.
2. Repeat procedure 10 times.

9924112 - 2013 GEM Service Manual

FRONT CALIPER SERVICE

Caliper Exploded View



A. Caliper Assy.
B. Bleeder Screw
C. Brake Pad Adjust. Screw
D. Scraper Mounting Bolts
E. Brake Pads
F. Caliper Mount
G. Boots
H. Pistons
I. Square O-rings
J. Brake Scraper

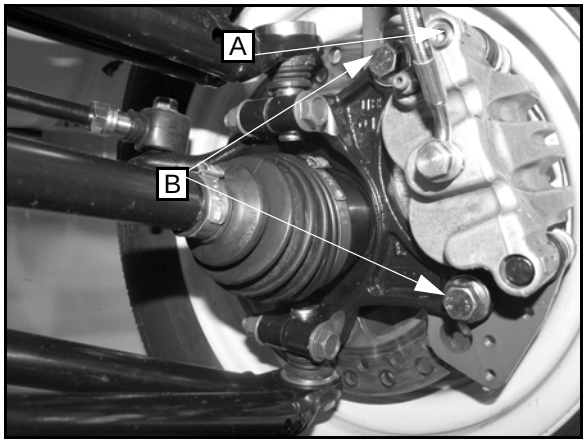
Caliper Removal

1. Remove front tire and wheel assembly. See Wheel and Tires section.

⚠ WARNING

Use care when supporting vehicle so that it does not tip or fall. Severe injury or death may occur.

2. Clean caliper area before removal.
3. Place a container below caliper to catch brake fluid when removing line.
4. Remove brake line from caliper. Allow fluid to drain into container for disposal.
5. Loosen brake pad adjustment set screw (A) 2-3 turns.



CAUTION

When removing or installing caliper, use care not to damage brake line. Support caliper to avoid kinking or bending brake line.

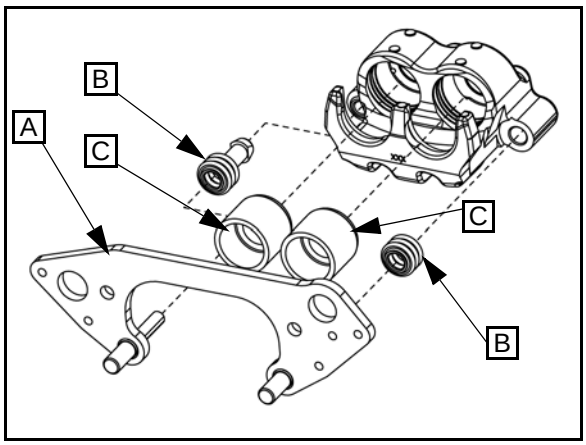
6. Remove two mounting bolts (B) and brake caliper.

9924112 - 2013 GEM Service Manual

Caliper Disassembly

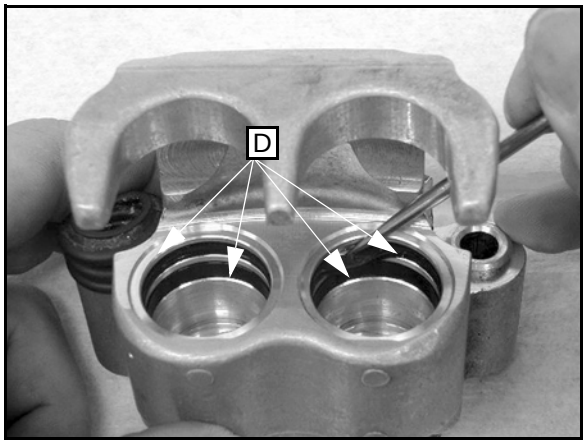
Thoroughly clean caliper before disassembly and prepare clean work area.

1. Remove both brake pads from caliper. See Front Brake Pads section.
2. Remove mounting bracket (A) and dust boots (B) from caliper.



IMPORTANT: Do not remove the caliper pistons with a standard pliers. The piston sealing surfaces will become damaged if standard pliers are used.

3. Using commercially available caliper piston pliers, extract pistons (C) from caliper.
4. Using pick, carefully remove square O-rings (D) from caliper.

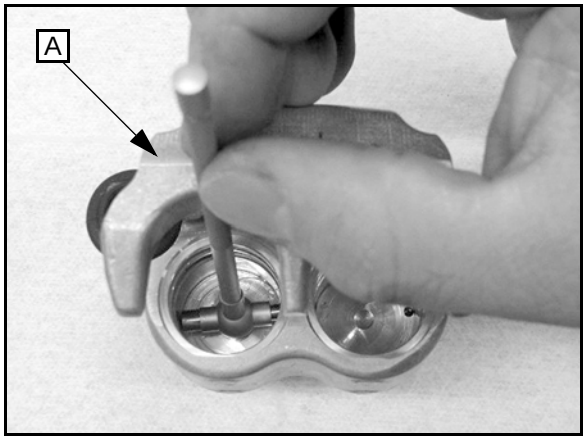


IMPORTANT: Ensure seal grooves in caliper body are cleaned.

5. Using brake cleaner or alcohol, clean caliper, mounting bracket (A), and pistons (C).

Caliper Inspection

1. Inspect caliper (A) for nicks, scratches, pitting or wear. Measure bore size and compare to specifications. Replace if damaged or worn beyond service limit.



= **In. / mm.**

Front Caliper Piston Bore I.D.:
Standard: 1.373” (34.87 mm)
Service Limit: 1.375” (34.93 mm)

2. Inspect piston (H) for nicks, scratches, pitting or wear. Measure piston diameter and replace if damaged or worn beyond service limit.

= **In. / mm.**

Front Caliper Piston O.D.:
Standard: 1.370” (34.80 mm)
Service Limit: 1.368” (34.75 mm)

3. Inspect brake disc and pads. See Pad Inspection in this section.

9924112 - 2013 GEM Service Manual

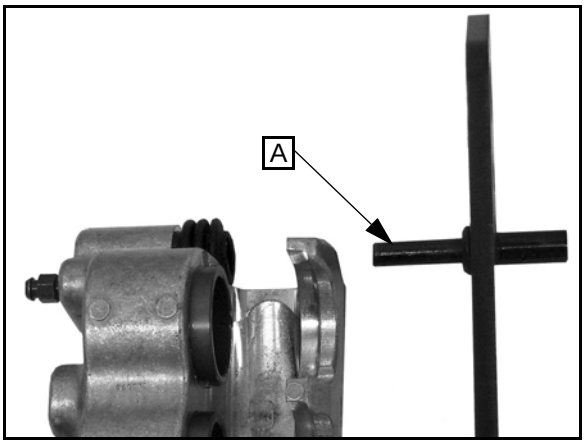
Caliper Assembly

IMPORTANT: Ensure seal grooves in caliper body are cleaned.

1. Install new square O-rings in caliper.
2. Coat pistons with clean Polaris DOT 4 Brake Fluid. Install pistons with twisting motion while pushing inward. Piston should slide in and out of bore smoothly, with light resistance.

Polaris DOT 4 Brake Fluid: P/N 2872189

3. Lubricate mounting bracket pins (A) with silicone grease and install dust boots.



4. Install and compress mounting bracket and ensure dust boots are fully seated. Install brake pads.
5. Using brake parts cleaner or denatured alcohol, clean disc and pads to remove any dirt, oil or grease.

Caliper Installation

CAUTION
When removing or installing caliper, use care not to damage brake line. Support caliper to avoid kinking or bending brake line.

1. Install caliper and torque mounting bolts to specification.

= T
Front Caliper Mounting Bolts: **28 ft-lbs (38 Nm)**

2. If removed, install brake scraper.
3. Install brake lines. Torque banjo bolt to specification.

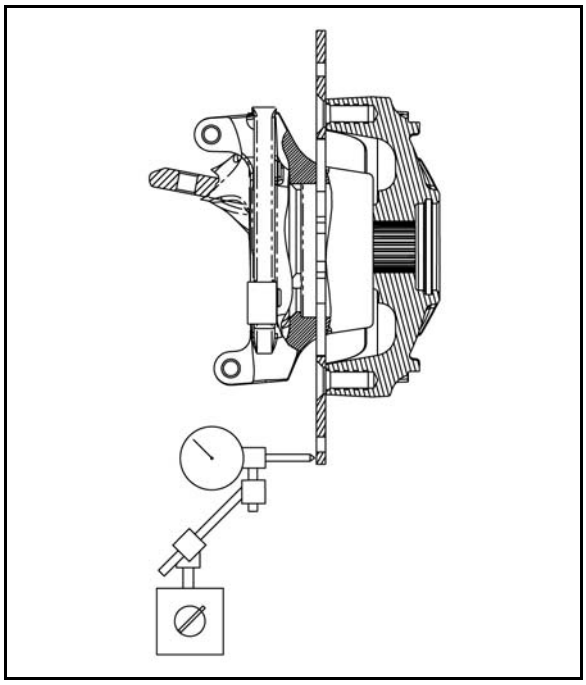
= T
Brake Line Banjo Bolt: **20 ft-lbs (27 Nm)**

4. Tighten brake pad adjustment screw until stationary pad contacts disc, then back off 1/2 turn.
5. Perform brake bleeding. See Brake Bleeding in this section.
6. Install front tire and wheel assembly. See Wheel and Tires section.
7. Field test unit for proper braking action before putting into service. Inspect for fluid leaks and firm brakes. Ensure brake is not dragging when pedal is released. If brake drags, re-check assembly and installation.
8. If new brake pads are installed, perform brake burnishing. See Brake Burnishing in this section.

FRONT BRAKE DISC

Disc Runout

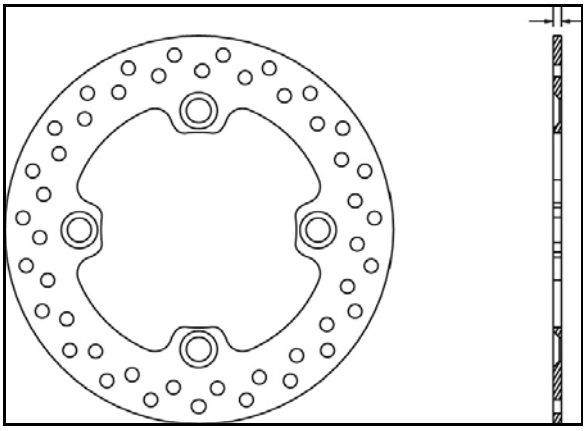
1. Mount dial indicator as shown. Slowly rotate the disc and read total runout on the dial indicator. Replace disc if runout exceeds specification.



= In. / mm.
Brake Disc Runout: **Service Limit .010” (.254 mm)**

Disc Inspection

1. Visually inspect disc for scoring, scratches or gouges. Replace the disc if any deep scratches are evident.



2. Using a 0 to 1-inch micrometer, measure disc thickness at eight different points around pad contact surface. Replace disc if worn beyond service limit.

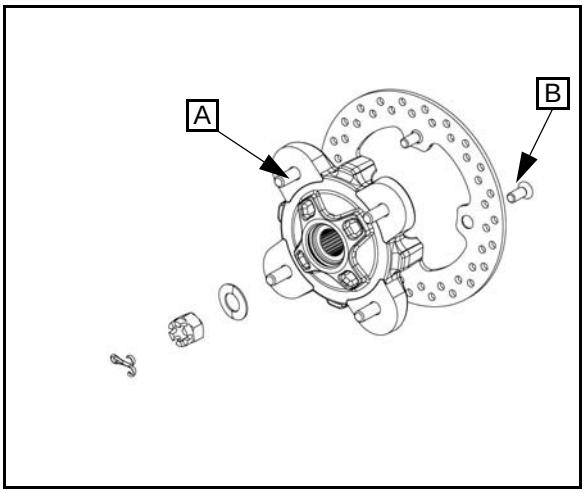
= In. / mm.
Brake Disc Thickness: **New .188” (4.78 mm)** **Service Limit .170” (4.32 mm)**

= In. / mm.
Brake Disc Thickness Variance **Service Limit: .002” (.051 mm)** **difference between measurements**

9924112 - 2013 GEM Service Manual

Disc Removal / Replacement

1. Remove front brake caliper. See Front Caliper Service in this section.
2. Remove cotter pin, retaining nut, and washer.



3. Remove wheel hub (A) from vehicle and remove four mounting bolts (B) retaining disc to hub.

CAUTION

Always use new brake disc mounting bolts. The bolts have a pre-applied locking agent which is destroyed upon removal.

4. Clean wheel hub (A) mating surface and install new disc on wheel hub. Torque four, new mounting bolts (B) to specification.

= **T**

Front Brake Disc Mounting Bolts:
18 ft-lbs (24 Nm)

5. Install wheel hub, washer, and retaining nut. Torque retaining nut to specification and install new cotter pin.

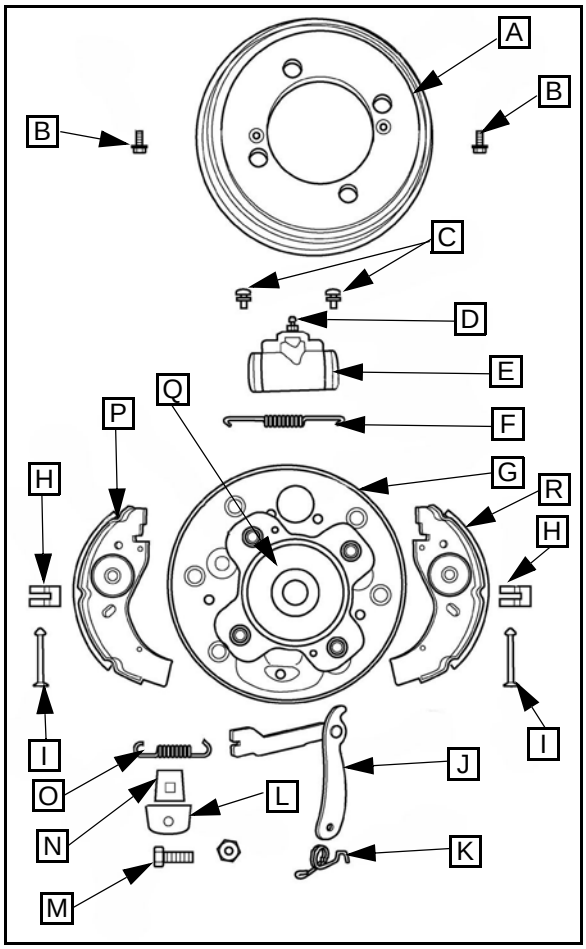
= **T**

Front Wheel Hub Retaining Nut:
75 ft-lbs (102 Nm)

6. Install front brake caliper. See Front Caliper Service in this section.
7. Field test unit for proper braking action before putting into service. Inspect for fluid leaks and firm brakes. Ensure brake is not dragging when pedal is released. If brake drags, re-check assembly and installation.

9924112 - 2013 GEM Service Manual

REAR DRUM SERVICE (E2, E4, ES, EL)



A. Drum	J. Actuator lever
B. Drum mounting bolts	K. Actuator return spring (outer)
C. Wheel cylinder bolts	L. Spacer
D. Bleeder screw	M. Spacer mounting bolt / nut
E. Wheel cylinder	N. Lower shoe retainer
F. Upper spring	O. Actuator return spring (lower)
G. Mounting / backing plate	P. Front Brake shoe
H. Retention pin clips	Q. Spindle
I. Retention pins	R. Rear Brake shoe

REAR BRAKE REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.
2. Remove cotter pin and clevis pin attaching parking brake cable to actuator lever (J).
3. Remove parking brake cable from actuator lever (J).
4. Remove brake line from wheel cylinder (E) and allow fluid to drain into suitable container for disposal.
5. Remove four bolts attaching brake assembly to axle end flange.
6. Remove rear brake assembly.

REAR BRAKE DISASSEMBLY

1. Perform rear brake shoe removal. See Rear Brake Shoes in this section.
2. Remove two bolts (C), wheel cylinder (E), and actuator return (outer) spring (K).
3. Remove wheel cylinder (E), actuator return (lower) spring (O), and actuator lever (J).

REAR BRAKE ASSEMBLY

1. Install actuator lever (J), actuator return (lower) spring (O), and wheel cylinder (E).
2. Install wheel cylinder (E) and mounting bolt (C) furthest from actuator lever (J).
3. Position actuator lever spring (outer) K), ensuring it engages actuator lever (J) and is directly over mounting hole in wheel cylinder (E). Insert last bolt (C) and tighten.

9924112 - 2013 GEM Service Manual

REAR BRAKE INSTALLATION

NOTE: Ensure the correct (RH or LH) drum brake assembly is present.

1. Install RH or LH rear brake assembly.
2. Install four bolts through rear axle end into spindle on rear of brake assembly. Torque bolts to specification.

= T
Bolts to Brake Assembly and Axle End Flange: **20 ft-lbs (27 Nm)**

3. Attach brake line to wheel cylinder. Torque to specification.

= T
Brake Line to Wheel Cylinder: **37 in-lbs (4 Nm)**

4. Insert parking brake cable into actuator lever.
5. Insert clevis pin into parking brake actuator lever, ensuring parking brake cable is engaged securely with cotter pin.
6. Install rear tire and wheel assembly. See Wheel and Tires section.
7. Bleed brakes. See Brake Bleeding instructions in this section.
8. Adjust parking brake cable. See Parking Brake Cable Tension Adjustment in this section.

BRAKE SHOE REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.

WARNING
Use care when supporting vehicle so that it does not tip or fall. Severe injury or death may occur.

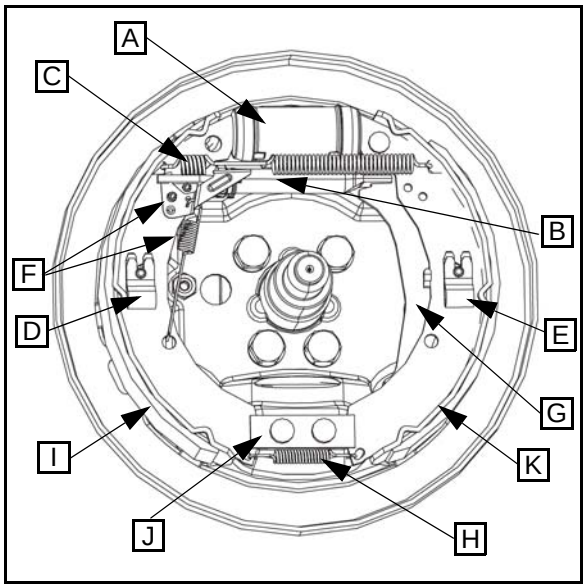
2. Remove two screws and drum from assembly.
3. Remove clips from retention pins at center of each shoe and remove pins.
4. Remove bolt, retaining plate, and spacer at lower shoe pivot point.
5. Remove actuator return spring (inner).
6. Remove actuator return spring (outer).
7. Lift shoes away from wheel cylinder and off center locating post.

BRAKE SHOE INSTALLATION

NOTE: The shoes must properly engage wheel cylinder pistons.

1. Position trailing shoe on center of locating post and onto wheel cylinder.
2. Position leading shoe on center of locating post and onto wheel cylinder.
3. Install actuator return spring (outer).
4. Install actuator return spring (inner).
5. Install lower pivot point spacer with narrow side up, retainer (rounded side down), bolt, and nut.
6. Install pins and new clips onto retention pins at center of each shoe.
7. Install drum and two screws onto assembly.
8. Install rear tire and wheel assembly. See Wheel and Tires section.

REAR DRUM SERVICE (E6, E6S, ELXD)



A. Wheel cylinder
B. Automatic adjuster screw assembly
C. Return spring
D. Hold down clip
E. Hold down clip
F. Automatic adjuster lever and spring
G. Actuator lever
H. Anchor spring
I. Front brake shoe
J. Brake anchor
K. Rear brake shoe

REAR BRAKE REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.
2. Release tension at parking brake equalizer.
3. Remove drum.
4. Remove parking brake cable from actuator lever.
5. Remove brake line from wheel cylinder and allow fluid to drain into suitable container for disposal.
6. Remove four bolts attaching brake assembly to axle end flange.
7. Remove rear brake assembly.

REAR BRAKE INSTALLATION

1. Install rear brake assembly.
2. Install four bolts attaching brake assembly to axle end flange. Tighten bolts to specification.

= T
Bolts to Brake Assembly and Axle End Flange: **65 ft-lbs (88 Nm)**

3. Attach brake line to wheel cylinder. Torque to specification.

= T
Brake Line to Wheel Cylinder: **37 in-lbs (4 Nm)**

4. Install parking brake cable into actuator lever.

NOTE: Ensure the correct (RH or LH) drum brake assembly is present.

5. Install hub and torque retaining nut to specification.

= T
Hub Retaining Nut: **165 ft-lbs (224 Nm)**

6. Install drum.
7. Install rear tire and wheel assembly. See Wheel and Tires section.
8. Bleed brakes. See Brake Bleeding instructions in this section.
9. Adjust parking brake cable. See Parking Brake Cable Tension Adjustment in this section.

9924112 - 2013 GEM Service Manual

BRAKE SHOE REMOVAL

1. Remove rear tire and wheel assembly. See Wheel and Tires section.

> **⚠ WARNING**
>
> Use care when supporting vehicle so that it does not tip or fall. Severe injury or death may occur.

2. Remove drum assembly.
3. Remove clips from retention pins at center of each shoe and remove pins.
4. Remove lower anchor spring.
5. Remove upper return spring.
6. Remove automatic adjuster spring
7. Lift shoes away from wheel cylinder and off center locating post.

BRAKE SHOE INSTALLATION

NOTE: The shoes must properly engage wheel cylinder pistons.

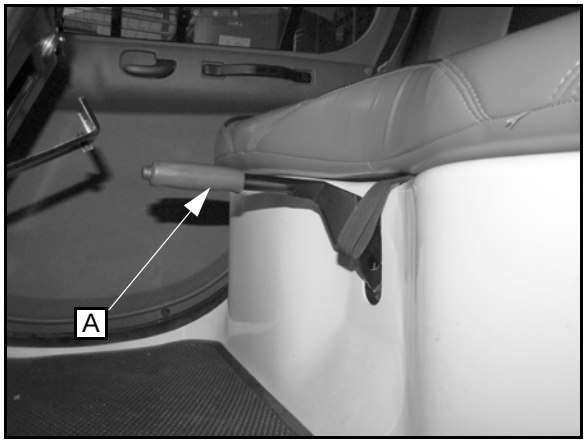
1. Position trailing shoe on center of locating post and onto wheel cylinder.
2. Position leading shoe on center of locating post and onto wheel cylinder.
3. Install upper return spring.
4. Install lower anchor spring.
5. Install automatic adjuster spring.
6. Install pins and new clips onto retention pins at center of each shoe.
7. Install drum assembly.
8. Install rear tire and wheel assembly. See Wheel and Tires section.

PARKING BRAKE LEVER ASSEMBLY

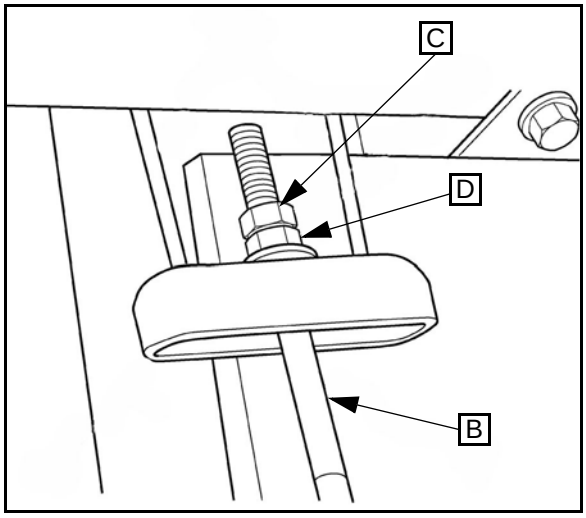
PARKING BRAKE LEVER REMOVAL (e2, eS, eL, eLXD)

> **WARNING**
>
> Use caution when working near batteries. Always position master disconnect switch OFF and cover battery terminals to prevent electrical shock. Accident contact with battery terminals can result in damage or personal injury.

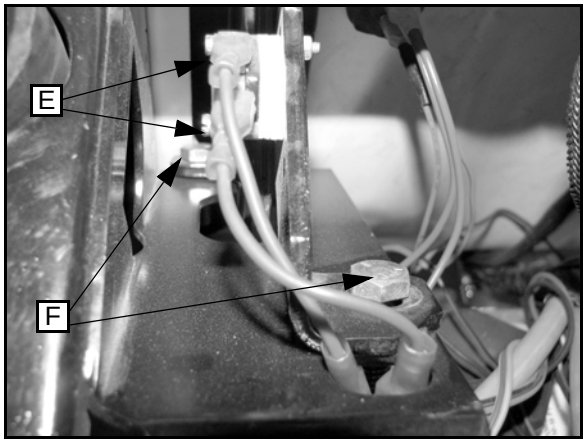
1. Chock wheels.
2. Remove lower seat. See Bench Seat in Body section.
3. Position master disconnect switch OFF.
4. Cover battery terminals to prevent electrical contact.
5. Release parking brake lever (A).



6. Locate threaded adjusting rod/cable assembly (B) at lever end.
7. Remove rear jam nut (C) and front jam nut (D) from adjusting rod/cable assembly (B).



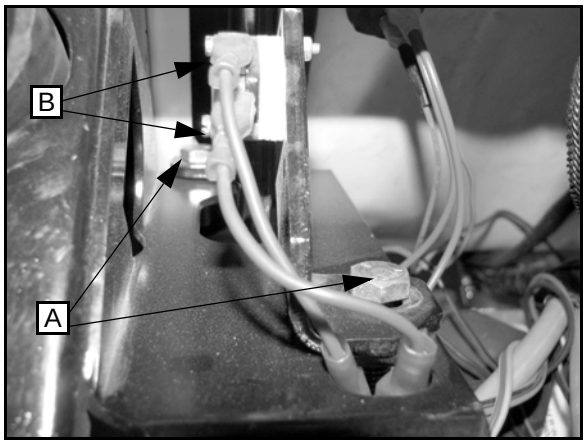
8. Disconnect parking brake switch wires (E) from switch terminals.



9. Remove two mounting bolts (F) from parking brake lever brackets.
10. Remove parking brake lever.

PARKING BRAKE LEVER INSTALLATION (e2, eS, eL, eLXD)

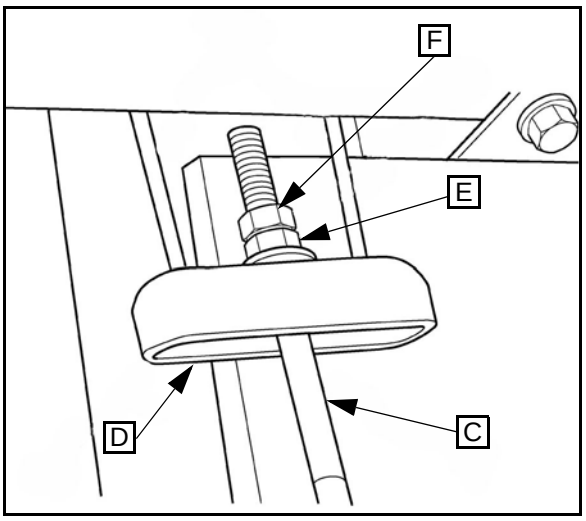
1. Position parking brake lever and install two mounting bolts (A) through parking brake lever brackets.



2. Connect parking brake switch wires (B) to proper terminals on switch: Red/White on center terminal, and Tan on upper (most forward) terminal.

9924112 - 2013 GEM Service Manual

3. Insert adjusting rod/cable assembly (C) into parking brake cable equalizer (D).



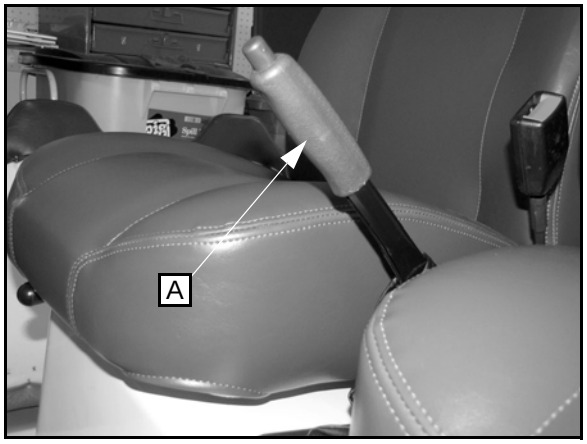
4. Install front jam nut (E) and rear jam nut (F) onto from adjusting rod/cable assembly (C).
5. Adjust tension on parking brake cables. See Parking Brake Cable Tension Adjustment in this section.
6. Uncover battery terminals.
7. Install lower seat. See Bench Seat in Body section.
8. Position master disconnect switch ON.

PARKING BRAKE LEVER REMOVAL (e4, e6, e6S)

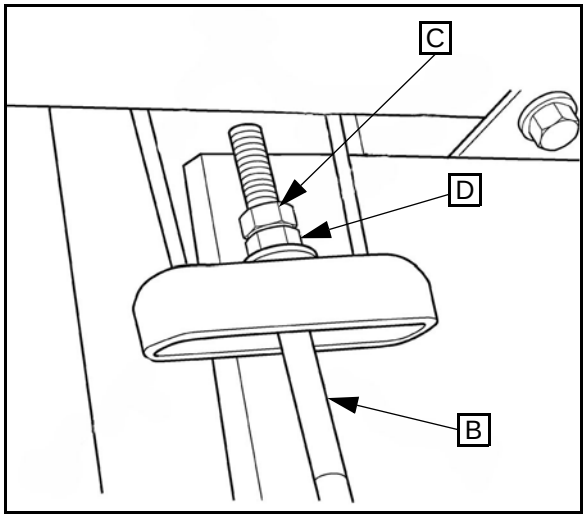
WARNING

Use caution when working near batteries. Always position master disconnect switch OFF and cover battery terminals to prevent electrical shock. Accident contact with battery terminals can result in damage or personal injury.

1. Remove parking brake lever boot.
2. Release parking brake lever (A).

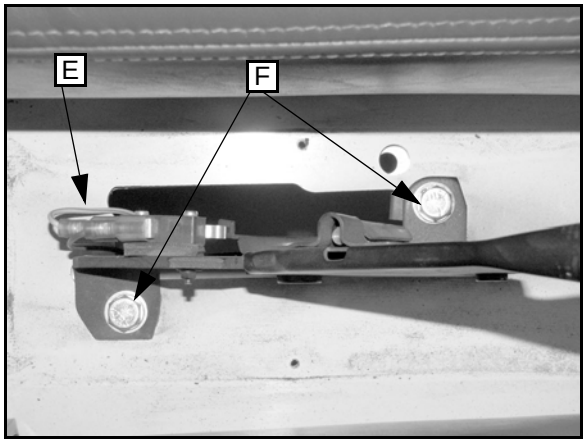


3. Raise and support vehicle on suitable hoist.
4. Locate threaded adjusting rod/cable (B) at end of parking brake lever.



5. Remove rear jam nut (C) and front jam nut (D) from adjusting rod/cable assembly (B).

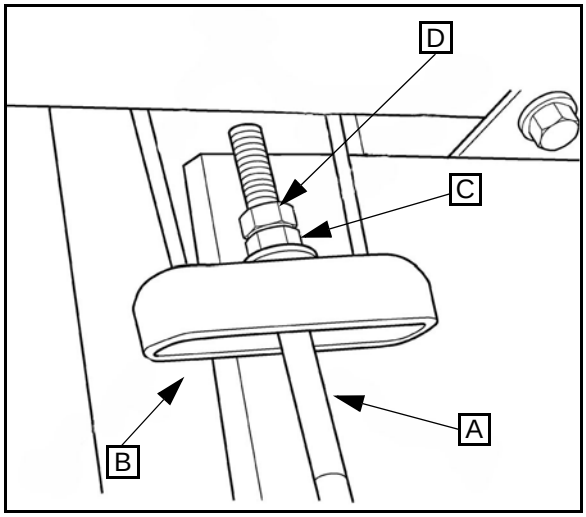
6. Disconnect parking brake switch wires (E) from switch terminals.



7. Lower vehicle.
8. Remove two mounting bolts (F) from parking brake lever brackets.
9. Remove parking brake lever.

PARKING BRAKE LEVER INSTALLATION (e4, e6, e6S)

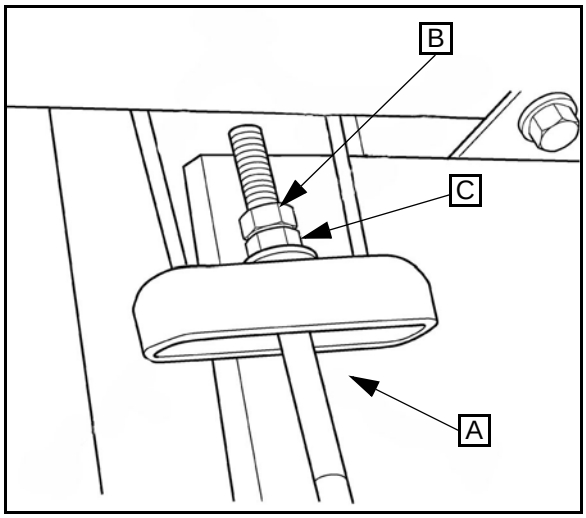
1. Position parking brake lever assembly and install two mounting bolts through parking brake lever bracket.
2. Connect parking brake switch wires to proper terminals on switch: Red/White on center terminal, and Tan on upper (most forward) terminal.
3. Insert adjusting rod/cable assembly (A) into parking brake cable equalizer (B).



4. Install front jam nut (C) and rear jam nut (D) onto adjusting rod/cable assembly (A).
5. Adjust tension on parking brake cables. See Parking Brake Cable Tension Adjustment in this section.
6. Install parking brake lever boot.

PARKING BRAKE CABLE TENSION ADJUSTMENT

1. Chock wheels.
2. Release parking brake lever.
3. Locate threaded adjusting rod/cable assembly (A) at end of lever.



4. Loosen rear jam nut (B) to release front jam nut (C).
5. Thread front jam nut (C) forward or backward as needed to adjust tension.
6. Tighten rear jam nut (B) against front jam nut (C) to lock in place.
7. Unchock wheels.
8. Apply parking brake lever and test by attempting to roll vehicle forward by pushing it. If vehicle moves, repeat cable tension adjustment procedure.

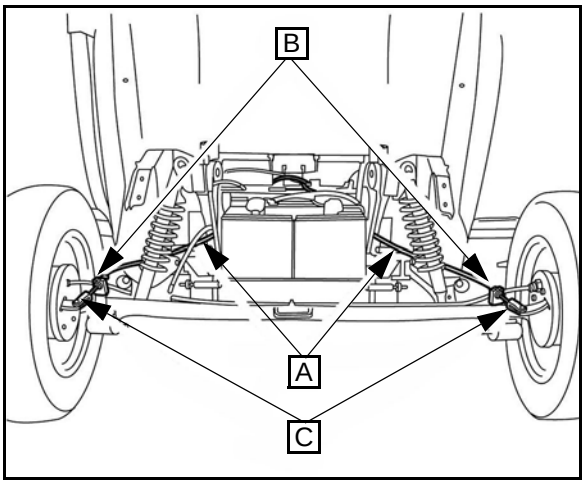
NOTE: The vehicle will not drive with the parking brake lever set. Ensure release of lever before operation.

9924112 - 2013 GEM Service Manual

PARKING BRAKE CABLE ASSEMBLY

DESCRIPTION

Two cables are attached to the parking brake lever by a tension equalizer and to the parking brake actuator levers on the rear brake assemblies.



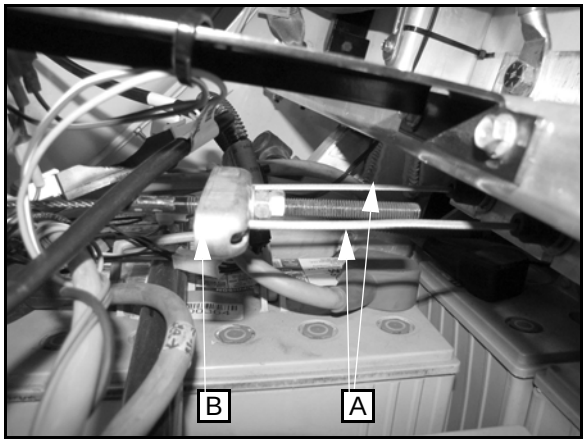
A. Parking brake cables
B. Cable mounting bracket
C. Actuator lever

OPERATION

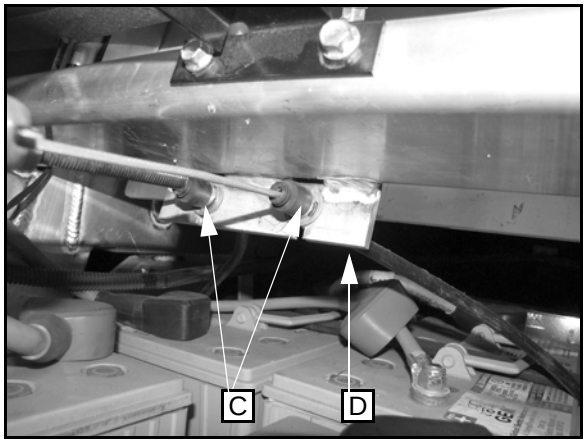
Pulling up on the parking brake lever causes the parking brake adjuster assembly to pull on the parking brake cables. A ratchet holds the parking brake lever in place, maintaining pressure on the cables. A push button on the end of the parking brake cable disengages the ratchet, allowing the lever to be returned to its normal position, thereby releasing the tension on the cables.

PARKING BRAKE CABLE REMOVAL (e2, eS, eL)

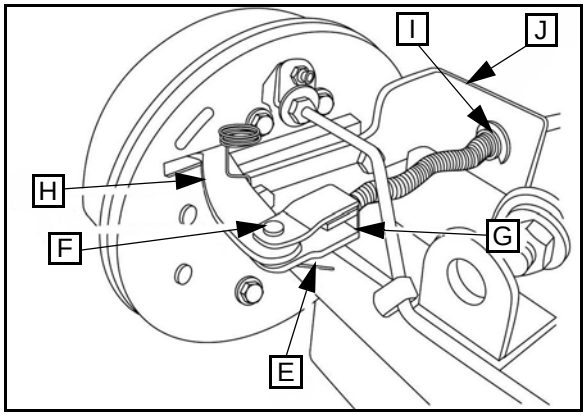
1. Chock both wheels.
2. Position master disconnect switch OFF.
3. Remove lower portion of bench seat. See Bench Seat in Body section.
4. Cover battery terminals to prevent electrical contact.
5. Release parking brake lever.
6. Release tension on parking brake cables. See Brake Cable Tension Adjustment in this section.
7. Remove parking brake cable (A) from equalizer (B).



8. Remove retaining ring (C) from cable retainer (D) on frame.



9. Remove cotter pin (E), clevis pin (F), and cable end (G) from actuator lever (H).

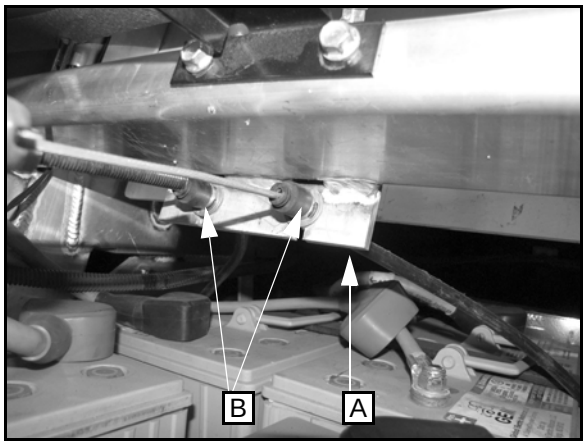


10. Remove retaining ring (I) from cable mounting bracket (J).
11. Remove parking brake cable (A).

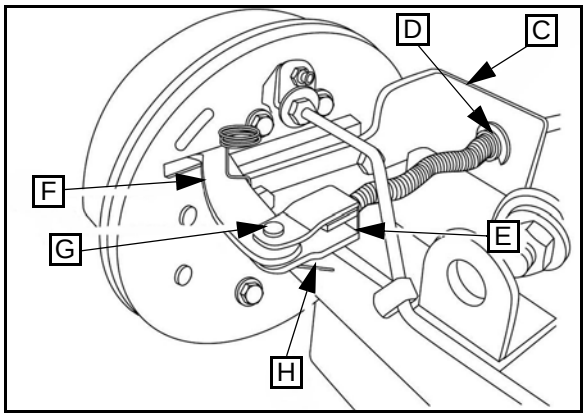
9924112 - 2013 GEM Service Manual

PARKING BRAKE CABLE INSTALLATION (e2, eS, eL)

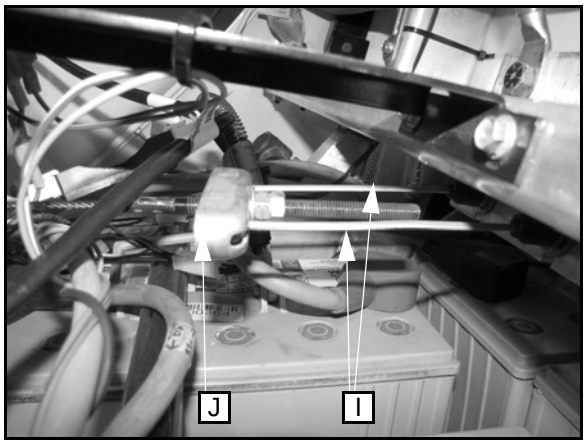
1. Install parking brake cable into front cable retainer (A) on frame and attach with retaining ring (B).



2. Install parking brake cable into cable mounting bracket (C) and attach with retaining ring (D).



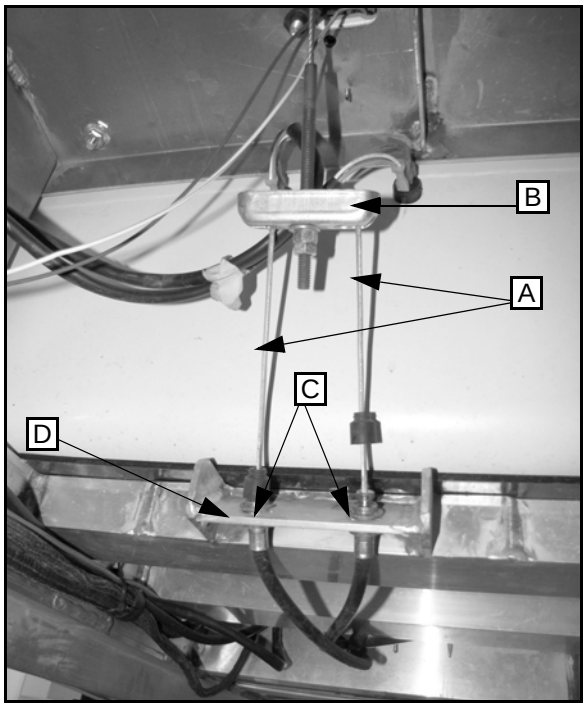
3. Position cable end (E) over actuator lever (F).
4. Install clevis pin (G) and cotter pin (H) to attach cable end to actuator lever.
5. Insert parking brake cable (I) into equalizer (J).



6. Adjust tension on parking brake cable. See Parking Brake Cable Tension Adjustment in this section.
7. Uncover battery terminals.
8. Install lower portion of bench seat. See Bench Seat in Body section.
9. Position master disconnect switch ON.
10. Unchock tires.

PARKING BRAKE CABLE REMOVAL (e4)

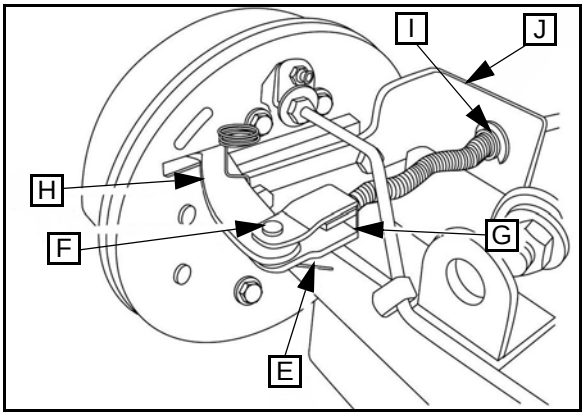
1. Raise and support vehicle on a suitable hoist.
2. Position master disconnect switch OFF.
3. Remove lower portion of bench seat. See Bench Seat in Body section.
4. Cover battery terminals to prevent electrical contact.
5. Release parking brake lever.
6. Release tension on parking brake cables. See Brake Cable Tension Adjustment in this section.
7. Remove parking brake cable (A) from equalizer (B).



8. Remove retaining ring (C) from cable retainer (D) on frame.

9924112 - 2013 GEM Service Manual

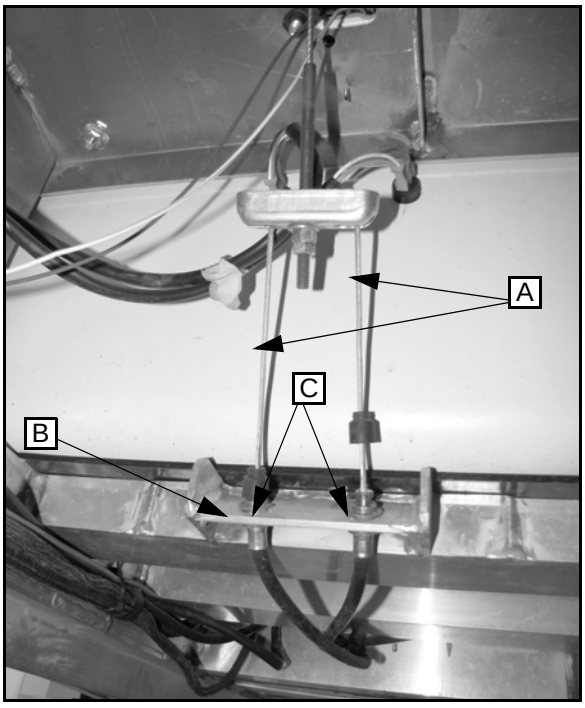
9. Remove cotter pin (E), clevis pin (F), and cable end (G) from actuator lever (H).



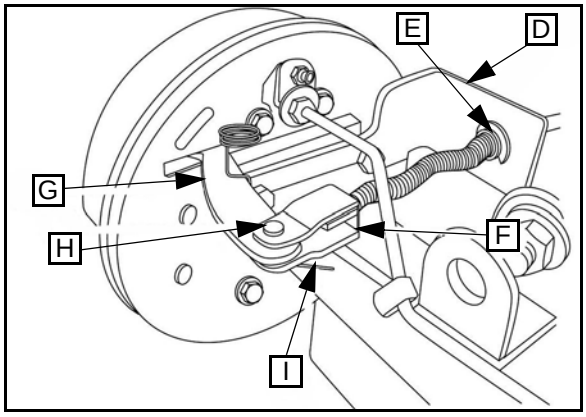
10. Remove retaining ring (I) from cable mounting bracket (J).
11. Using battery compartment area to access cable routing, remove parking brake cable.

PARKING BRAKE CABLE INSTALLATION (e4)

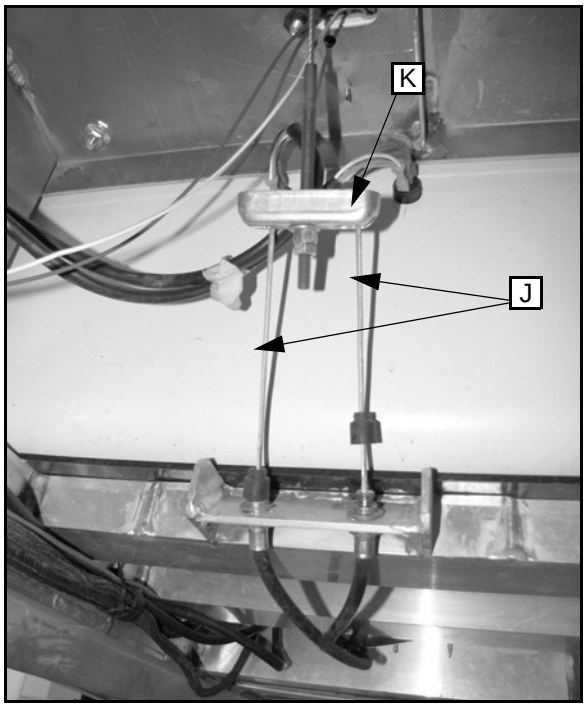
1. Using battery compartment area, install and route parking brake cable.
2. Install parking brake cable (A) into front cable retainer (B) on frame and attach with retaining ring (C).



3. Install cable into cable mounting bracket (D) and attach with retaining ring (E).



4. Position cable end (F) over actuator lever (G).
5. Install clevis pin (H) and cotter pin (I) to attach cable end (F) to actuator lever (G).
6. Insert parking brake cable (J) into equalizer (K).



7. Adjust tension on parking brake cable. See Parking Brake Cable Tension Adjustment in this section.
8. Uncover battery terminals.
9. Install lower portion of bench seat. See Bench Seat in Body section.
10. Position master disconnect switch ON.
11. Lower vehicle.

9924112 - 2013 GEM Service Manual

PARKING BRAKE CABLE REMOVAL (eLXD)

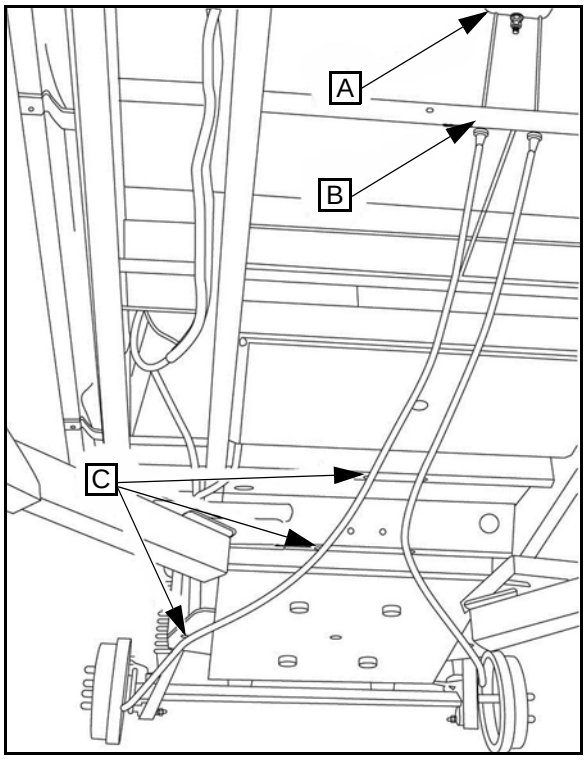
1. Position master disconnect switch OFF.
2. Remove rear wheel and tire assembly. See Wheels and Tires section.
3. Remove lower portion of bench seat. See Bench Seat in Body section.
4. Cover battery terminals.
5. Release parking brake lever.
6. Release tension on parking brake cables. See Brake Cable Tension Adjustment in this section.
7. Remove parking brake cable from actuator lever. See Rear Brake Assembly in this section.
8. Remove cable from equalizer.
9. Remove retaining ring from front backing plate.
10. Remove parking brake cable.

PARKING BRAKE CABLE INSTALLATION (eLXD)

1. Install parking brake cable into front cable retainer on frame and attach with retaining ring.
2. Attach parking brake cable to actuator lever and assemble brakes. See Rear Brake Assembly in this section.
3. Insert parking brake cable into equalizer.
4. Adjust tension on parking brake cable. See Parking Brake Cable Tension Adjustment in this section.
5. Install rear wheel and tire assembly. See Wheels and Tires section.
6. Uncover battery terminals.
7. Install lower portion of bench seat. See Bench Seat in Body section.
8. Position master disconnect switch ON.
9. Lower vehicle.

PARKING BRAKE CABLE REMOVAL (e6, e6S)

1. Remove rear wheel and tire assembly. See Wheels and Tires section.
2. Release parking brake lever.
3. Release tension on parking brake cable. See Brake Cable Tension Adjustment in this section.
4. Remove parking brake cable from actuator lever. See Rear Brake Assembly in this section.
5. Remove cable from equalizer (A).

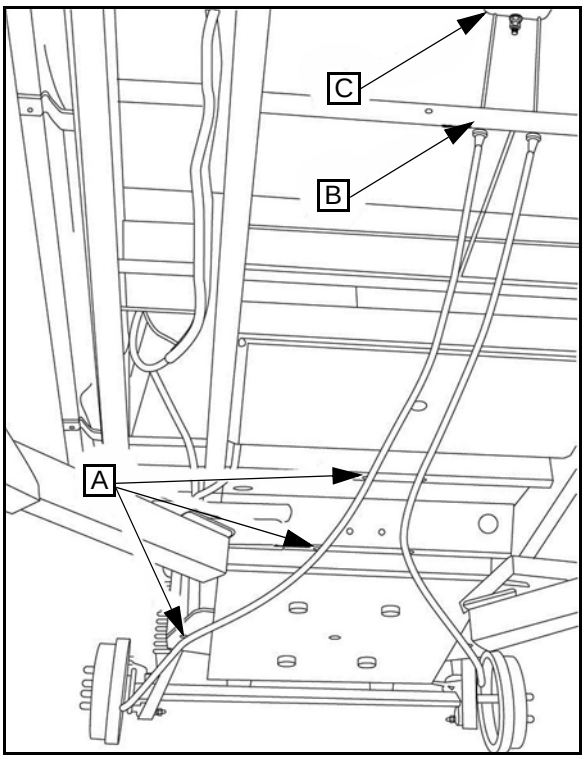


6. Remove parking brake cable from front frame backing plate (B).
7. Using drill, remove three rivets per side (C).
8. Remove parking brake cable.

9924112 - 2013 GEM Service Manual

PARKING BRAKE CABLE INSTALLATION (e6, e6S)

1. Route parking brake cable and, using rivet gun, install three new rivets (A) per side.



2. Install parking brake cable to front frame backing plate (B).
3. Attach parking brake cable to actuator lever and assemble brakes. See Rear Brake Assembly in this section.
4. Insert parking brake cable into equalizer (C).
5. Adjust tension on parking brake cable. See Parking Brake Cable Tension Adjustment in this section.
6. Install rear wheel and tire assembly. See Wheels and Tires section.
7. Uncover battery terminals.
8. Install lower bench seat. See Bench Seat in Body section.
9. Position master disconnect switch ON.
10. Lower vehicle.

9924112 - 2013 GEM Service Manual

TROUBLESHOOTING

BRAKE DIAGNOSIS

- Check the condition of tires and wheels. Damaged wheels and worn, damaged, or under-inflated tires can cause pull, shudder, vibration, and a condition similar to grab.
- If complaint was based on noise when braking, check suspension components. Rock the front and rear of the vehicle and listen for noise that might be caused by loose, worn or damaged suspension or steering components.
- Inspect brake fluid level and condition. Note that the brake reservoir fluid level will decrease in proportion to normal lining wear.

NOTE: Brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.

- If fluid level is abnormally low, look for evidence of leaks at caliper, drum assemblies, hoses and lines, and master cylinder.
- If fluid appears contaminated, drain out a sample to examine. System will have to be flushed if fluid is separated into layers, or contains a substance other than brake fluid. Use clean brake fluid to flush the system.
- Check parking brake operation. Verify free movement and full release of cables and lever. Also note if vehicle was being operated with parking brake partially applied.
- Check brake pedal operation. Verify that pedal does not bind and has adequate free play. If pedal lacks free play, check pedal for being loose or for binding condition. Do not road test until condition is corrected.
- If components checked appear OK, road test the vehicle.
- During the road test, make normal and firm brake stops in 10-20 mph range. Note faulty brake operation such as low pedal, hard pedal, fade, pedal pulsation, pull, grab, drag, noise, etc.
- Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, calipers or wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component. Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the cause of the problem.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up, worn brake pads or brake linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin brake rotors or brake drums or substandard brake lines and hoses can also cause a spongy pedal. The proper course of action is to bleed the system, and replace the worn components and substandard quality brake hoses if suspected.

HARD PEDAL / HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to brake pads or brake linings that are water soaked, contaminated, glazed, or badly worn. Pedal pulsation is caused by components that are loose, or beyond tolerance limits. The primary cause of pulsation is out of round brake rotors or brake drums. Other causes are loose wheel bearings and worn, damaged tires.

BRAKE NOISES

Some brake noise is common during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

9924112 - 2013 GEM Service Manual

BRAKE SQUEAK OR SQUEAL

Brake squeak or squeal may be due to linings that are wet or contaminated with brake fluid, grease, or oil. Glazed linings and rotors with hard spots can also contribute to squeak. Dirt and foreign material embedded in the brake lining will also cause squeak/ squeal. A very loud squeak or squeal is frequently a sign of severely worn brake pads and linings. If the pads or linings are worn through, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

Loose or worn components, or glazed/burnt linings usually cause brake chatter. Additional causes of chatter are rear brake linings not securely attached to the shoes, loose wheel bearings and contaminated brake linings.

THUMP OR CLUNK NOISE

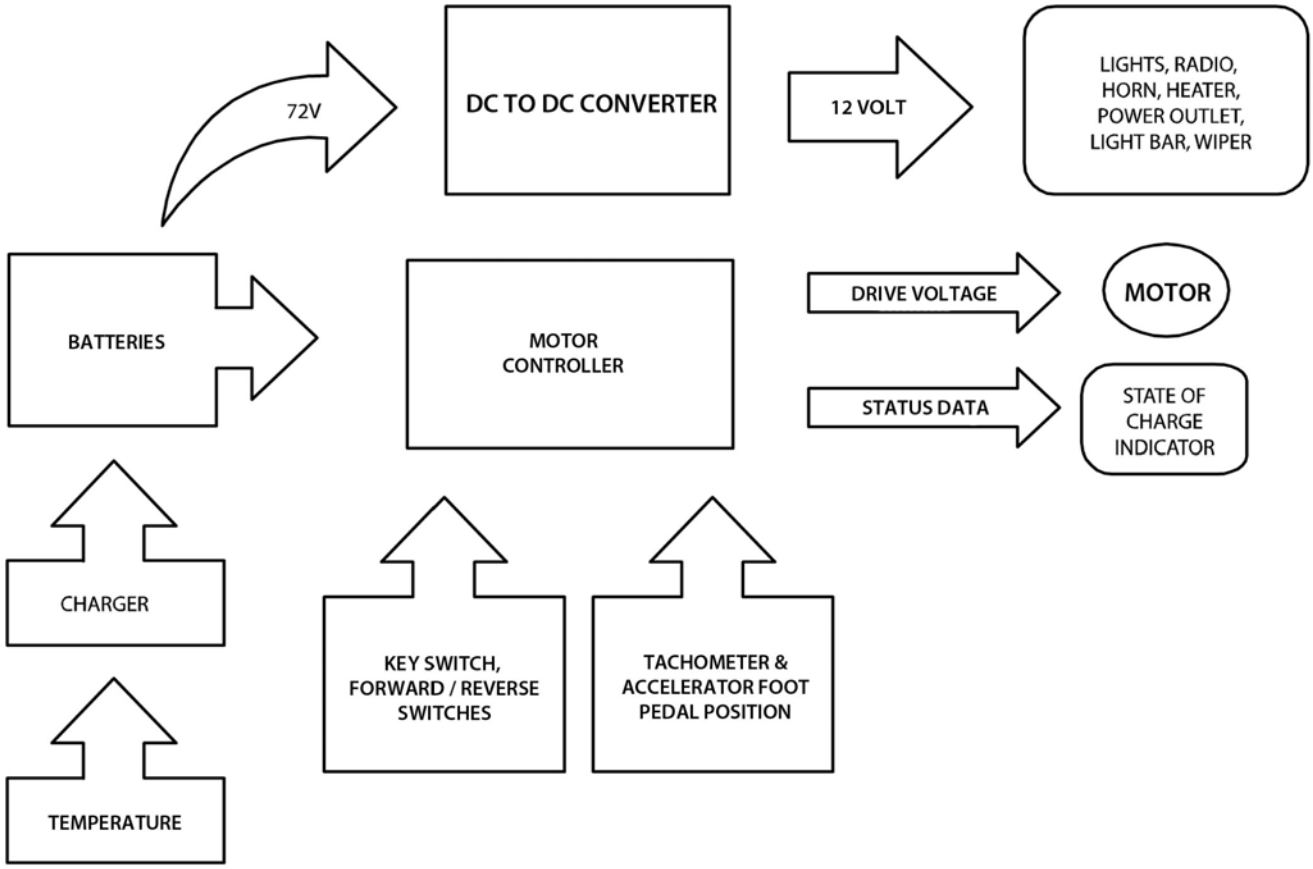
Thumping or clunking noises during braking are frequently not caused by brake components. In many cases, such noises are caused by loose or damaged steering, suspension, or engine components. However, worn out, improperly adjusted, or improperly assembled brake shoes can also produce a thumping noise.

CHAPTER 5
Electrical

9924112 - 2013 GEM Service Manual

9924112 - 2013 GEM Service Manual

ELECTRICAL SYSTEM



5

DESCRIPTION

The electrical system of the GEM car is shown in the block diagram above. For purposes of operational description, the system is divided into three groups the Power System, the Drive System and, the Accessory System.

NOTE: The master disconnect switch is located in the lower dash unit of the fuse access panel.

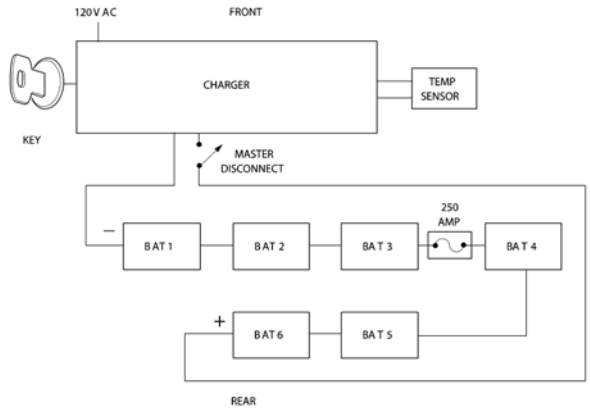
⚠ WARNING

HIGH VOLTAGE - USE CAUTION. To reduce the risk of electrical shock, personal or property damage, be sure to always turn off the Master Disconnect Switch. Allow a few minutes for the electrical system to discharge before attempting service to the vehicle. Disconnect any one of the battery cables from an accessible battery in the battery compartment. This will totally disable all 72-volt HIGH VOLTAGE power from the electrical system. Never wear loose jewelry, rings or watches. Use insulated tools to prevent shocking.

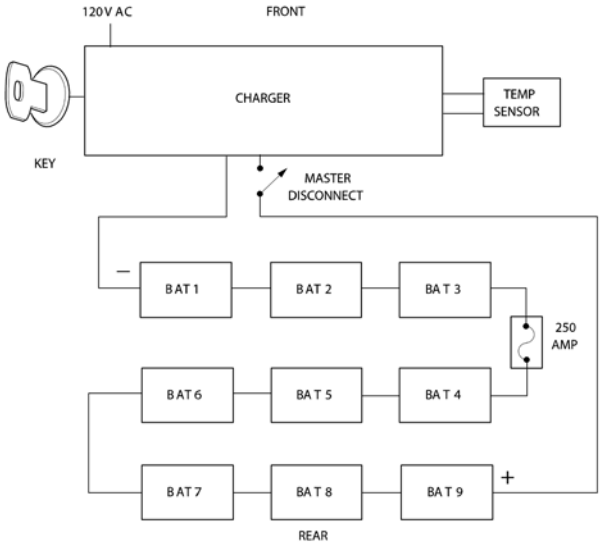
9924112 - 2013 GEM Service Manual

POWER SYSTEM

DESCRIPTION



Power System GEM e2, GEM e4, GEM eS



Power System GEM e6, GEM eLXD

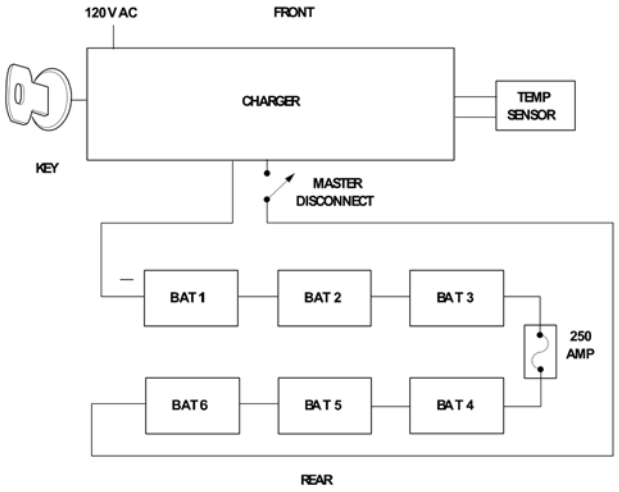
The purpose of the power system is to provide primary power for the drive and accessory systems. The power system consists of the batteries, battery charger, fuse, key switch, temperature sensor, and power harness (not shown in the block diagram). Six 12-volt or nine 8-volt (GEM e6®, GEM eL XD OPTION) series-wired lead-acid batteries and provide a total power supply voltage of 72 volts.

OPERATION

The battery charger automatically recharges the battery to 100% charge when plugged into a standard 110-volt, 15-amp-breaker outlet. When the charger is active, it prevents the vehicle from being operated. The battery charger monitors battery temperature by means of a temperature sensor. If the battery temperature reaches above 122 degrees F (49 degrees C), the charger will shut down.

DIAGNOSIS AND TESTING

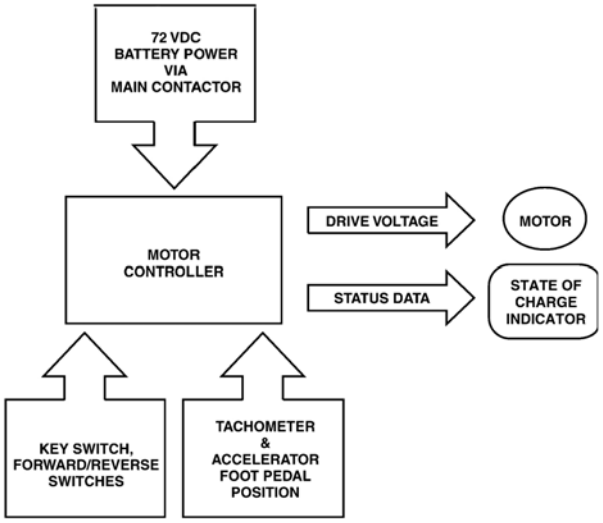
Diagnosis and testing of the power system is integrated with the diagnosis and testing of the drive system.



Power System GEM e6, GEM eL

DRIVE SYSTEM

DESCRIPTION



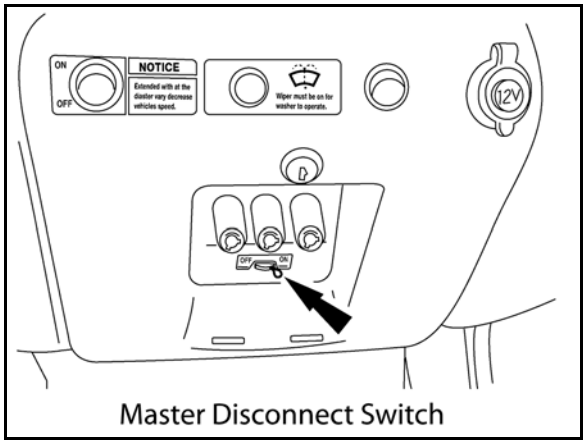
The drive system consists of the main contactor, motor controller, DC motor, state of charge indicator, tachometer, accelerator foot pedal, drive mode switch, main wiring harness and other associated wiring.

OPERATION

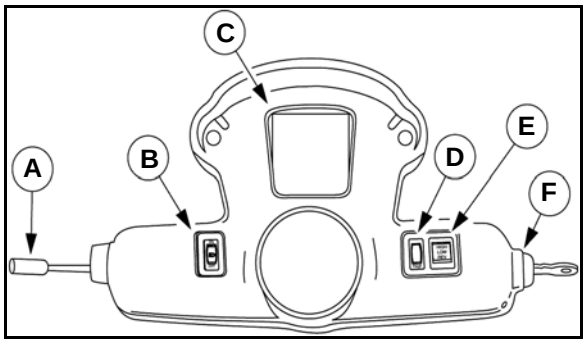
The drive system is powered by the 72 VDC generated by the batteries. If the main contactor is closed, the motor controller provides drive voltage to the motor based on inputs from the drive mode switch, motor tachometer, and the accelerator foot pedal position. The position of the drive mode switch determines vehicle direction. The variable speed, reversible, DC motor supplies mechanical drive power. Power and drive system operation is monitored by the motor controller; status information is displayed on the LCD display.

The basic operation procedures described in the Owner's Manual must be followed for the drive system to operate properly. If the drive system does not operate, verify the following steps have been completed:

- Master disconnect switch is in the ON position.
- Batteries are charged and the battery charger is not plugged in.
- Parking brake has been released.
- Key switch is in the ON position.
- After turning the key switch on, the vehicle drive mode switch has been placed in DRIVE LOW, DRIVE HIGH, or REVERSE.



Master Disconnect Switch



A. Turn signal lever, windshield wiper switch, horn button
B. Light switch
C. LCD display
D. Trip reset button
E. Vehicle drive mode switch
F. Key switch

9924112 - 2013 GEM Service Manual

DRIVE SYSTEM DIAGNOSIS AND TESTING

The purpose of this section is to aid in the isolation of problems with the drive system and power system. The primary means of troubleshooting the drive and power system is via error codes displayed on the LCD display (A). If system problems cannot be isolated by use of error codes, refer to the Drive and Power System Troubleshooting Charts in this section.

WARNING

Whenever possible, service the vehicle with the master disconnect switch turned off. If the master disconnect switch is on, to measure voltage, use extreme caution. Dangerous voltage is present. Remove all jewelry such as rings, watches, or necklaces that could contact electrical connections and conduct electricity. Severe injury, burns, or even death could occur if caution is not used.

NOTE: The information provided in this section is a guide only. There are numerous variations in the skill level of personnel that service this vehicle. This manual cannot possibly accommodate all skill levels and provide advice for each. A basic understanding of electronics and troubleshooting techniques is required.

DRIVE AND POWER SYSTEM ERROR CODES

The motor controller monitors the drive system when the vehicle is powered up (key is in the ON position). The motor controller reports any problems detected by displaying error codes on the multi-purpose LCD display located in the center of the instrument pod. Error codes are explained in the table below. Error codes are displayed by a service number and an illuminated wrench icon on the LCD display. See pages below for error code definitions.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM ERROR CODES

<table>
<tr><th>Error Code</th><th>Fault Description</th><th>Corrective Action</th></tr>
<tr><td>None</td><td>Display on the liquid crystal display (LCD) is blank.</td><td>Verify that the following fuses have continuity through the fuses. With the key and the Master Disconnect Switch (MDS) in the ON position with a voltmeter make sure there is voltage present at both sides of the fuses using chassis ground as a reference. See fuse chart below.
<table>
<tr><th>Fuse Position</th><th>Symptom</th></tr>
<tr><td>Fuse F5</td><td>No display
Vehicle Moves</td></tr>
<tr><td>Fuse F9</td><td>No display
No Movement</td></tr>
<tr><td>Fuse F10 (See also Park Brake Circuit)</td><td>Brake Light Icon ON
No Movement</td></tr>
<tr><td>Fuse F13</td><td>No display
No Movement</td></tr>
</table>
If OK, with a voltmeter check the following:

1. With the Master Disconnect Switch in the ON position, check for voltage between Display Connector IPS Harness, D2 Pin A (12 volt unswitched) and D2 pin G (12 volt ground).

2. Turn the key ON and check the voltage between D2 Pin K and D2 Pin G.

3. Both voltage checks for Steps 1 and 2 should indicate 12 volts DC present.

4. If no voltage is present, test or repair the circuit. Refer to Display Circuit diagram in this Section.

5. If voltage is present at both locations on the connector to the Display, and there are no loose connections, then the LCD may need to be replaced.</td></tr>
<tr><td>05</td><td>Start switch failed to close.</td><td>Check start switch circuit from the Motor Controller to the start switch. Start switch may be defective. Refer to START SWITCH TESTING and the MOTOR CONTROLLER CIRCUIT diagram in this Section for troubleshooting the start switch circuit.</td></tr>
<tr><td>06</td><td>Accelerator Pedal was pushed and there is improper or no contact at the Drive Mode Switch (defective switch or not in the correct position between drive mode positions).</td><td>Refer to the ACCELERATOR POTENTIOMETER TESTING and the MOTOR CONTROLLER CIRCUIT diagram in this Section for troubleshooting the Drive Mode Switch circuit.</td></tr>
<tr><td>08</td><td>Accelerator voltage input is too high on power up after initial key switch closure. Open circuit at CH1 harness Pin 8. Open potentiometer wiper at CH1 harness Pin 7.</td><td>The Accelerator Pedal input to the Motor Controller, CH1 harness, Pin 7 should be less than 0.9 VDC before pressing the pedal. If the voltage is greater than 0.9 VDC, the Accelerator Pedal may be defective. Verify continuity between CH1 harness Pins 7 and 8.</td></tr>
</table>

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM ERROR CODES (CONTINUED)

<table>
<tr><th>Error Code</th><th>Fault Description</th><th>Corrective Action</th></tr>
<tr><td>09</td><td>Improper contact at the Drive Mode Switch (defective switch as indicated by a short internally or not selected in the correct position between positions). Check for moisture in the switch.</td><td>Refer to the Motor Controller Circuit diagram for troubleshooting the Drive Mode Switch. Check for voltage present. See Drive Mode Switch chart below with Controller Connector unplugged.
<table>
<tr><th>Position</th><th>Pin 4</th><th>Pin 5</th><th>Pin 6</th></tr>
<tr><td>HI</td><td>0</td><td>0</td><td>72V</td></tr>
<tr><td>LOW</td><td>72V</td><td>0</td><td>0</td></tr>
<tr><td>REV</td><td>0</td><td>72V</td><td>0</td></tr>
</table>
Verify the switch is bad.</td></tr>
<tr><td>11</td><td>Accelerator Pedal was pushed when the car was first turned on. Code 11 sets while driving.</td><td>Release the accelerator pedal, select a drive mode and then push the accelerator pedal.
Check accelerator circuit and pedal assembly. (See accelerator pedal diagnosis and testing.)
Check parking brake lever microswitch – remove red/white and tan wires and connect these wires together to bypass this circuit. Check key switch. Unplug the 3-wire connector to the back side of the key switch. Put a jumper wire between the red/white and white wires to bypass this circuit.</td></tr>
<tr><td>14</td><td>Rolling Radius or Gear Ratio or Top Speed parameters are out of limits for the motor.</td><td>Rolling Radius or Gear Ratio or Top Speed parameters are out of limits for the motor. Reprogram the Controller function settings to the proper values.</td></tr>
<tr><td>15</td><td>Low battery pack voltage (less than 68.3 VDC).</td><td>Charge the car (see Charger in this section for instructions on charging the battery).</td></tr>
<tr><td>16</td><td>Battery pack voltage is greater than 86 VDC.</td><td>Check the battery pack. Verify that the proper voltage is present (see Step 4 of the Drive System Troubleshooting Chart for instructions on checking battery voltage). If the voltage is over 86 VDC, try running the headlights for a little while to drain the battery charge. Position key switch OFF for ten seconds and re-position ON. If the voltage is below 86 VDC and the code still displays, there is a problem with the sensing circuit in the motor controller.</td></tr>
<tr><td>21</td><td>Problem with the accelerator pedal wiring.</td><td>See Accelerator Pedal – Diagnosis and Testing</td></tr>
<tr><td>23</td><td>Motor field current is too high when the start switch is closed and the reverse drive mode is selected.</td><td>Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.</td></tr>
<tr><td>24</td><td>Motor field current is too high when the start switch is closed and the forward drive mode is selected.</td><td>Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.</td></tr>
</table>

DRIVE AND POWER SYSTEM ERROR CODES (CONTINUED)

Error Code	Fault Description	Corrective Action
27	The 12 volt bus voltage is too low from the controllers internal power supply.	Verify 72 volts to Pins 1 and 2 of 23-pin connector of controller. **POSSIBLE CAUSE** Discharged Battery. - Check battery to insure proper state of charge. Voltage may be dropping below 15V under load. - Loose connection at P1. Insure the wire connection at P1 is tight. Shorted Motor Tachometer: - Disconnect tachometer/speed sensor and run control. If status Code 27 does not appear, check tachometer. - Defective control. - Replace controller unit.
41	Open thermal protector or transistor over temperature. Voltage at thermal protector internal to controller is too low.	The Motor Controller is in thermal cutback. Allow cooling and the status code should disappear. If the problem persists after the Motor Controller has cooled, contact Technical Support at 1.866.764.0616. **POSSIBLE CAUSE** Control is in thermal cut back. - Allow control to cool, status code should disappear. - Defective control. - Replace controller unit.
42	Motor armature offset voltage is too high.	Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.
43	Motor Armature offset voltage is too low internal to the controller.	Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM ERROR CODES (CONTINUED)

Error Code	Fault Description	Corrective Action
44	Armature transistor did not turn off properly internal to the controller.	Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.
45	Armature transistor did not turn on properly internal to the controller.	Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. Replace the motor controller. If Motor tests ok, replace Controller. If Motor tests bad, replace Motor and retest operation.
46	“Look ahead” test for motor controller A2 voltage is less than 12.5% of battery voltage.	This status code will be displayed if the voltage at A2 is less than 12.5% of battery voltage and the current is greater than 52 amps when the controller is in the neutral state. This can be caused by a short circuit from motor armature to the frame. Test for a short by opening the main disconnect switch and using an ohmmeter to measure between motor controller A2 and ground; there should be an open circuit (greater than 5000 ohms.) If there is a short, check the wiring, and remove the short. If there is not a short, replace the motor controller.
49	Motor field current is too low during the run mode.	This status code will be displayed if the current draw in the motor field is less then 1.3 amps and the armature current is greater than 100 amps for more than 1.27 seconds during the run mode. Check wiring between the motor controller and the motor field connections (F1 and F2). Check for an open field winding of the motor as well F1-F2 = 1.0-1.3 ohms (if so replace motor). Replace the motor controller.
51	Motor controller is not getting 72 volts.	First go through the Drive and Power System Troubleshooting Chart A. If directed back to the Drive and Power System Error Code Chart perform the following procedure. Note: Between each step, if the code appears the code will need to be cleared. To clear the code turn the key and Master Disconnect switch (MDS) off for 15 minutes. Make sure Emergency Brake is on. Turn on MDS and then the key switch. Did Code 51 appear? If it does the motor controller has failed, which may be caused by a shorted motor. Replace the controller, remove and inspect motor for shorting or burnt windings, If the code 51 does not appear, check for burnt contactor points. One way is to do a voltage drop test across the points. There should not be any more than a few millivolt drop (or tenths of a volt). Next try driving the car in each mode Reverse, Low and High, Did the code set? If it did, clear the code. Make sure the key and the MDS are off. Remove and insulate the F1, F2, A1, and A2 wires from the motor. Turn on the MDS, key, and try driving the car in Reverse, Low, and High. Did the code 51 appear? If not, the motor is shorted and should be replaced. If the code 51 does appear the controller has failed because of a shorted motor. Replace both motor and controller. Perform continuity checks to Motor between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing.

DRIVE AND POWER SYSTEM ERROR CODES (CONTINUED)

Error Code	Fault Description	Corrective Action
57	Motor controller motor current sensor input is too low while running.	First go through the Drive and Power System Troubleshooting Chart A. If directed back to the Drive and Power System Error Chart perform the following procedure. Note: Between each step if the code appears, the code will need to be cleared. To clear the code, turn the key and Master Disconnect Switch (MDS) off for 15 minutes. Make sure Emergency Brake is on. Turn on MDS and then the key switch. Did Code 57 appear? If it does the motor controller has failed, which may be caused by a shorted motor. Replace the controller, remove, and inspect motor for shorting or burnt windings. If the Code 57 does not appear, check for burnt contactor points. One way is to do a voltage drop test across the points. There should be no more than a few mill-volt drop (or tenths of a volt). Next, try driving the car in each mode: Reverse, Low and High. Did the code set? If it did, clear the code. Make sure the key and the MDS are off. Remove and insulate the F1, F2, A1, and A2 wires from the motor. Turn on the MDS, key, and try driving the car in Reverse, Low, and High. Did the Code 57 appear? If not, the motor is shorted and should be replaced. If the Code 57 does appear the controller has failed because of a shorted motor. Replace both motor and controller. Perform continuity checks to Motor between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing.
64	Control detects that the line driver input (P2-P17) is less than 12% battery volts when the key switch is turned ON.	Open wire to Pin 17 primary winding of the Main Contactor. Shorted Line driver transistor. See Troubleshooting Diagram A.
65	Current limit in the line contactor coil is exceeded during run mode. The line contactor will drop out and the key switch will have to be recycled to reset the control.	Shorted line contactor coil. Short between the wires connected to the line contactor coil (wires between Pins 17 and 2 of the motor controller). See Troubleshooting Diagram A. If the line contactor coil resistance is correct, replace the motor controller unit.
66	Field transistor exceeds its current limit. The line contactor will drop out and the key switch will have to be recycled to reset the control.	Verify the controller outputs and the motor inputs are not shorted. Perform continuity checks between F1-F2 = 1.0-1.3 ohms, A1-A2 = 0.2-0.7 ohms, and A1 A2 F1 F2 have no continuity to the chassis or motor housing. If Motor tests ok, replace Controller.
76	Capacitor voltage is too high during regenerative braking.	Stop vehicle. Shut off key switch and master disconnect switch. Wait several minutes turn back on. If code reappears replace the motor controller. If code appears while driving monitor voltage at Controller NEG and POS. If voltage exceeds 96 volts on deceleration or driving downhill with regenerative braking or batteries are fully charged, this may be normal until further discharge to battery pack.

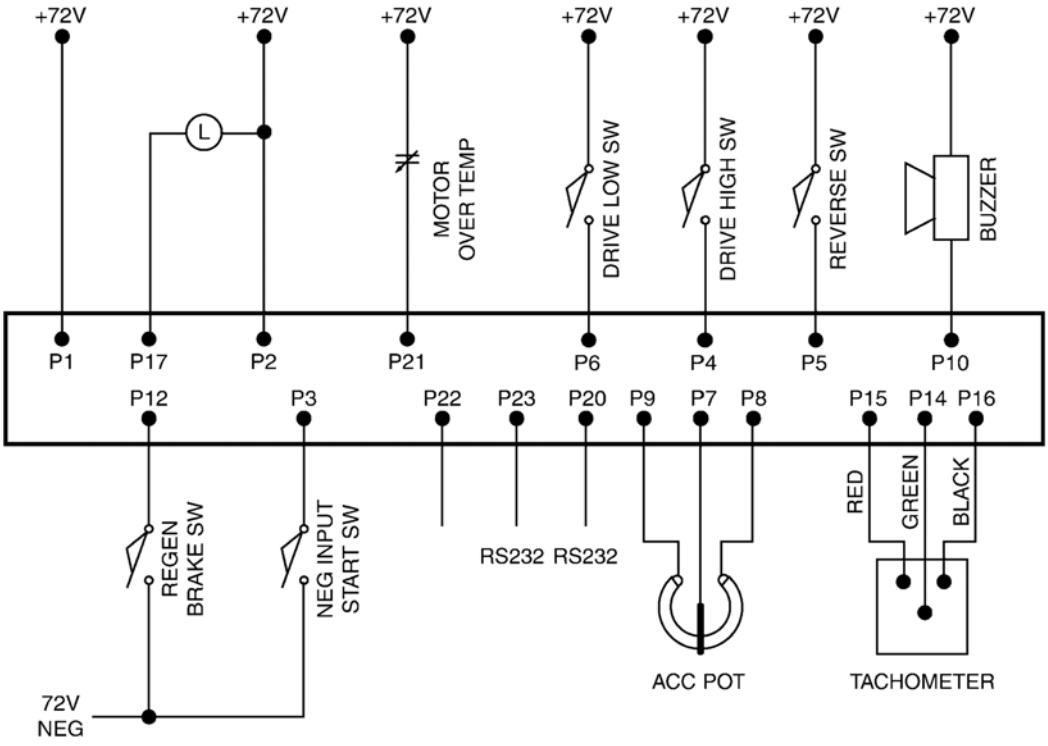
9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM ERROR CODES (CONTINUED)

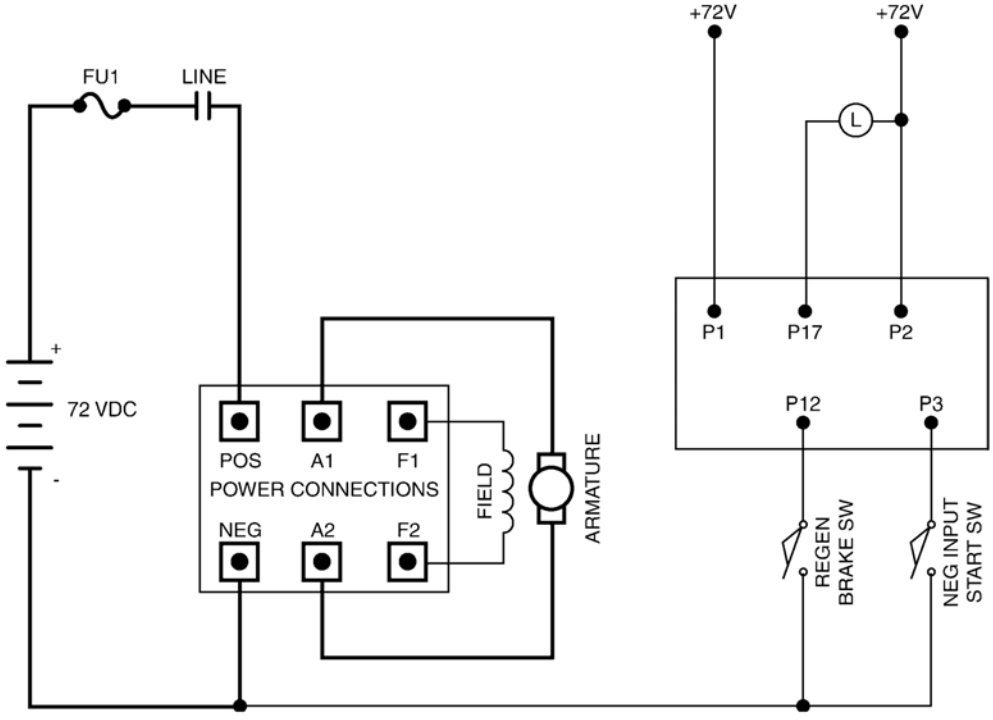
Error Code	Fault Description	Corrective Action
77	Capacitor voltage too high during motoring.	Stop vehicle. Position key switch and master disconnect switch OFF. Wait several minutes re-position ON. If code reappears, replace motor controller.
81	No tachometer signal is detected.	Defective wiring between tachometer and the motor controller. See Troubleshooting Diagram A. Replace tachometer. Motor armature sensor magnet may be fractured. Verify tachometer and controller wiring circuit. Replace tachometer/speed sensor or motor.
82	Armature current exceeds 280 amps for 3.5 seconds and the accelerator pedal is calling for maximum performance in the control mode.	Continued operation of vehicle in high motor current condition. Operating control at stall motor current for more than 3.5 seconds. Function 16 is incorrectly adjusted for control % on time. - Adjust function per OEM instructions. See Troubleshooting Diagram C. Shut off key switch and set emergency parking brake. Turn master disconnect switch off for 60 seconds. Turn everything back on and verify operation. Load test batteries (see procedures in this section). See Error Code 81. No input signal from tachometer (Speed Sensor) can cause Code 82.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM TROUBLESHOOTING DIAGRAMS



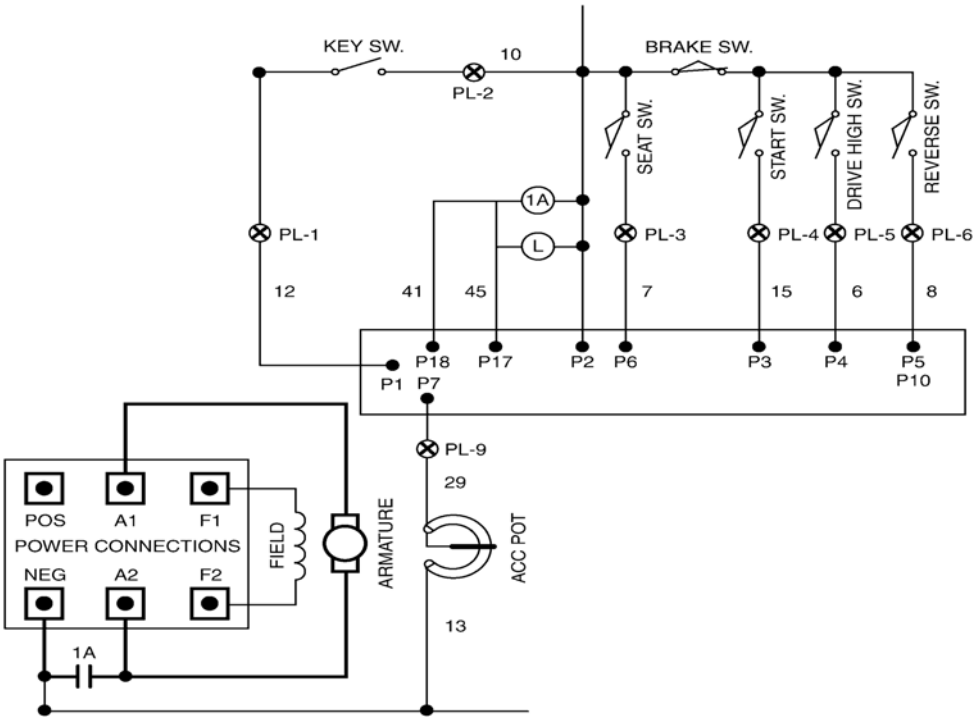
Troubleshooting Diagram A



Troubleshooting Diagram B

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM TROUBLESHOOTING DIAGRAMS (CONTINUED)



Troubleshooting Diagram C

DRIVE AND POWER SYSTEM TROUBLESHOOTING CHARTS

The Drive and Power System Troubleshooting Chart A should be used as a guide to isolate electrical problems with the batteries, master disconnect switch, main contactor, and motor controller that are not covered by the fault codes. Drive and Power System Troubleshooting Chart B should be used to as a guide to isolate problems with the motor, motor magnets, tachometer, and LCD. For problems with the lights, horn, heater, light bar, power outlet, radio, or wiper, refer to the Accessory System Troubleshooting Chart.

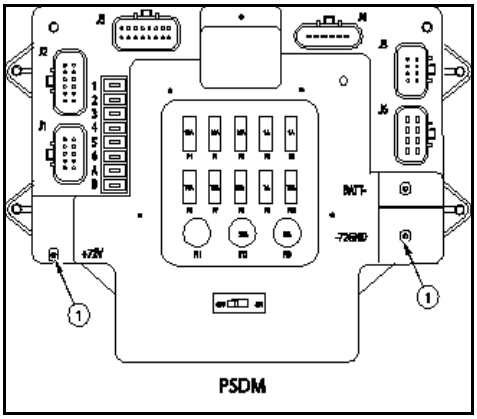
DRIVE AND POWER SYSTEM TROUBLESHOOTING CHART A

NOTE: All DC voltage measurements should be taken with respect to motor controller NEG terminal (72 VDC) or chassis ground (12 VDC).

Step	Action	Yes	No
1	Prior to turning the key switch to the ON position, verify the following: - Vehicle battery charger is not connected to AC power - Master disconnect switch is turned on - Accelerator pedal is not depressed Are all conditions met?	Proceed to Step 2.	Make the necessary correction, and try operating the vehicle again.
2	Turn the key to the ON position. Apply the foot brake, release the parking brake, depress and release the accelerator pedal. Did you hear a clunk sound from the contactor under the dash?	Proceed to Step 3.	Proceed to Step 4,
3	Are any error codes displayed on the LCD?	Stop and use the DRIVE SYSTEM ERROR CODES to isolate the vehicle fault.	Proceed to Step 4.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM TROUBLESHOOTING CHART A (CONTINUED)

Step	Action	Yes	No
4	Remove the upper and lower dash panels and locate the power signal distribution module (PSDM). Measure the voltage on the PSDM at the measuring points indicated.  Is the voltage approximately 72 VDC?	Proceed to Step 5.	If voltage is present, but less than 70 VDC, charge the batteries. If no voltage verify the Main fuse is not Open. (Main 250A fuse is located under the bench style seat toward the passenger side on the frame above the batteries.) Turn the Master Disconnect Switch OFF and ohm the fuse. If no voltage check voltage from Battery 1 negative to battery 6 positive (or Battery 9 positive for e6® option or eL XD Models). If voltage is low check individual battery voltages and cabling.
5	Check Brake icon on Display; is icon illuminated with the Park Brake lever in the up position? Does the icon disappear when the Park Brake lever is down/released?	Proceed to Step 6.	Test the Parking Brake relay circuit. See Main Contactor circuit diagram in this section.
6	Apply foot brake, turn the key ON, release emergency brake, momentarily step on accelerator pedal and measure the voltage between the white wire connected to the contactor coil and 72-volt negative terminal at PSDM. Is there approximately 72 VDC?	Proceed to Step 7.	Proceed to Step 10.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM TROUBLESHOOTING CHART A (CONTINUED)

Step	Action	Yes	No
7	Measure the voltage on the black/green wire on the contactor, turn the key on, apply foot brake, release parking brake, momentarily depress accelerator pedal. Does voltage go from 72 volts to 0 volts?	Replace the contactor.	If voltage on the back/green wire stays at 72 volts proceed to Step 8.
8	Turn the master disconnect switch off. Use an ohmmeter and measure the resistance at the black/green wire connected to the main contactor coil and Pin 17 of the 23-pin connector on the top of the motor controller. Is the resistance approximately 0 ohm?	Proceed to Step 9.	Replace controller wire harness.
9	Steps 9a through 9c will verify critical inputs to the motor controller. Each must be present before the motor controller will close the main contactor. Are all critical inputs good?	Replace the motor controller.	Troubleshoot circuit(s) suggested in Steps 9a through 9c.
9a	With the key and the master disconnect switch in the ON position, measure the voltage between Pin 1 of the 23-pin connector on the top of the motor controller and the 72-volt negative terminal on the controller. Is the voltage approximately 72 VDC?	Proceed to Step 9b.	Use the Main Contactor Circuit Diagram to determine where the constant 72 VDC to the controller has been lost.
9b	Measure the voltage at Pin 2 of the 23-pin connector with the key switch in the ON position. Is the voltage approximately 72 VDC?	Proceed to Step 9c.	Use the Main Contactor Circuit Diagram to determine where the constant 72 VDC to the controller has been lost.
9c	Turn the master disconnect switch OFF. Use an ohmmeter, measure the resistance at the PSDM -72 VDC terminal and the motor controller 72 VDC ground. Is the resistance approximately 0 ohms?	All critical inputs (for contactor operation) are good.	Replace the wire between the PSDM -72 VDC terminal and the motor controller.
10	Turn the key switch ON and measure the voltage at the PSDM connector J5 Pin A. Is the voltage approximately 72 VDC?	Replace the harness between the PSDM and the main contactor coil. Refer to the Main Contactor Circuit Diagram.	Proceed to Step 10a.
10a	With the master disconnect switch off, remove Fuse 13 and check for continuity. Does the fuse have continuity?	Proceed to Step 10b.	Replace Fuse 13.
10b	With the Master Disconnect Switch ON, measure voltage at Pin H in the J5 harness connector of the PSDM. Refer to the Motor Control System circuit diagram in this section. Is voltage approximately 72 VDC?	Proceed to Step 10c.	Replace the PSDM.

9924112 - 2013 GEM Service Manual

DRIVE AND POWER SYSTEM TROUBLESHOOTING CHART A (CONTINUED)

Step	Action	Yes	No
10c	With master disconnect switch on, measure voltage at Pin 21 of the motor controller module. Is voltage approximately 72 VDC?	Replace the motor controller.	Proceed to Step 10d.
10d	Measure resistance between Pin 21 of motor controller module and Pin A of motor temperature switch. Is the resistance approximately 0 ohms?	Proceed to Step 10e.	Replace the wire harness between the motor controller and electric motor.
10e	Measure resistance between Pin A and B of the motor temperature switch. Is the resistance approximately 0 ohms?	Proceed to Step 10f.	Replace motor.
10f	Measure resistance between Pin B of the motor temperature switch and Pin H of the PSDM. Is the resistance approximately 0 ohms?	Proceed to Step 11.	Replace wire harness between the PSDM and electric motor.
11	Check Fuse 9 for continuity with the master disconnect switch OFF. Measure the voltage between Fuse 9 and ground with the master disconnect switch ON. Is the voltage approximately 12 VDC?	Proceed to Step 12.	Check Key Switch wiring. Proceed to Step 11a.
11a	With the Master Disconnect Switch ON, check voltage at PSDM connector J4, Pin C to chassis ground. Is the voltage approximately 12 volts?	Replace PSDM.	Proceed to Step 11b.
11b	With the Master Disconnect Switch ON, check voltage at main RED and BLACK wires coming from the charger. Is the voltage approximately 72 volts?	Replace DC/DC converter/charger assembly.	Check battery cabling and master disconnect switch.
12	Turn the master disconnect switch OFF and the key switch to ON. Use an ohmmeter and measure the resistance at PSDM connector J2, Pin J and PSDM connector J3, Pin A. Is the resistance approximately 0 ohms?	Replace PSDM.	Replace the key switch.

DRIVE AND POWER SYSTEM TROUBLESHOOTING CHART B

NOTE: All DC voltage measurements should be taken with respect to motor controller B- (72 VDC) or chassis ground (12 VDC).

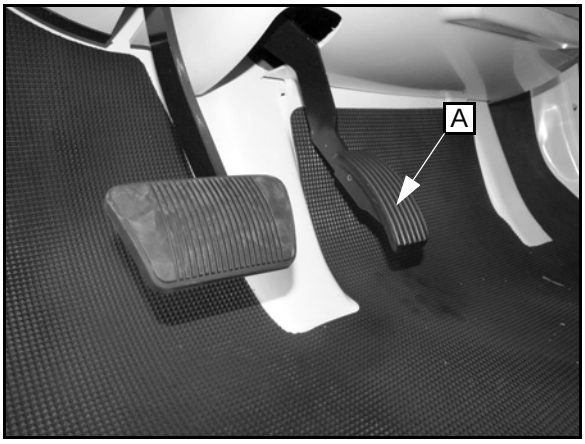
Step	Condition	Diagnostic	Correction
1	LCD does not show MPH indications when the car is moving.	Check the Tachometer for loose connections.	Check for 12 volts at the Speed Sensor on the motor between the Red wire and the Black wire. Key switch and MDS turned On. If 12 volts is present, turn the Key and MDS Off. Unplug the 23-pin connector from the top of the controller. Check the Green wire, Pin 14 from the connector to the sensor for continuity. If good, go to Step 2.
2	LCD does not show MPH indications when the car is moving. (continued)	Check the Tachometer for loose connections. (continued)	Remove the Speed Sensor. Inspect the magnet on the end of the Motor armature shaft for fractures. If the magnet is broken replace the magnetic assembly. If the magnet is Not broken, replace the Speed Sensor.
3	Vehicle operates properly, but there are no status indications or lights illuminated on the LCD.	Verify connections between the PSDM and the LCD.	Check Fuse 5 – if open; No display, but vehicle drives. Check Fuse 9 – if open; No display, vehicle does not drive. If there are tight connections and there is 12-volt and 72-volt, replace the LCD.
4	Battery charger will not charge batteries.	Verify the voltage to the battery charger (110 VAC).	If voltage was not present, connect AC power and try charging the batteries again. If the batteries will not charge, go to Step 5.
5	Battery charger will not charge batteries and voltage to the battery charger (110 VAC) has been verified.	Observe the Indicator/ Status lights on the side of the charger unit.	Refer to Charger Fault codes in this section.
6	Battery charger will not charge batteries, voltage to the battery charger (110 VAC) has been verified, and the Temperature Sensor has been verified.	Verify voltage of each battery is greater than 11.5 VDC for 12-volt batteries or 7.5 VDC for 8-volt batteries.	For any battery lower than recommended levels, turn OFF the MDS and charge each battery individually using an Alternate Charge Method. See CHARGING WHEN BELOW MINIMUM VOLTAGE in this Section.
7	The Power Cord plug icon on the LCD is illuminated with the car unplugged from charging. Car will not move.	With AC cord still unplugged, verify voltage on the Green wire at PSDM connector J1 Pin J. Check for 72 volts.	If there is No voltage present, check for 72 volts on the Green wire of the charger harness at the spade terminal connection. If 72 volts is present check resistance between the Green wire of J1 Pin J on PSDM to the Green wire on the charger harness spade connector. Repair or replace the wire harness if resistance is more than 5 Ohms. If 72 volts is not coming from the charger in the Green wire at the spade connector, replace the charger.

9924112 - 2013 GEM Service Manual

ACCELERATOR PEDAL

DESCRIPTION

The accelerator pedal is located on the floor, close to the center of the vehicle and is used to control vehicle speed.



A. Accelerator pedal

OPERATION

Pressing down on the pedal will increase speed. Letting up on the pedal will reduce power to the electric motor and vehicle speed will slowly decrease.

ACCELERATOR PEDAL DIAGNOSIS AND TESTING

The accelerator pedal module consists of two electrical components - the accelerator pedal position sensor and the start switch. Testing for accelerator pedal position sensor and the start switch are described separately below. It may be helpful to reference the Motor Circuit electrical diagram while testing these components.

Both the accelerator pedal position sensor and the start switch are calibrated to the accelerator pedal from the factory. If testing of either component indicates a fault, the entire accelerator pedal assembly must be replaced as a unit.

ACCELERATOR PEDAL POSITION SENSOR TESTING

1. Turn the key on to provide power to the accelerator pedal position sensor.
2. Access the 23-pin connector located on the top of the motor controller (under the hood).
3. Use a voltmeter to measure the voltage at pin 7 with reference to the motor controller NEG. At idle with the accelerator pedal fully released, voltage should read 0.3-0.5 VDC. Push the accelerator pedal down; the voltage at pin 7 should gradually increase. When the accelerator pedal is completely down, the voltage should reach approximately 4 VDC. If the voltage does not vary as described, replace the accelerator pedal assembly.

START SWITCH TESTING

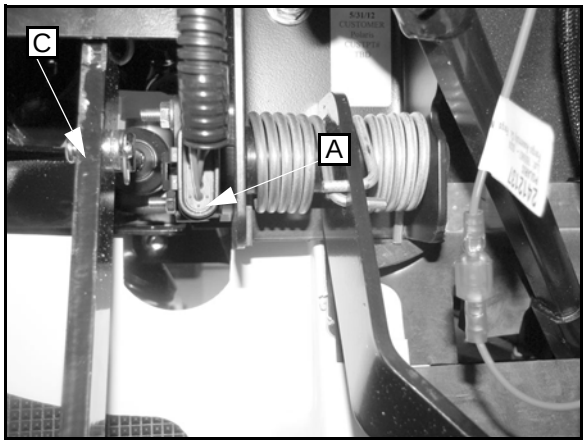
1. Turn the key on to provide power to the start switch.
2. Access the 23-pin connector located on the top of the motor controller (under the hood).
3. Use a voltmeter to measure the voltage at pin 3 with reference to the motor controller NEG. At idle with the accelerator pedal fully released, voltage should read 5.0 VDC. Push the accelerator pedal down; the voltage at pin 3 should read 0 VDC at any position off idle. If the voltage does not vary as described, replace the accelerator pedal assembly.

ACCELERATOR PEDAL REMOVAL

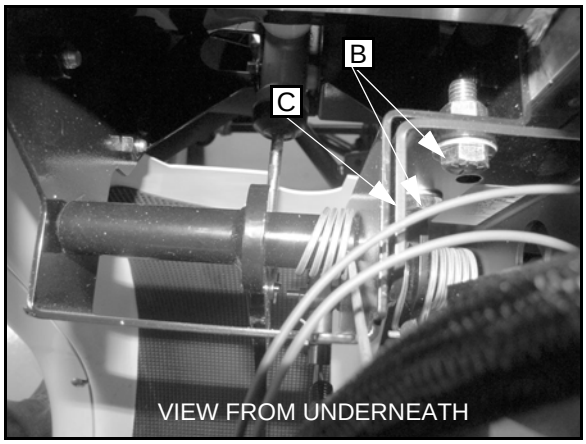
CAUTION

Exercise caution while working between dash frame supports. Wear protective gloves and clothing to prevent cuts.

1. Position key switch and master disconnect switch OFF.
2. Remove upper and lower dash panels. See Body section.
3. Disconnect foot pedal wire harness connector (A).



4. Remove two bolts (B), two flat washers, two nuts, and pedal (C).



ACCELERATOR PEDAL INSTALLATION

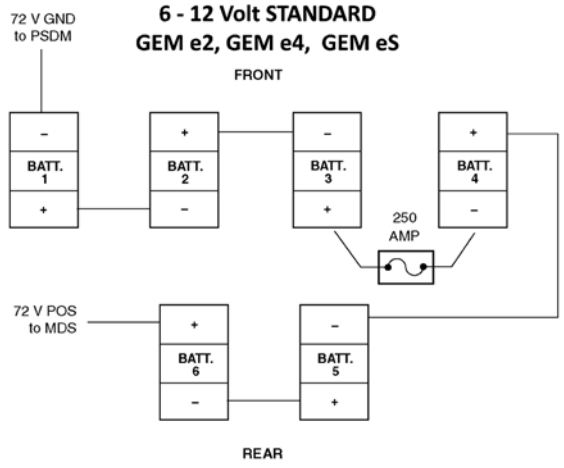
CAUTION

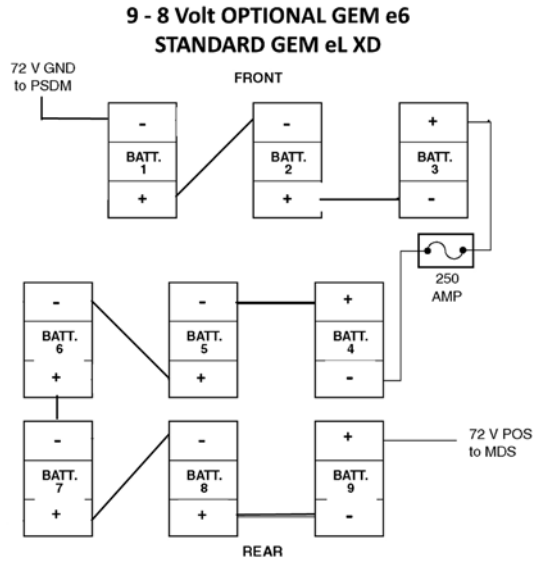
Exercise caution while working between dash frame supports. Wear protective gloves and clothing to prevent cuts.

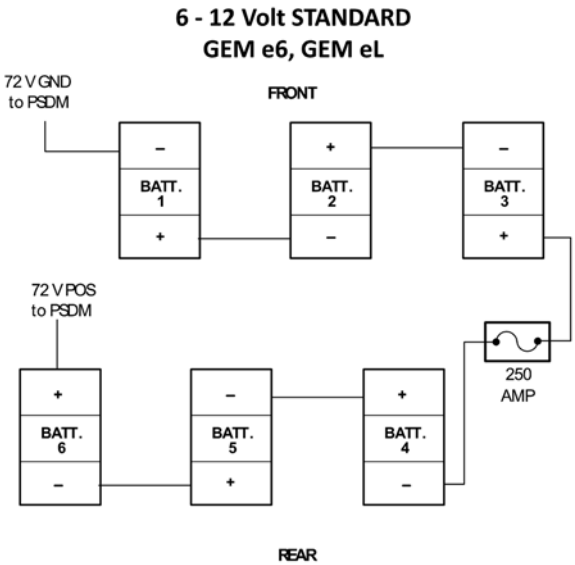
1. Install pedal, two nuts, two flat washers, and two bolts.
2. Connect foot pedal wiring harness connector.
3. Install upper and lower dash. See Body section.
4. Position key switch and master disconnect switch to ON.

9924112 - 2013 GEM Service Manual

BATTERY







DESCRIPTION

Six 12-volt lead acid (nine 8-volt 6-passenger & long back extra duty model option) batteries supply 72-volt power for the vehicle. Two are located under the spat or under the bed of the vehicle. Four are located under the front cushion on two-passenger models, and under the rear seat cushion on four-passenger models. Three under middle section bucket seat, 6-passenger models (option) and 6 batteries under the seat cushion on the 6-passenger and long back extra duty models.

The batteries supplied with the GEM electric vehicle are deep cycle marine batteries. They are designed to handle discharges down to 20-30% of their rated capacity without doing any internal damage. Since the batteries in the electric vehicle must supply 100% of the energy required for operation, they are subject to deep discharges and then must be recharged to restore their capacity. In comparison, the standard automotive battery is known as a starting, lighting, and ignition (SLI) battery. It is designed to supply a very high cranking current for a brief period and then maintains the accessory loads on the car.

NOTE: Due to the different operating characteristics of the two types of batteries, automotive type starting batteries should never be substituted in place of a deep cycle marine battery. Polaris Industries Inc., recommends factory replacement components for best vehicle performance.

BATTERY LIST

- DEKA DC31DT
- DEKA 8 G31 gel 12 volt
- DEKA 8G8VGC gel 8 volt

OPERATION

The GEM car has a battery control and recharge system specially designed for electric vehicle usage. The charging system is designed to maximize the battery pack life while recharging the pack, in the shortest time, with available household current (110-volt, 15 amp, A/C outlet). The following guidelines will insure that you get the maximum battery life and performance out of your GEM electric vehicle.

- New batteries will not deliver their full capabilities until they have been discharged and recharged 20 to 30 times. Batteries should be fully charged before first use of new vehicle and before releasing vehicle for daily use.
- Typical life cycles of the Gel batteries are 600 charge cycles at a 80% rate of discharge and flooded batteries are 200 charge cycles at a 80% rate of discharge (80% rate of discharge indicates 20% operating power left in vehicle battery pack). The charge life cycles will be doubled if the vehicle is only discharged to a 50% rate. This information should be taken in to consideration when determining battery state of health, current age and life span.
- When recharging, it is preferable to have the battery pack at close to room temperature. Do not have in direct sunlight, on hot pavement or in excess heat of 110 degrees F (43 degrees C) or higher.
- Batteries should be charged after each period of use.
- Lead acid batteries do not develop a memory and need not fully discharge before recharging.

BATTERY CODES

A - January	G - July
B- February	H - August
C - March	I - September
D - April	J - October
E - May	K - November
F - June	L - December

The number after the letter is the year in which the battery was produced.

5 - 2005	8 - 2008
6 - 2006	9 - 2009
7 - 2007	0 - 2010

BATTERY CARBON PILE LOAD TEST

Test batteries at 1/2 CCA for 15 seconds. The voltage during the load should not drop below 10.5 volts for 12 volt batteries or 6.5 volts for 8 volt batteries, and with no more than 1/2 (0.5) of a volt difference between batteries. Deka: 8G31, Gel, sealed, CCA 550 @ 0 degrees F (-17 degrees C), CA 780 @ 32 degrees F (0 degrees C), 97.6 AH, BCI group 31, Test at 275 amps. Deka: 8G8VGC Gel, sealed, CCA 400, 165 AH Test at 200 amps.

POWER BRAKING LOAD TEST

NOTE: DO NOT STALL THE VEHICLE MORE THEN ONE TIME PER BATTERY TO ALLOW FOR COOLING TIME OF THE MOTOR AND CONTROLLER.

8-Volt Battery Option GEM e6® & GEM eL XD

1. Block wheels, clear, and secure area in front and around vehicle.
2. Set voltmeter to lowest scale above 15 volts.
3. Hook voltmeter to Battery 1 negative and positive using correct polarity.
4. Set drive mode switch to DRIVE HIGH.
5. Depress and hold brake pedal solid. Release emergency park brake handle.
6. While watching voltmeter, floor and hold accelerator down.
7. In about 5 seconds, motor controller should cut off power to motor.
8. Let up on accelerator pedal and record lowest reading observed on voltmeter at or before the cut-off.
9. Position key switch to OFF.
10. Repeat Steps 3 through 9 for Batteries 2 through 9.

The batteries recorded voltages should not drop below 7 volts, and there should not be a difference of more then 1/2 (0.5) of a volt between any of the batteries or the low batteries will need to be replaced.

12-Volt Battery Only

1. Block wheels, clear, and secure area in front and around vehicle.
2. Set voltmeter to lowest scale above 15 volts.
3. Hook voltmeter to Battery 1 negative and positive using correct polarity.
4. Set drive mode switch to DRIVE HIGH.
5. Depress and hold brake pedal solid. Release emergency park brake handle.
6. While watching voltmeter, press accelerator to floor and hold.

9924112 - 2013 GEM Service Manual

7. In about 5 seconds, motor controller should cut off power to motor.
8. Reduce pressure on accelerator pedal and record lowest reading observed on voltmeter at or before cut-off.
9. Position key switch OFF.
10. Repeat Steps 3 through 9 for Batteries 2 through 6.

The batteries recorded voltages should not drop below 11.5 volts, and there should not be a difference of more than 1/2 (0.5) of a volt between any of the batteries or the low batteries will need to be replaced.

⚠ WARNING

Always wear safety glasses or approved eye protection when servicing the vehicle. Wear a full-face shield when working with batteries. Always use insulated tools when working around batteries or electrical connectors.

⚠ WARNING

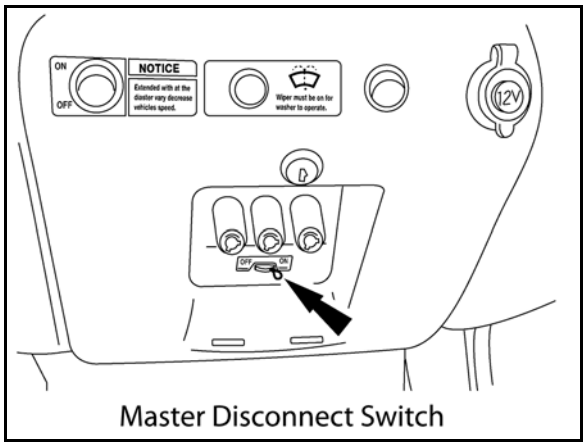
Battery fluid is a corrosive acid solution and can burn or even blind you. Don't allow battery fluid to contact eyes, skin or clothing. If acid splashes in eyes or on the skin, flush the area immediately with large amounts of water. Battery gas is flammable and explosive. Keep flame or sparks away from the battery or any other booster source with an output greater than 12 volts. Don't allow cable clamps to touch each other. Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.

⚠ CAUTION

It is essential when replacing the cables on the battery that the positive cable is attached to the positive post and the negative cable is attached to the negative post. Battery posts are marked positive (+) and negative (-) and identified on the battery case. Cable clamps should be tight on the terminal posts and free of corrosion.

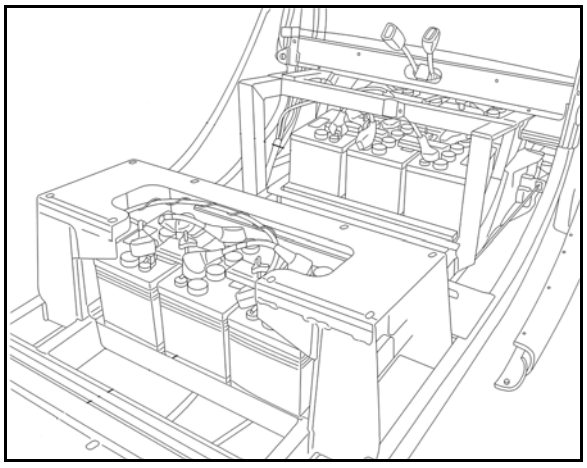
REMOVAL AND DISPOSAL

1. Position master disconnect switch OFF.



Master Disconnect Switch

2. Remove bench seat (see Bench Seats).
3. Remove the spat or utility bed. (See Spat or Utility Bed in Body section).
4. Remove floor access panel (e6 or e6S models).



5. Disconnect main negative battery cable.
6. Remove hold-downs.
7. Disconnect all cables for all front or rear batteries noting connections and locations.
8. Remove each battery.
9. Lift batteries out using proper lifting procedures or battery lifting tools.
10. Reverse procedure to install.
11. Use ecologically sound procedures to dispose of batteries.

9924112 - 2013 GEM Service Manual

BATTERY SAFETY

Improper use and care of batteries can result in serious personal injury or property damage. Always observe the following safety precautions:

- The battery produces explosive gases. Keep sparks, flame or cigarettes away. Always wear safety goggles or face shield when working near battery.
- The battery contains toxic materials. Do not damage battery case. If case is broken or damaged, avoid contact with battery contents. Neutralize acid spills with baking soda and water solution. Properly dispose of a damaged or worn-out battery. Check with local authorities for proper disposal methods.
- Do not short circuit battery. Severe fumes and fire can result.

⚠ WARNING

Explosive gasses, cigarettes, flames or sparks could cause battery to explode. Always shield eyes and face from battery. Do not charge or use booster cables or adjust post connections without proper instructions or training. Keep vent caps tight and level.

⚠ WARNING

Poison / acid causes severe burns. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. In the event of accident flush with water and call a physician immediately.

FIRST AID TREATMENTS

- **External contact:** Flush immediately with plenty of water.
- **Internal:** Call a physician immediately. Then drink large quantities of water or milk: Follow with milk of magnesia, beaten egg or vegetable oil.
- **Eye contact:** Flush with water for 15 minutes. Get prompt medical attention.

⚠ WARNING

Always wear protective clothing, gloves and goggles when handling batteries and electrolyte. Do not smoke near batteries.

RECOMMENDED EQUIPMENT

There are many tools that may help in properly caring for and maintaining batteries. Below is a list of basic items that Polaris Industries Inc. recommends for this task:

- Wrench
- Post Cleaner
- Distilled Water
- Baking Soda
- Voltmeter
- Vaseline - Battery Terminal Protectant Spray
- Hydrometer
- Goggles & Gloves
- Discharge Machine

Batteries should be carefully inspected on a regular basis in order to detect and correct potential problems before they can do harm. It is a great idea to start this routine when the batteries are first received.

1. Examine outer appearance of battery.
   - Look for cracks in the container.
   - The top of the battery, the posts, & connections should be clean, free of dirt, fluids, and corrosion. If batteries are dirty, refer to the Cleaning section for the proper cleaning procedure.
   - Repair or replace any damaged batteries.
2. Fluids on or around the battery may be an indication electrolyte is spilling, leaching, or leaking out. Leaking batteries must be repaired or replaced.
3. Check all battery cables and their connections.
   - Look closely for loose or damaged parts.
   - Battery cables should be intact. Broken or frayed cables can be extremely hazardous.
   - Replace any cable that looks suspicious.

IMPORTANT: Do not over tighten terminals. Doing so can result in post breakage, post meltdown, and internal battery damage.

4. Tighten all wiring connections to the proper specification (see below). Make certain there is good contact with the terminals.

= T

Deka 8V Gel Battery Terminals:
95 - 105 in-lbs (11-12 Nm)
Deka 12V Gel / DC31DT Battery Terminals:
120 - 180 in-lbs (14-20 Nm)

9924112 - 2013 GEM Service Manual

BATTERY TESTING

Visual inspection alone is not sufficient to determine the overall health of the battery. Both open circuit voltage and specific gravity readings can give a good indication of the battery's charge level, age, and health. Routine voltage and gravity checks will not only show the state of charge but also help spot signs of improper care, such as undercharging and over-watering, and possibly even locate a bad or weak battery. The following steps outline how to properly perform routine voltage and specific gravity testing on batteries.

NOTE: Temperature in the following section refers to electrolyte temperature not ambient temperature.

SPECIFIC GRAVITY TEST FLOODED (WATER BASED) BATTERIES

NOTE: Do not add water at this time.

1. Fill and drain the hydrometer 2 to 4 times before pulling out a sample.

NOTE: There should be enough sample electrolytes in the hydrometer to completely support the float. The float should be floating freely and not touching the sides of the cylinder.

2. Take reading of sample, record it, and return electrolyte back to cell.
3. Check all cells in battery by repeating Steps 1 and 2.
4. Replace vent caps and wipe off any electrolyte that might have been spilled.
5. Correct readings to 80° F:
   - Add 0.004 to readings for every 10° above 80°F.
   - Subtract 0.004 for every 10° below 80° F.
6. Compare readings.
7. Check state of charge using Table below.

Percentage of Charge	Specific Gravity Corrected to 80° F	Open-Circuit Voltage
100	1.277	12.73
90	1.258	12.62
80	1.238	12.50
70	1.217	12.37
60	1.195	12.24
50	1.172	12.10
40	1.148	11.96
30	1.124	11.81
20	1.098	11.66
10	1.073	11.51

The readings should be within factory specification of 1.277 ± 0.007. If not, follow the steps below.

1. Check and record voltage level(s)
2. Put battery(s) on complete charge.
3. Take specific gravity readings again.

If any specific gravity reading is still not within the factory specification, follow the steps below.

1. Check voltage level(s).
2. Perform equalization charge.
3. Take specific gravity readings again.

If any specific gravity reading is still not within the factory specification of 1.277 ± 0.007 then one or more of the following conditions may exist:

1. The battery is old and approaching end of life.
2. The battery was left in a state of discharge too long.
3. Electrolyte was lost due to spillage or overflow.
4. A weak or bad cell is developing.
5. Battery was watered excessively previous to testing.

NOTE: Batteries in conditions 1-4 should be taken to a specialist for further evaluation or retired from service.

OPEN CIRCUIT VOLTAGE TEST

For accurate voltage readings batteries must remain idle (no charging, no discharging) for at least 6 hours. Preferably for 24 hours.

1. Disconnect all loads from batteries.
2. Measure voltage using DC voltmeter.
3. Check state of charge with table below.
4. Charge battery if it registers 0% to 70% charged.

If battery registers below the table below values, the following conditions may exist:

1. The battery was left in a state of discharge too long.
2. The battery has a bad cell.

Batteries in these conditions should be taken to a specialist for further evaluation or retired from service.

Percentage of Charge	Specific Gravity Corrected to 80° F	Open-Circuit Voltage
100	1.277	12.73
90	1.258	12.62
80	1.238	12.50
70	1.217	12.37
60	1.195	12.24
50	1.172	12.10
40	1.148	11.96
30	1.124	11.81
20	1.098	11.66
10	1.073	11.51

DISCHARGE (LOAD) TEST

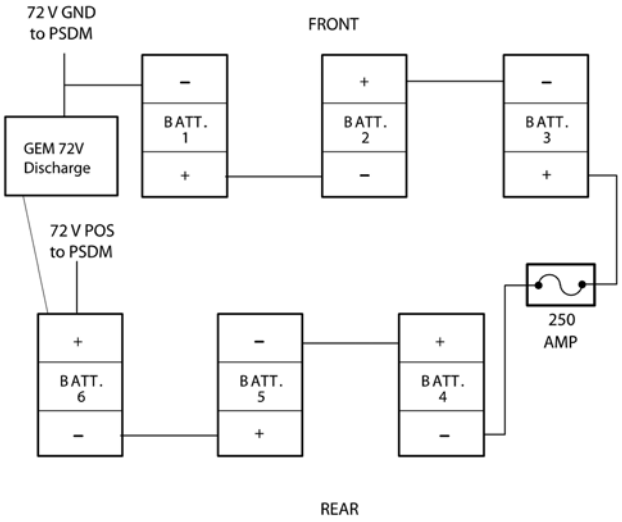
There are two reasons for using a discharge unit on a battery set:

1. To determine battery capacity.
2. To find defective cells or batteries in a battery set.

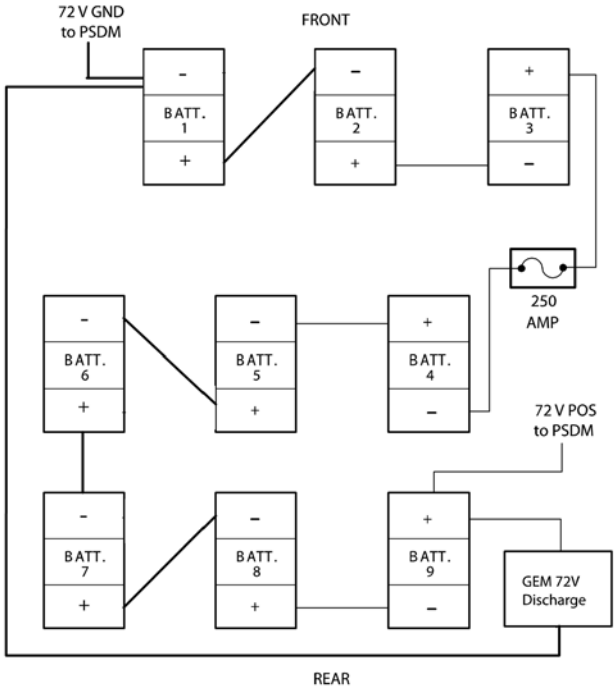
Battery energy is measured in minutes obtained upon discharging a fully charged battery set with a known resistive load at a controlled temperature until a shut-off voltage of 10.5 volts per battery for 12-volt batteries is reached, or 7 volts per battery for 8-volt batteries.

NOTE: Follow all manufacturer instructions when operating discharge units. A 72-volt discharge unit can be acquired through the SPX website, part number PL-51019, 72-volt Lester discharge unit. The discharge units are intended for use on vehicles equipped with the standard 6-12 volt battery configuration below, though is capable of operation on vehicles equipped with 9-8 volt battery configuration below. Procedure continued on next page.

6 - 12-Volt Battery Configuration



9 - 8-Volt Battery Configuration



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9924112 - 2013 GEM Service Manual

1. Fully charge batteries.
2. Position master disconnect switch OFF.
3. Connect discharge unit(s) to main +72 volts and main -72 volts.
4. After all safety procedures specified by manufacturer have been followed, start unit.
5. When unit shuts off, record discharge time.

⚠ WARNING

If the battery leads are reversed, the discharge machine will not run. However, an electrical arc could occur and result in an explosion.

CALCULATING BATTERY CAPACITY

Battery capacity is expressed by the percentage of time until shut-off voltage is reached. In order to determine the accurate capacity of a battery set, the manufacturer's rating at a 75-amp discharge rate must be known. Also, this value is only accurate for mature batteries, ones that have 50-70 cycles on them.

EXAMPLE:

- Manufacturer's rating - 56 minutes @ 75 amp
- Discharger shuts down after 42 minutes
- Battery capacity is 42/56 * 100% = 75.0%

If capacity is below 50%, batteries may be nearing the end of their life and need to be replaced. Test for defective cells.

BATTERY MODEL	MFG RATING
DC31DT	40 min at 75 amp
8G31	48 min at 75 amps
8G8VGC	75 min at 75 amps

NOTE: Manufacturer specified discharge rates are for conditioned battery packs.

TESTING FOR DEFECTIVE CELLS

During a discharge, all cells in a battery set should discharge at the same rate. If one or more of the cells decrease at a faster rate, the total discharge time may indicate an unacceptable result. Therefore, the individual batteries must be compared against the others to see if one or more of the units need to be replaced.

1. After discharge unit has shut down from previous test, start unit again.
2. Take voltage measurements across each battery while the discharger is running.
3. If one or two of the batteries differ in voltage from the other(s) by more than 0.5 volts, replace the ones with low voltages.
4. Turn discharge unit off.

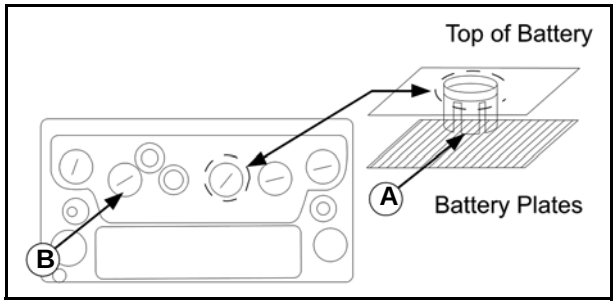
EXAMPLE:

- Battery 1: 11.0 volts
- Battery 2: 10.2 volts
- Battery 3: 10.3 volts
- Replace Batteries 2 and 3.

NOTE: Be sure to charge batteries after completing the discharge test. Leaving batteries in a discharged state causes sulfating to occur which will reduce the life of the batteries.

BATTERY WATERING

NOTE: This applies to flooded batteries only. "Flooded," means water base batteries.



A. Bottom of fill well

B. Vented cap

NOTE: Gel Batteries do not have fill wells, as they are maintenance free.

Flooded batteries need water. More importantly, watering must be done at the right time and in the right amount or else the battery's performance and longevity suffers. Water should always be added after fully charging the battery. Prior to charging, there should be enough electrolytes to cover the plates. If the battery has been discharged (partially or fully), the electrolyte level should also be above the plates. Keeping the electrolyte at the correct level after a full charge will prevent having to worry about the level at other states of charge. Depending on the local climate, charging methods, application, etc. Polaris recommends that batteries be checked once a month until you get a feel for how "thirsty" your batteries are.

⚠ WARNING

The electrolyte is a solution of acid and water. Skin contact should be avoided.

⚠ CAUTION

• Do not let the plates get exposed to air. This will damage (corrode) the plates.
• The electrolyte level should not be up inside the fill well. This may cause the battery to over-flow electrolyte during charging, resulting in a loss of capacity as well as causing a corrosive mess.
• Do not use water with a high mineral content.
• Use distilled or de-ionized water only.

1. Remove vent caps and look inside the fill wells.
2. Check electrolyte level; the minimum level is at the top of the plates.
3. If necessary add just enough water to cover the plates at this time.
4. Replace and tighten all vent caps.
5. Put battery on complete charge before adding any additional water. See Charging in this section.
6. Once charging is completed, remove vent caps and look inside fill wells.
7. Add water until electrolyte level is about 1/8 inch below bottom of fill well.
8. Clean, replace, and tighten all vent caps.

BATTERY CLEANING

After time batteries, attract dust, dirt, and grime. In addition, electrolyte expelled from the battery vent caps due to over-watering and/or overcharging can form a conductive path that will cause the batteries to discharge. Keeping them clean will help one spot trouble signs if they appear and avoid problems associated with grime.

IMPORTANT: When cleaning, do not allow any cleaning solution, or other foreign matter to get inside the battery.

1. Ensure all vent caps are tightened.
2. Clean battery top with cloth or brush and solution of baking soda and water.
3. Rinse with water and dry with clean cloth.
4. Clean battery terminals and inside of cable clamps using post and clamp cleaner.
5. Clean terminals will have bright metallic shine.
6. Reconnect clamps to terminals and thinly coat them with battery terminal protectant.
7. Keep area around battery clean and dry.

⚠ CAUTION

Never hose the batteries down with tap water. The sulfuric acid content of the electrolyte will spread to other surfaces and cause corrosive damage.

⚠ WARNING

Never add acid to a battery.

9924112 - 2013 GEM Service Manual

BATTERY STORAGE

Periods of inactivity can be extremely harmful to lead-acid batteries. When placing a battery into storage, follow the recommendations below to make sure that the battery remains healthy and ready for use.

NOTE: Storing, charging or operating batteries on concrete is perfectly OK.

SMC - STORAGE MAINTENANCE CYCLE

NOTE: Your GEM car is equipped with a SMART charge capability. Simply leave the vehicle plugged into a standard 110 VAC 15 A power outlet. The charger unit will automatically power on once every 2 weeks for gel batteries and once every 7 days for flooded, run a charge cycle and automatically shut down. The charger will repeat this procedure 24 times as long as power is not interrupted. This works best for maintenance free sealed gel batteries. Water filled lead acid batteries may still require some attention to maintain proper fluid levels.

IMPORTANT: Avoid temperature extremes when choosing a storage area.

- Avoid locations where freezing temperature is expected. Keeping batteries at a high state of charge will also prevent freezing. Freezing results in irreparable damage to battery plates and container.
- Avoid direct exposure to heat sources, such as radiators or space heaters. Temperatures above 80 degrees F (27 degrees C) accelerate the battery's self-discharge characteristics.

1. Completely charge battery before storing.
2. Store vehicle in cool, dry location, protected from elements.
3. During storage, monitor specific gravity or voltage. Batteries in storage should be given boost charge when they show 70% charge or less. See table in “Open Circuit Voltage Test”.
4. Completely charge battery before reactivating.
5. For optimum performance, equalize batteries before putting them back into service.

BATTERY CHARGING

WARNING

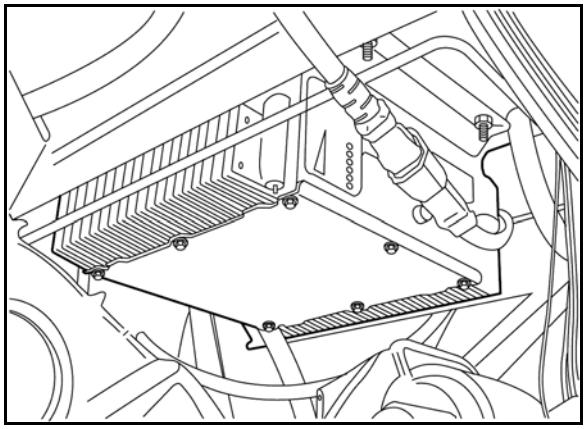
Charge batteries only in well-ventilated area. Keep sparks or flames away from charging battery.

Become familiar with the charger and follow the instructions. See Charger in this chapter.

1. Batteries should be charged after each period of use.
2. Lead-acid batteries do not develop memory and need not be fully discharged before recharging.
3. Check electrolyte level. See Watering in this section.
4. Tighten all vent caps before charging.
5. Do not undercharge batteries. Under charging causes stratification.
6. Do not charge a frozen battery.
7. Avoid charging at temperatures above 120 degrees F (49 degrees C).

CHARGER

DESCRIPTION



The battery charger is located under the hood assembly and is mounted to a plate above the motor/gear box assembly, and is an integral part of the vehicle.

The battery charge receptacle is located on the front hood assembly. It accepts a standard 3-wire (grounded) extension cord and should not exceed 25 feet in length 14 gauge wire, or 50 feet in length for 12 gauge wire.

OPERATION

Insert the proper extension cord into the battery charger receptacle and into a standard 110-volt A/C, 15 amp-breaker outlet. (GFI is recommended). **If using a GFI protected charger cord, plug into a standard circuit breaker that is NOT GFI protected.**

NOTE: Make sure the master disconnect switch is in the ON position.

When the battery charger is active, an integrated relay of the control circuit will enable and prevent further operation to the drive system of the vehicle, leaving it disabled. The LCD (see further in this section) will illuminate and is only to be used as a guide. The indicator lights of the display panel on the left side of the charger will inform you of the current battery charge status.

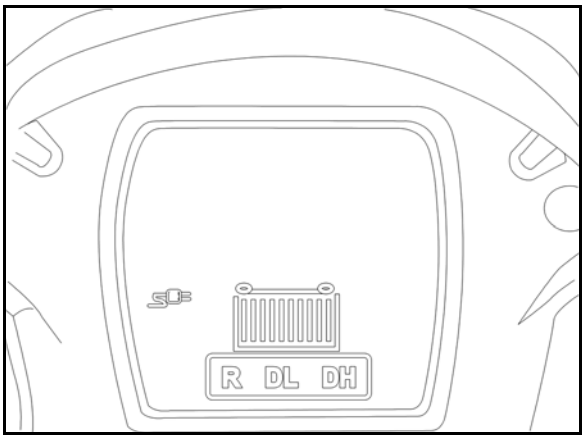
BATTERY CHARGE LEVEL

To ensure that your GEM car is 100% charged you can follow these easy steps.

> **⚠ CAUTION**
>
> Fully charge batteries before extended periods of use and/or storage. In extreme temperature (hot/cold) climates, battery self-discharge will increase. Batteries will also freeze if not properly charged.

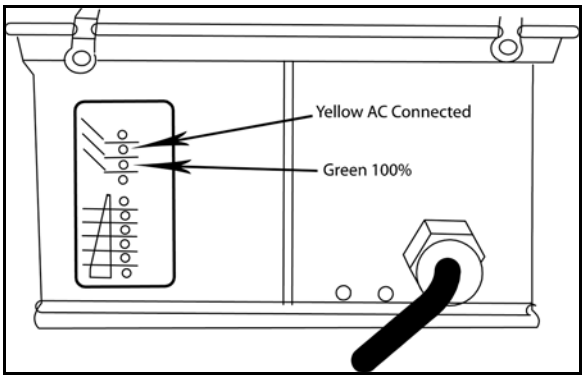
1. To properly charge GEM vehicle, plug car in and look at display. Note charger cord icon and battery icon of display illuminate, along with battery percentage indicator.

2. When charging cycle is complete after 8 to 14 hours (depending on battery pack of 6-12 volt or 9-8 volt), battery percentage indicator will extinguish and only charger cord icon and bar graph will display.



9924112 - 2013 GEM Service Manual

3. Determine 100% charge by looking at charger located under hood. Kneel down beside left front wheel. Look over tire toward center of vehicle. Locate yellow and black charger unit. When left plugged in to charge, solid green light should appear on charger indicating 100% charge cycle.



CHARGER REPLACEMENT

1. Position master disconnect switch OFF.
2. Remove upper and lower dash panels. See Body section.
3. Disconnect electrical connections, noting connection and orientation.
4. Unlatch and open hood.
5. Disconnect charge receptacle wire from charger.
6. Raise and support the vehicle using suitable hoist.
7. Remove four mounting nuts from charger.
8. Reverse procedure to install.

CHARGING WHEN BELOW MIN VOLTAGE

The on-board charger has a safety feature, which does not allow it to turn on if the pack voltage is below 36 volts. If the battery pack goes below this level an alternative charging procedure must be followed.

NOTE: Use the appropriate charger for the application. Failure to do so may result in injury or personal and property damage. Use a 12-volt charger for 12-volt type batteries only. Charge one battery at a time individually. Use a 24-volt charger for 8-volt and/or 12-volt type batteries; two 12-volt batteries at one time or three 8-volt batteries at one time.

1. Position master disconnect switch OFF.
2. Using automotive-type charger, charge each battery individually. Set charger on medium current level (10-30 Amps). Allow enough charge time so voltage on each battery is at least 11.5 volts (30 minutes to 1 hour per battery).
3. After all batteries have been charged, remove charger and position master disconnect switch ON. Measure total pack voltage. If pack voltage is above low voltage threshold, plug in on-board charger. Allow on-board charger to run its complete cycle.

If a fault occurred anytime during charging, the red FAULT LED will flash with a code corresponding to the error. There are several possible conditions that will generate errors. Some errors are serious and require human intervention to first resolve the problem and then to reset the charger by removing and then restoring AC power. Other errors will automatically recover when the fault condition is eliminated. To determine which error occurred, the FAULT LED will flash a number of times at rate of one second, and then pause for 1.5 seconds and then repeat.

9924112 - 2013 GEM Service Manual

OPERATING INSTRUCTIONS

1. Always use grounded outlet. When using extension cord, avoid excessive voltage drops by using grounded 3-wire 12 AWG cord.
2. The charger will automatically turn ON and go through short LED indicator self-test (all LED's will flash in up-down sequence for two seconds). If charger is used with master disconnect switch OFF and is waiting to be connected to battery pack, charging algorithm number will be displayed for 11 seconds (see “Check / Change Charging Algorithm”) before ultimately displaying under-voltage fault until AC is cycled.
3. Once minimum battery voltage is detected, the charger will enter the bulk charging constant-current stage and current to the batteries will be displayed by the LED light on the display of the charger unit. 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 ('AC' LED extinguished). If the ambient temperature is too high, then the charging power will also be reduced, attempting to lower the internal temperature (charger display will flash YELLOW LED light but may become blank or “blacked out”).
4. When the battery is at approximately 80% state of charge, the bulk stage has completed and an > 80% charge indication is given by turning on the '80%' LED. 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 (the '100%' LED will flash).
6. When the '100%' 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 charge cycle after the interval time has elapsed (every 7 days for flooded batteries; every 14 days for gel batteries).
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 them to reset the charger by interrupting AC power for at least 30 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 Temperature Out of Range: the battery is too hot or cold to charge. Check temperature sensor for open or shorted circuit.

[2 FLASH] Battery Voltage Out of Range: the battery voltage is too high or low to allow charging to proceed.

[3 FLASH] Charge Time out: 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] AC Shutdown; auto-recover. Charger has shutdown due to AC voltage going out of range (under 104 VAC). Charger will restart when AC voltage comes back in to range and the SMC interval has elapsed.

[5 FLASH] Over-Temperature: auto-recover. Charger has shutdown due to high internal temperature which typically indicates there is not sufficient air flow for cooling - (see Installation Instruction 1). Charger will restart and charge to completion if temperature is within accepted limits.

[6 FLASH] QuiQ Fault: an internal fault has been detected. Verify location and connection of the charger main RED and BLACK wires. Unplug AC power for 30 seconds, then plug in again. If fault still remains, replace charger.

CHECK/CHANGE CHARGE ALGORITHM

The charger comes pre-loaded with charge algorithms as detailed in table below. Each time AC power is applied with the battery pack NOT connected, the charger enters and algorithm display mode for about 11 seconds. During this time, the current algorithm number is indicated by the number of blinks of the '80%' LED and Remote LED. A single-digit algorithm number is indicated by the number of blinks followed by a pause. A 2-digit algorithm number is indicated by the number of blinks for the 1st digit followed by a pause, then the number of blinks for the 2nd digit followed by a longer pause. To check/change the charging algorithm.

ALG #	Battery Type
13	Trojan flooded NC #30XHS/ SCS225
14	DEKA gel 12V NC #8G31
15	DEKA gel 12V PRC #8G31
24	DEKA gel 8V NC #8G8VGC
25	DEKA gel 8V PRC #8G8VGC
32	DEKA flooded NC #DC31DT

1. Disconnect the charger positive connect by flipping the master switch. Start with the switch in the OFF position. Apply AC power and after the LED test, the algorithm number will display for 11 seconds.
2. To enter algorithm selection mode, flip the master disconnect switch ON during the 11 seconds display period right after the first algorithm number is displayed for 1 second and then OFF. **HINT: Count to 1 as 100.**
3. To change algorithm, turn switch ON during the 2 minute display period for 4 seconds and then OFF - the algorithm number will advance after 3 seconds. **HINT: Count to 4 as 100, 200, 300, 400.**
4. Repeat until desired algorithm number is displayed. A 2-minute time out is extended for every increment. Incrementing beyond the last algorithm moves back to the first algorithm. After the desired algorithm number is displayed, turn the switch ON until the output relay is heard to click (10 seconds) - the selection is now stored in permanent memory.

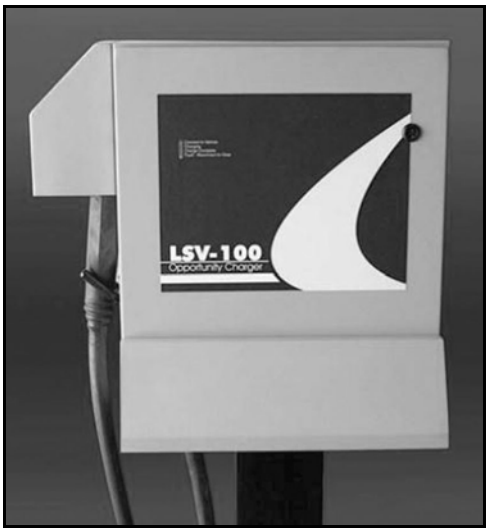
NOTE: Pack recovery (PRC) algorithm selection is not stored in permanent memory. After selecting this algorithm, connect the charger to the battery without interrupting AC power. After about 10 seconds, the charger will begin charging. Use of the PRC algorithm is indicated by the '80%' and '100%' LEDs flashing together. When the PRC charge completes a full charge cycle, the charger will revert back to the previous algorithm (i.e., Algorithm 15 will change back to 14 and Algorithm 25 will change back to 24).

5. It is highly recommended to confirm a newly changed algorithm selection by repeating Step 1.

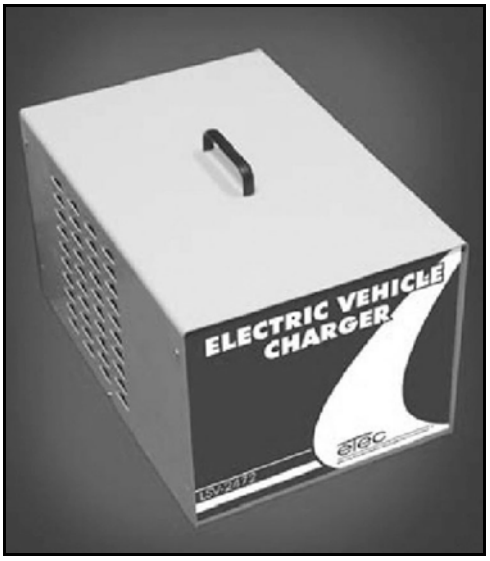
FAST CHARGING SYSTEM

DESCRIPTION

The Fast Charger is a battery charging system that allows for opportunity charging of an electric vehicle. The LSV-100 is a stand-alone unit that is externally isolated from the vehicle and secured to its own Pedestal style mount (sold separately) or mounted to a wall.



The Convenience Charger is a unique battery charging system that allows for opportunity charging of an electric vehicle. The LSV-2472 is ideally suitable for electric vehicles operating in applications such as campuses, commercial fleets, military bases and resorts. This unit is special as it is portable and easily transferrable from one location to another.



OPERATION

The charger is equipped with a large cabled harness that needs to be inserted to the battery charge receptacle, located under the hood of the vehicle. (“Accessory” option would have to be installed on each GEM vehicle to be used with Fast Charger or Convenience Charger.)

If using the LSV-100 be sure the main circuit breaker for the unit is turned On for power to the Fast Charger. Once it is plugged in to the vehicle it will automatically detect battery voltage present and begin the charge cycle.

If using the LSV-2472 be sure to connect the AC power cord to the appropriate wall circuit for power. Once it is plugged in to the vehicle it will automatically detect battery voltage present and begin the charge cycle.

NOTE: Make sure the Master Disconnect Switch (MDS), located in the Access Panel of the white Lower Dash, is turned ON.

When the charger is active, an integrated relay of the control circuit will enable and prevent further operation to the drive system of the vehicle, leaving it disabled. The LCD (see further in this section) will illuminate and is only to be used as a guide. The indicator light of the display panel on the Fast Charger unit will inform you of the current battery charge status.

9924112 - 2013 GEM Service Manual

The Fast Charger Receptacle is installed under the hood of the GEM vehicle and comes with all of the major components necessary to charge from the LSV-100 Fast Charger or the LSV-2472 Convenience Charger.The charger user interface consists of four (4) LED's (LSV-100 only) on the front panel of the unit (from top to bottom):

White - The charger has been powered up and is ready for use. The vehicle can then be connected to the charger. (This LED normally blinks)

Blue - Charging is underway. The speed at which the blue light flashes indicates the rate of charge being supplied to the batteries.

Green - Charging has completed and it is safe to disconnect the vehicle from the charger.

Red - A fault condition has been identified. Refer to the Troubleshooting section for assistance and explanation of fault codes for the Fast Charge system.

FAST CHARGER TROUBLESHOOTING

The Fast Charge unit (LSV-100) is equipped with a red LED on the front panel. This LED will illuminate in the event of an error. The LED will flash repeatedly a given number of times between 1 and 8 with a 2-second pause between a series of flashes. The number of flashes per series corresponds to one of the following fault conditions:

[1 FLASH] Vehicle Detection Fault - Battery pack voltage out of range, too high/low.

[2 FLASH] Current Not Detected - Related battery pack voltage detection issue; no connection, control not responding; Current less than 2 amps.

[3 FLASH] Unexpected High Current - Related battery pack voltage detection issue; Current in Step 3 jumped greater than 40 amps.

[4 FLASH] Over Current/Under Voltage - current exceeded 108 amps for 0.3 seconds.

[5 FLASH] Under Current/Over Voltage - current less than 2 amps or voltage greater than 118VDC; loss of current caused spike in voltage for more than 2 seconds; exceeded 115VDC in Step 3, possible Open circuit battery pack or dead pack.

[6 FLASH] Thermal Fault - Chargers Temperature sensor on vehicle or internal Module or Rectifier temperature exceeded 122 degrees Fahrenheit.

[7 FLASH] Invalid Start Current/Programming Fault - The control failed to communicate with the module; Module disconnected or Controller defective.

[8 FLASH] Amp Hour Limit Reached - Maximum Amp/hour rate exceeded.

To clear any fault condition, disconnect the vehicle from the charger. Disconnect AC power if possible. Wait several minutes. Reconnect AC power and then reconnect power from the charger to the vehicle.

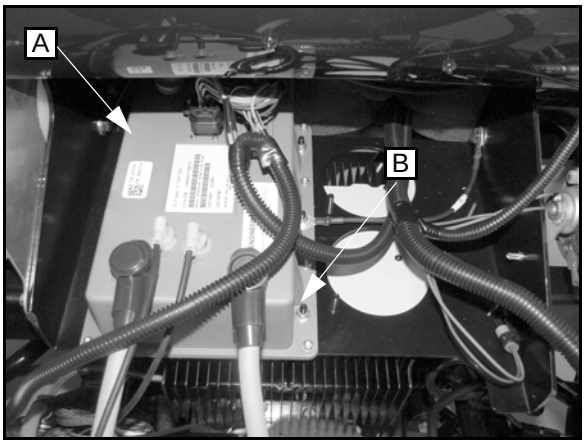
NOTE: Some faults may not reset. For more information see table below.

Fast Charger Troubleshooting Table

SYMPTOM	POSSIBLE CAUSE
When I plug in the charger I do not see the charger current rise and the fan does not work.	1. The cable may not be fully seated in the charge receptacle. Try re-seating the plug into the vehicle. 2. Verify that the A/C receptacle has the proper voltage for the charger.
The charger will charge the batteries but the fan does not turn on.	1. The cable may not be fully seated in the charge receptacle. Try re-seating the plug into the vehicle. 2. Check the loop back wire between pins 3 & 4 on the charging receptacle.
The fan turns on but no current is delivered.	1. Check for 24VAC between pins 1 & 2 on the charging plug with the charger plugged into the AC receptacle. 2. Verify that the A/C receptacle has the proper voltage for the charger.
After plugging in the charger the charger will suddenly stop charging and the fan will turn off as well.	Verify that the circuit breaker for the AC circuit is of the proper current for this charger. Also make sure that no other equipment is attached to the same circuit. If both of these conditions are met unplug the charger and contact GEM technical support.
The A/C plug will not fit into the wall outlet.	The charger is delivered with a typical A/C plug for a 220VAC, 15A circuit. Other receptacle configurations are available. Check with a local electrician to replace the wall receptacle, the charger plug or both. Ensure that the circuit is properly sized for the charger load.
The DC plug will not fit into the Electric Vehicle charge Receptacle.	1. Verify that the plug is properly oriented. A keyed divot should be facing up when inserting the plug into the charger. 2. Unplug the charger completely and inspect the DC charger cable and the charger receptacle for damage or obstructions. If any damage is present on the DC charging cable contact GEM technical support immediately.
During charging the fan will turn off or the fan does not turn at all.	If after checking to make sure that the DC cable is secure the fan still does not work unplug the charger and contact GEM technical support.

MOTOR CONTROLLER

DESCRIPTION



A. Motor controller

The motor controller, located under the hood assembly, is the brain of the GEM vehicle. Based on inputs from the accelerator pedal and the drive mode switch, the controller converts battery power into the appropriate drive power for the vehicle's electric motor. The controller also generates drive system status information that is displayed on the liquid crystal display (LCD).

OPERATION

The controller functions automatically when the key switch is in the ON position. There are no other direct operator interactions with the motor controller module. Operation of the motor controller is accomplished by actuation of the devices such as the accelerator pedal, and the drive mode switch.

DIAGNOSIS AND TESTING

The motor controller function is critical to every aspect of the drive system. If a fault occurs with the motor controller, you should see an error code on the liquid crystal display (LCD). Use the Drive and Power System Error Codes section to help in isolating the fault.

MOTOR CONTROLLER REMOVAL

1. Turn master disconnect switch OFF.
2. Unlatch and open hood.
3. Note connector locations and wire orientations on motor controller (A), and disconnect all cables and connectors.
4. Remove six bolts (B) and motor controller (A).

MOTOR CONTROLLER INSTALLATION

1. Install motor controller (A) and six bolts (B). Torque bolts to specification.

= T
Motor Controller Mounting Bolts: **65 in-lbs (7 Nm)**

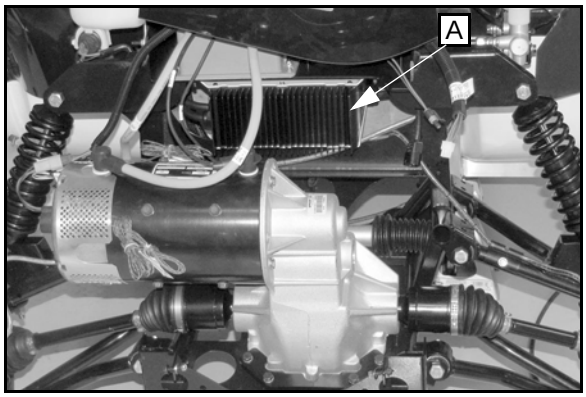
2. Connect all wires and connectors. Torque negative and positive armature cables to specification.

= T
Negative And Positive Armature Cables: **50 in-lbs (6 Nm)**

3. Close and latch hood.
4. Turn master disconnect switch ON.

DC / DC CONVERTER

DESCRIPTION



A. DC/DC Converter

The DC/DC converter is located under the hood assembly. It is an integrated unit to the battery charger, previously discussed in this section. The converter serves the function of converting the high voltage delivered by the batteries (72 VDC) to lower voltage (12 VDC). The lower voltage is used to power all the devices that are part of the accessory system - key switch, headlights, taillights, directional indicators, brake lights, horn, heater, light bar, power outlet, radio and wiper. The DC/DC converter supplies 30 amps.

OPERATION

The DC/DC converter functions automatically when the master disconnect switch is in the ON position. An enable circuit is controlled by the key switch and an internal time delay for switched 12-volt power.

DIAGNOSIS AND TESTING

Diagnosis and testing of the DC/DC converter is covered in the Accessory System Troubleshooting Chart. The circuit diagrams provided in this manual are also useful in isolation of problems associated with the DC/DC converter.

DC / DC CONVERTER REMOVAL

1. Position master disconnect switch OFF.
2. Remove upper and lower dash panels. See Body section.
3. Unlatch and open hood.
4. Note connector locations and wire orientations, and remove electrical connections to DC/DC converter (A).
5. Disconnect charge receptacle wire from charger.
6. Remove four bolts and four nuts from charger with integrated DC/DC converter (A) and remove unit.

DC / DC CONVERTER INSTALLATION

1. Install DC/DC converter (A), four bolts, and four nuts. Torque to specification.

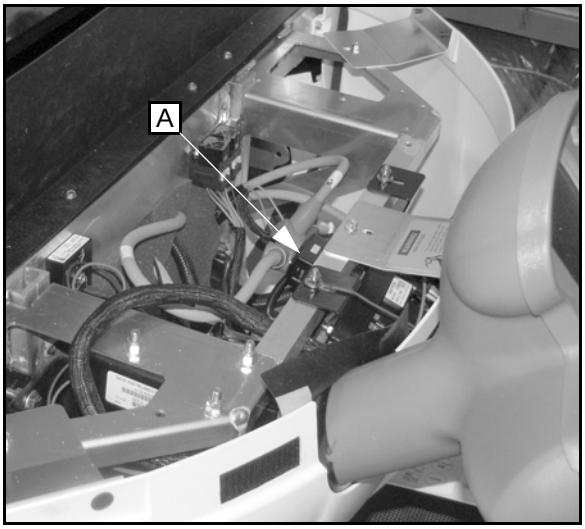
= T
DC/DC Converter Mounting Nuts: **120 in-lbs (163 Nm)**

2. Install charger and DC/DC converter connections.
3. Connect charge receptacle.
4. Install upper and lower dash panels. See Body section.
5. Close and latch hood.
6. Position master disconnect switch ON.

9924112 - 2013 GEM Service Manual

MAIN CONTACTOR

DESCRIPTION



A. Main contactor

The main contactor is an electronically controlled switch that provides a high-current connection between the battery and the motor controller. It is located under the dash, and behind the PSDM.

OPERATION

The motor controller activates the main contactor if the key switch is on, and the motor controller determines high voltage, high current power should be supplied to the drive motor. The motor controller will not activate the main contactor if an error condition exists. See Drive and Power System Error Codes chart.

MAIN CONTACTOR REMOVAL

1. Position master disconnect switch OFF.
2. Remove upper and lower dash. See Body section.
3. Remove electrical connections, noting connection and orientation of each wire.
4. Remove screws that mount contactor to the front bulkhead.

MAIN CONTACTOR INSTALLATION

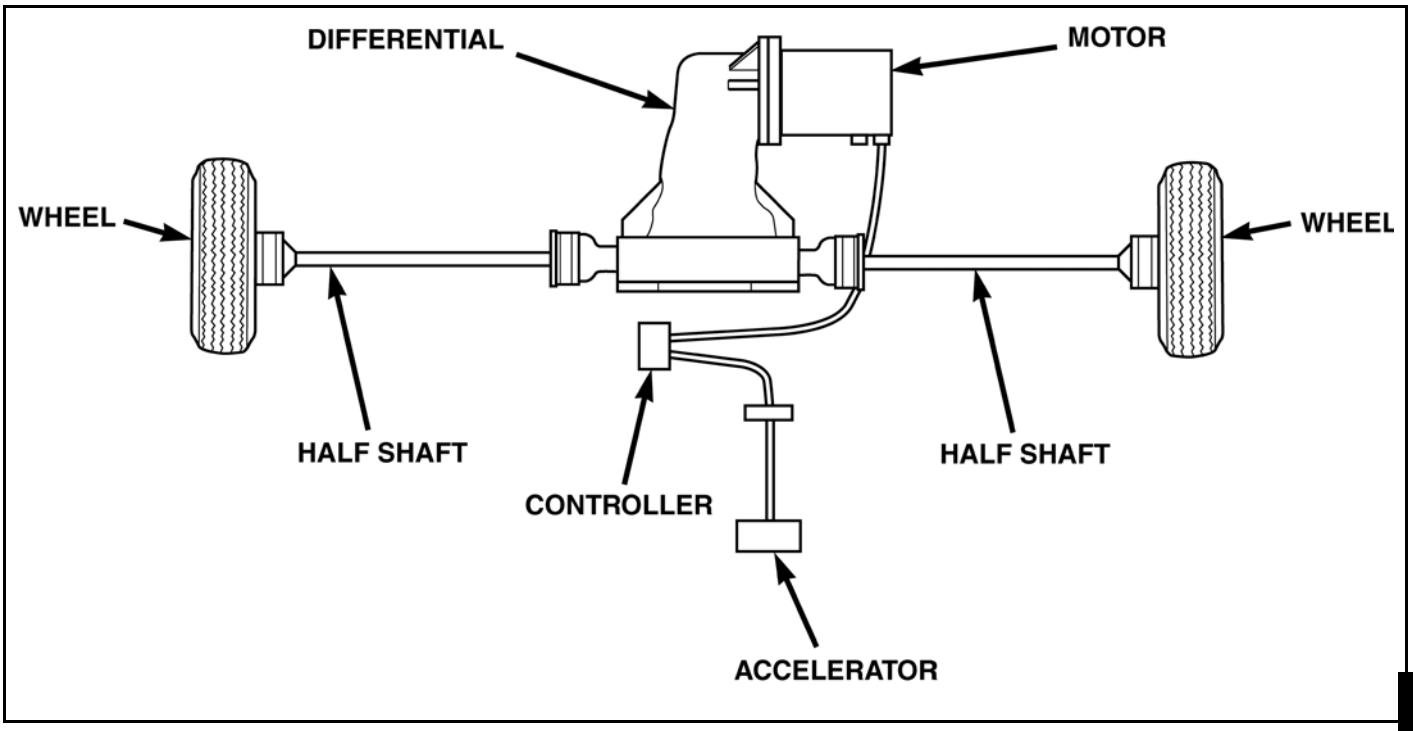
1. Install contactor and screws to front bulkhead. Torque to specification.

= T
Main Contactor Retaining Nuts: **120 in-lbs (163 Nm)**

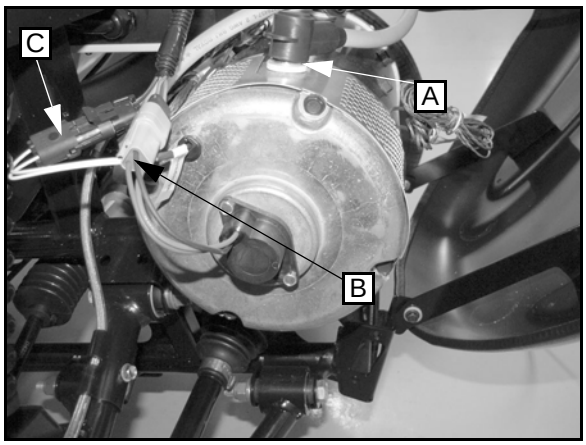
2. Connect electrical connections, noting connection and orientation for each wire.
3. Install upper and lower dash. See Body section.
4. Position master disconnect switch ON.

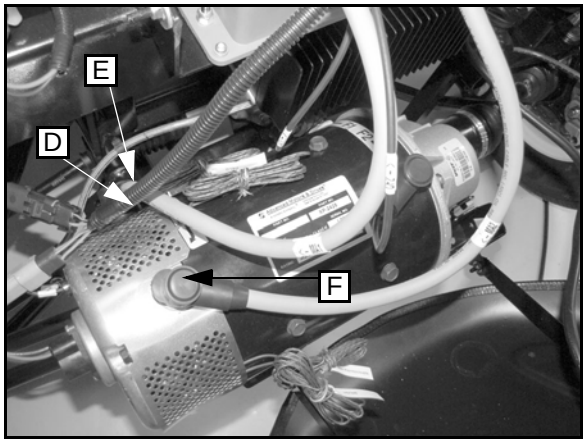
MOTOR

DESCRIPTION



Power to the drivetrain is supplied by a 72-volt electric motor, which is attached to the differential. The motor speed (RPM) is monitored by a small magnet and a speed sensor (tachometer) mounted to the center rear of the motor.





A. Motor armature 2

B. Speed sensor (tach)

C. Motor temp switch

D. Motor armature 1 (below E)

E. Motor field 2

F. Motor field 1

9924112 - 2013 GEM Service Manual

OPERATION

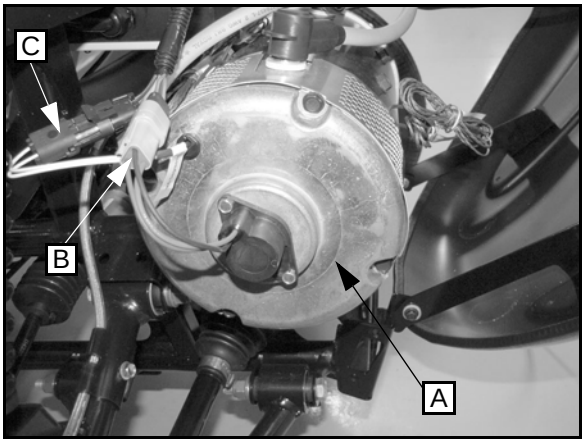
Motor activation and speed are controlled by the motor controller based on the signal from the potentiometer located in the accelerator pedal in the cab. A splined cup in the motor is connected to a splined shaft on the pinion gear in the differential. Rotational motion of the motor's cup transmits that motion to the differential.

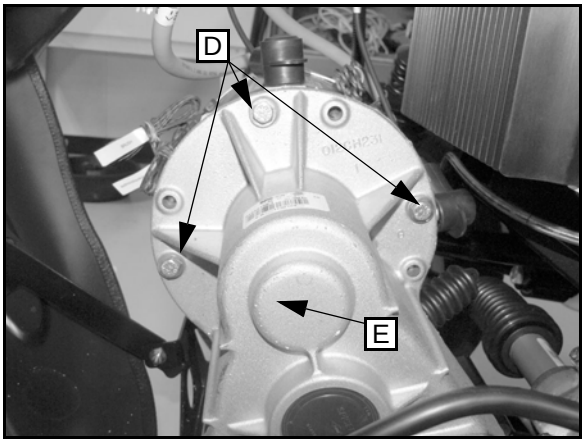
DIAGNOSIS AND TESTING

Refer to the Drive and Power System Troubleshooting Chart A and B. The circuit diagrams provided in this manual are also useful in isolation of problems.

MOTOR REMOVAL

1. Unlatch and open hood.
2. Position master disconnect switch OFF.
3. Remove front wheel and tire assemblies. See Wheel and Tire section.
4. If equipped, remove black plastic air scoop to gain access to motor (A).





5. Disconnect power wires from top and rear of motor (A) with, noting connections and locations.
6. Disconnect speed sensor (B).
7. Disconnect temp sensor (C).
8. While supporting 30-40 lbs. motor (A), remove three motor/differential mounting bolts (D), flat washers, and motor (C).
9. Noting orientation of power posts for reassembly, remove motor (A) from differential (E) and pull straight out.

MOTOR INSTALLATION

NOTE: The cupped end of the bumper will face outward.

1. Install new resilient bumper inside motor spline socket. Ensure bumper is completely installed in spline socket.
2. Lightly coat splined differential shaft (not necessary) with Valvoline Special Moly EP grease or equivalent (Too much grease will cause motor problems.)

Grease: **Valvoline Special Moly EP or equivalent**

3. Install motor, ensuring power posts face same direction as before.
4. Add Loctite® 242 and install three motor/differential mounting bolts and flat washers. Torque bolts to specification.

= **T**
Motor/Differential Mounting Bolts: **65 in-lbs (7 Nm)**

5. Connect power wires to top and rear of motor. Torque to specification.

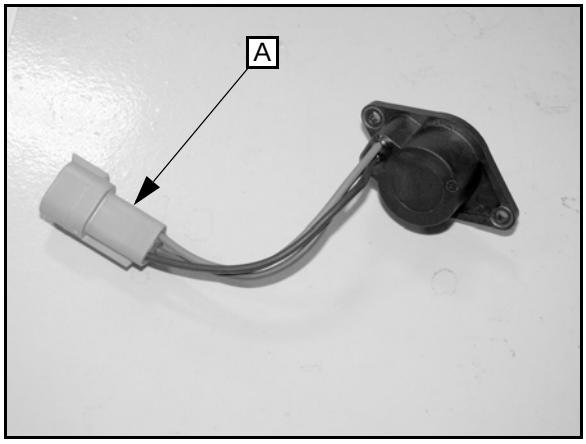
= **T**
Terminals: **40-60 in-lbs (5-7 Nm)**

6. Install air scoop if previously removed.
7. Install front wheel and tire assemblies. See Wheel and Tire section.
8. Position master disconnect switch ON.
9. Close and latch hood.

MOTOR MAGNET AND SPEED SENSOR (TACHOMETER)

DESCRIPTION

A small circular magnet is mounted to the motor spindle. A sensor, attached to a pigtail, sits in close proximity to the magnet. Access to the magnet and sensor is gained through a small plate in the center of the motor's end panel.



A. Speed sensor (tachometer)

OPERATION

When the motor armature rotates the magnet rotates also. The sensor detects the magnet's motion, and transmits a signal through its pigtail to the motor controller.

DIAGNOSIS AND TESTING

The speed sensor carries a 12-volt signal through a bus internal to the Motor Controller. Using a DC Voltmeter, unplug or back probe the red and black wires of the 3-wire speed sensor pigtail harness and check for 12 volts.

The green wire is a signal wire. Turn the key on. From the Motor Controller 23-pin harness, locate Pin 14 and back probe to the green wire of the 3-wire speed sensor pigtail harness and check for continuity.

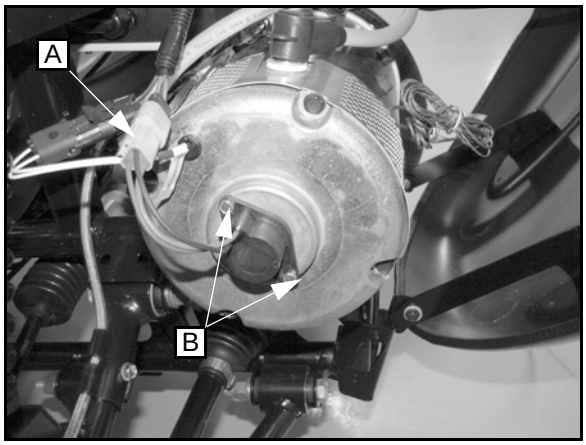
Perform a visual inspection of the sensor and the internal Motor Magnet. Remove the Speed Sensor from the end of the motor. Inspect the magnet attached to the motors armature shaft for fractures.

Refer to Troubleshooting Diagram A.

Refer to the Drive and Power Systems Troubleshooting Charts A & B.

SPEED SENSOR REMOVAL

1. Disconnect sensor/pigtail assembly (A).



2. Remove two bolts (B) and sensor/pigtail assembly (A).

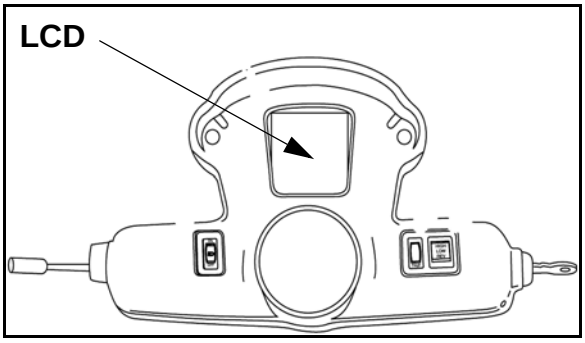
SPEED SENSOR INSTALLATION

1. Install sensor/pigtail assembly and two bolts.
2. Connect sensor/pigtail assembly.

9924112 - 2013 GEM Service Manual

LIQUID CRYSTAL DISPLAY (LCD)

DESCRIPTION



The liquid crystal display (LCD) is located in the center of the instrument pod and performs the following functions:

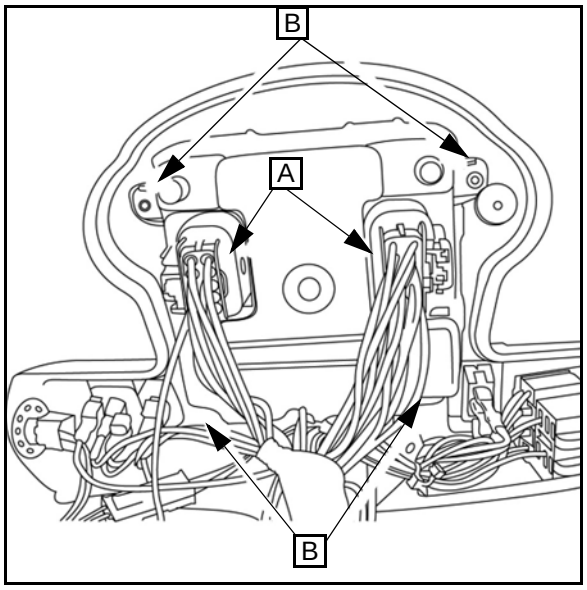
1. State of charge and charging indicator.
2. MPH/KPH speed indicator.
3. Accumulated miles/kilometers.
4. Drive mode indicator.
5. Fault code display.
6. Warning indicators and turn signal indicators.
7. E-meter/AC Power Consumption.

OPERATION

With key switch ON, the state of charge indicator displays remaining battery capacity. The remaining battery capacity is displayed in a bar type graph. There is one red bar, one yellow bar, and eight green bars for a total of ten bars. Each bar represents approximately 10% of battery capacity. For example, one red bar, one yellow bar, and three green bars would equal 50% battery capacity.

LCD REMOVAL

1. Remove upper dash panel. See Body section.
2. Remove lower dash panel. See Body section.
3. Remove RH and LH pod covers. See Pod Covers in Body section.
4. Disconnect two electrical connectors.
5. Remove two screws at back of LCD mounting bracket.



A. Electrical connectors
B. Mounting screws

LCD INSTALLATION

1. Install two screws into LCD.
2. Attach two connectors to back of LCD.
3. Install RH and LH pod covers. See Pod Covers in Body section.
4. Install lower dash panel. See Body section.
5. Install upper dash panel. See Body section.

9924112 - 2013 GEM Service Manual

PSDM

DESCRIPTION

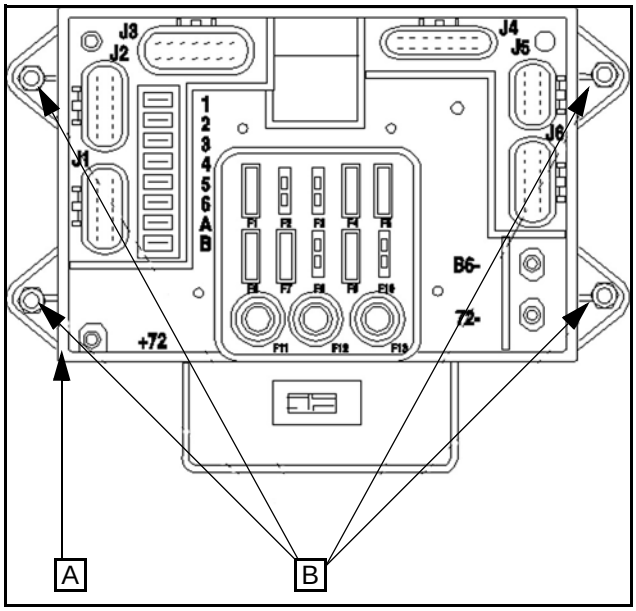
The Power Signal Distribution Module (PSDM) is an electrical component that acts as a central hub for all 72 and 12-volt power.

OPERATION

Both 72 and 12-volt inputs come into the PSDM and are dispersed through the fuses to the appropriate electrical components.

PSDM REMOVAL

1. Position key switch and master disconnect switch OFF.
2. Remove upper and lower dash. See Body section.
3. Noting connection and orientation for each wire, remove all connectors and cables from PSDM (A).
4. Remove four mounting nuts (B) securing PSDM (A) to mounting plate.



5. Lightly pry around mounting studs working back and forth between all studs, and remove PSDM (A).

PSDM INSTALLATION

NOTE: Side of nut with star washer must be mounted to enclosure.

1. Install PSDM and four mounting nuts. Torque mounting nuts to specification.

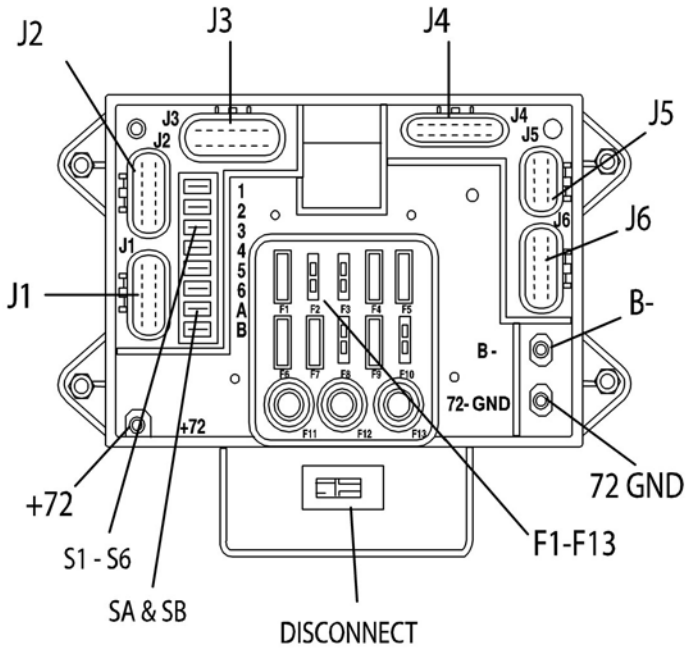
= T
PSDM Mounting Nuts: **72 in-lbs (9 Nm)**

2. Connect all connectors and cables noting connection and orientation for each wire.

= T
Cable Connection Studs (+72 stud, 72 GND stud, B- stud): **80 in-lbs (8 Nm)** MDS Cable Connections: **65 in-lbs (7 Nm)**

3. Install upper and lower dash. See Body section.
4. Position key switch and master disconnect switch ON.

1. PSDM CONNECTIONS



J1 - FRONT HARNESS

J2 - DISPLAY

J3 - DISPLAY

J4 - DC-to-DC

J5 - CONTROLLER

J6 - REAR

F1-F13 - FUSE

S1-SB - SPADE CONNECTORS FOR ACCESSORIES

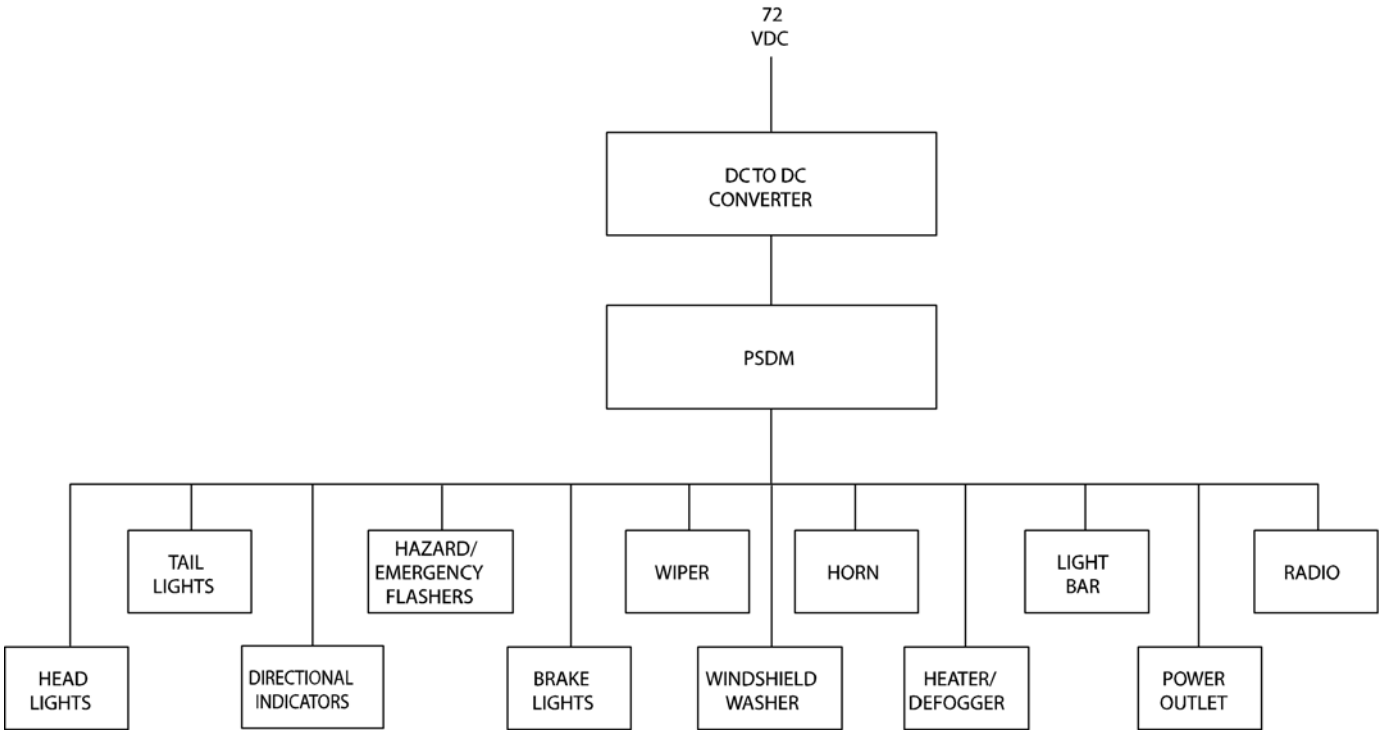
+72 - 72 VOLTS FROM THE BATTERY PACK

72 GND

B-

ACCESSORY SYSTEM

DESCRIPTION



The standard accessory system components for the GEM are essential for safe driving and consist of the headlights, taillights, directional indicators, brake lights, horn, power outlet, and wiper. Some vehicles are equipped with a radio, light bar, and heater that are considered optional equipment.

OPERATION

Standard accessories receive their 12-volt power from the fuse protected DC/DC converter. The DC/DC converter receives 72-volt input power directly from the six batteries and requires no user action for its operation. All other components of the Accessory System function identical to those devices in a standard automobile.

The two headlights are 12-volt single filament incandescent bulbs. A rocker switch located on the instrument pod activates headlights. (HI/LO beams are standard and consist of dual-filament bulbs.)

Taillights and brake lights are 12-volt dual filament incandescent bulbs. One filament is used for directional indicators and brake lights. The second taillight filament is activated when the headlights are turned on.

There are 4 directional indicators, left and right front, and left and right rear. Turn signal lever located on the left side of the instrument pod activates the directional indicators. The turn signal indicator has a built-in time delay relay and buzzer set for 45 seconds as a reminder. As the turn indicators are selected and not switched off within the 45-second period a small beeping sound will omit as a reminder to switch the turn signals off.

The horn provides a single continuous tone when the horn button is pressed. The horn button is located on the left side of the instrument pod.

The heater operates by the heater switch located in the center lower dash panel. The heater blower motor operates by receiving 12 VDC from the fuse protected DC/DC converter. The heater element runs on 72 VDC fused direct feed from the batteries through the heater contactor.

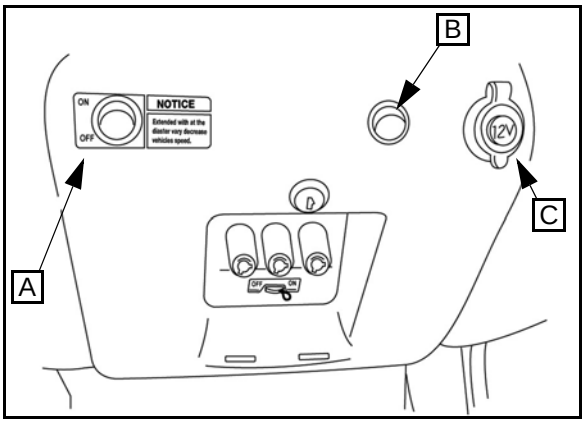
The light bar operates by the light bar switch located in the center lower dash. The light bar is powered by receiving 12 VDC from the fuse protected DC/DC converter.

The power outlet is located in the center lower dash and is running on 12 VDC from the fuse protected DC/DC converter.

9924112 - 2013 GEM Service Manual

The radio is located in the headliner and is running on 12 VDC from the fuse protected DC/DC converter.

A single speed DC motor powers the wiper. The motor automatically returns the wiper to the Parked position when the wiper is turned off. The windshield washer is activated using the multi-function turn signal lever switch located to the left of the instrument pod.



A. Heater switch
B. Light bar switch
C. Power outlet

DIAGNOSIS AND TROUBLESHOOTING

The purpose of this section is to aid in the isolation of problems with the accessory system. Unlike the drive system, the LCD does not provide any error codes to aid in troubleshooting problems with accessories. The most common problems with the accessory system are an open lamp filament, a faulty switch, improper wiring connections and blown fuses. For problems that cannot be resolved by lamp and fuse replacement, refer to the Accessory System Troubleshooting Chart and the wiring diagrams provided.

As was the case with the drive system, the information provided in this section is a guide only. There are numerous variations in the skill level of personnel that service this vehicle. This manual cannot possibly accommodate all skill levels and provide advice for each. A basic understanding of electronics and troubleshooting techniques is required.

9924112 - 2013 GEM Service Manual

ACCESSORY SYSTEM TROUBLESHOOTING CHART		
Condition	**Possible Causes and Diagnostic Steps**	**Correction**
A single bulb (headlight, taillight or directional indicator) does not work.	Remove the bulb (see bulb removal replacement instructions below), Visual inspect the bulb or measure the filament with an ohmmeter.	If the filament is visibly open or the filament resistance is greater than 100 ohms, replace the bulb.
The head lamps, tail lamps, the front and rear directional indicators, horn, heater, light bar, power outlet, radio and wiper do not work.	Using a voltmeter with the key switch ON, test for voltage at the following locations: • 12 VDC at the PSDM J4, pins A and B. • 72 VDC at the DC/DC converter/charger, main RED and BLACK wires). Verify the connectors on the DC/DC converter/charger and the PSDM J4 have not come loose.	If there is 72 VDC at the DC/DC converter/charger, RED and BLACK wires, and no voltage pins A and B at PSDM J4 with the key switch ON, replace the DC/DC converter/charger. If there is 12 VDC at the PSDM J4 pins A and B with the key switch ON, and the accessories are not working, verify fuses and then replace the PSDM as necessary.
Headlights and taillights do not work, but front and rear directional indicators do work.	Visually inspect the F1 fuse or measure with an ohmmeter to determine if it is open. Light switch.	Replace the F1 fuse if open (10A). If fuse is not open, use the Front Lighting Circuit Diagram (headlights and taillights share common circuitry) and a voltmeter to isolate the problem.
Rear brake lights do not work, but the rear directional indicators do work.	Brake pressure switch. Visually inspect fuse F6 or measure with an ohmmeter to determine if it is open.	Check for voltage at the brake lights when the brake pedal is pressed. If voltage is not present, check the brake pressure switch, voltage circuits, ground circuits, PSDM. Use the Rear Lighting Circuit Diagram and a voltmeter to isolate the problem. Replace the fuse if open.
Brake warning indicator stays Illuminated.	1. Check hand brake switch. Are there 12 volts at Red/White wire? 2. Check that switch has continently with hand brake released (handle down). 3. Check Circuit Diagram in this section.	1. If 12 volts is not present, check F10 fuse and Red/White wire at spade 6 in PSDM. 2. Replace or adjust switch as necessary. 3. Use Display Circuit Diagram and a voltmeter to isolate the problem.
The rear lamps do not work.	Verify tail light harness connection with rear harness.	If the connection is not loose, use the Rear Lighting Circuit Diagram and a voltmeter to isolate the problem.

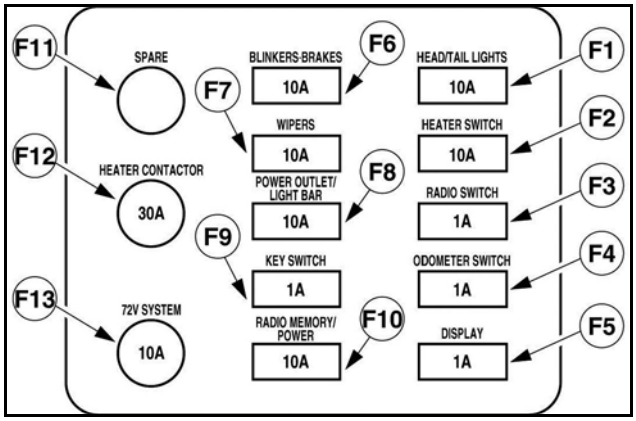
9924112 - 2013 GEM Service Manual

ACCESSORY SYSTEM TROUBLESHOOTING CHART (Continued)		
Condition	**Possible Causes and Diagnostic Steps**	**Correction**
The tail lamps do not work (when the lights are turned on), but the rear directional indicators do work.	Disconnect the taillight harness from the rear harness. Using an ohmmeter, measure resistance from Pins 2, 3 or 4 to ground. The resistance should measure no more than 100 ohms.	If the resistance to ground is higher than 100 ohms for either Pins 2, 3, or 4, check for a loose ground connection.
The rear directional indicators do not work, but the front directional indicators do work.	There is probably a loose or broken connection between the PSDM in the rear harness and the taillight harness.	Use the Rear Lighting Circuit Diagram and a voltmeter to isolate the problem.
Horn does not work.	Visually inspect the fuse F1 or measure with an ohmmeter to determine if it is open. Check voltage circuits, horn, horn switch (part of the multifunction switch), and ground.	Replace the fuse if open. Check for voltage at the horn when pressing the horn switch. If voltage is not present, check the horn switch and the circuit. If horn switch is faulty, replace the horn switch. If horn switch is OK, check the horn, horn ground and voltage circuit. Use the Horn/Power Outlet Circuit Diagram and a voltmeter to isolate the problem.
Heater does not work.	Visually inspect fuse F2 or measure with an ohmmeter to determine if it is open. Heater switch. Blower motor.	Replace the fuse if open. Use the Heater Circuit Diagram and a voltmeter to check the wiring connections, the heater switch and the blower motor to isolate the problem.
Heater operates but is blowing cold air.	Visually inspect fuse F12 or measure with an ohmmeter to determine if it is open. Heater contactor. Heater element.	Replace the fuse if open. Use the Heater Circuit Diagram and a voltmeter to check the wiring connections, the heater contactor and the heater element to isolate the problem.
Light bar does not work.	Visually inspect fuse F8 or measure with an ohmmeter to determine if it is open. Light bar switch. Light bar.	Replace the fuse if open. Use the Security Light Bar Circuit Diagram and a voltmeter to isolate the problem. Check the wire connections, the light bar switch and the light bar.
Power outlet does not work.	Visually inspect fuse F8 or measure with an ohmmeter to determine if it is open.	Replace the fuse if open. Measure the voltage at the PSDM S, pin 3. If it is 12 VDC the power outlet has a loose or broken connection to the ground or at PSDM S, pin 3. If there is no voltage and the other accessories work, replace the PSDM.

ACCESSORY SYSTEM TROUBLESHOOTING CHART (Continued)		
Condition	**Possible Causes and Diagnostic Steps**	**Correction**
Radio does not work.	Visually inspect fuses F10 and F3 or measure with an ohmmeter to determine if it is open. Radio assembly (radio and speakers).	Replace the fuses if they are open. Use the Audio System Circuit Diagram to check the wire connection and 12 VDC at PSDM S, pins 1 and 6. If there is 12 VDC at PSDM S, pins 1 and 6 with the key switch ON and there are no loose or broken connections in the wiring, replace the radio. If there is no voltage at PSDM S, pin 1 or pin 6 and the other accessories are working, replace the PSDM.
Wiper does not work.	The wiper motor has overload protection and may stop working for a short period of time if the windshield is very dry. Wait a moment and try operating the wipers again. If the wipers fail to operate, visually inspect fuse F7 or measure with an ohmmeter to determine if it is open. Wiper switch (part of the multifunction switch). Wiper motor.	Replace the fuse if open. Check for voltage at the wiper motor when the wiper switch is on. If voltage is not present, check the wiper switch (part of the multifunction switch), the voltage circuit, or the motor assembly. Use the Wiper Circuit Diagram and a voltmeter to isolate the problem.
Wiper works but the windshield washer does not.	Windshield washer pump. Windshield washer switch. Loose or broken wiring connections.	Use the Wiper Circuit Diagram and a voltmeter to check the voltage at the washer switch and the voltage and ground connections at the washer pump.

ACCESSORY SYSTEM COMPONENT REPLACEMENT

FUSE REPLACEMENT



F1 - Head/Tail Lights (10A)	F8 - Power Outlet and Light Bar (10A)
F2 - Heater Switch (10A)	F9 - Key Switch (1A)
F3 - Radio Switch (1A)	F10 - Radio Memory/Power (10A)
F4 - Odometer Switch (1A)	F11 - Spare
F5 - Display (1A)	F12 - Heater Contactor (30A)
F6 - Blinkers/Brakes (10A)	F13 - 72-Volt System (10A)
F7 - Window Wiper (10A)	

1. Open fuse panel access door.
2. Locate blown fuse using volt/ohm meter.
3. Use fuse puller to remove fuse.
4. Replace with appropriate size fuse. See ECM troubleshooting section for appropriate sizes.
5. Reverse the removal procedure to install.

HEADLIGHT REPLACEMENT

1. Unlatch and open hood.
2. Disconnect black and violet wires and remove light from mounting bracket.
3. Reverse procedure to reassemble.
4. Adjust headlight as follows: Position front of car about five feet away from wall. Turn on headlights and adjust them so center of beam on wall is about one inch lower than center of light on car.

FRONT TURN INDICATOR LAMP REPLACEMENT

1. Unlatch and open hood.
2. Remove lock nut from light and disconnect the red and black wires.
3. Replace light assembly.
4. Reverse removal procedure to install.

REAR TURN INDICATOR LAMP REPLACEMENT

1. Remove two screws and lens.
2. Twist bulb counterclockwise to remove, noting type of bulb, and replace. (2057/2067)
3. Reverse removal procedure to install.

WIPER MOTOR REPLACEMENT

1. Unlatch and open hood.
2. Remove upper dash panel. See Body section.
3. Remove wiper arm and blade with 13mm socket; or for the style without nut, gently pry off arm with a large screwdriver.
4. Remove Tek screws from wiper bracket.
5. Disconnect yellow/blue and white/blue electrical wires from wiper motor.
6. Remove capture nut, washer and rubber bushing from wiper shaft. Remove wiper from windshield sill.
7. Reverse removal procedure to install.

INSTRUMENT POD REPLACEMENT

1. Remove upper and lower dash panels. See Pod Covers in the Body section.
2. Remove Pod covers. See Pod Covers in Body section.
3. Remove steering wheel. See Steering Wheel in Steering and Suspension section.
4. Remove four self-tapping screws.
5. Reverse removal procedure to install.

9924112 - 2013 GEM Service Manual

LIGHT SWITCH REPLACEMENT

1. Remove upper and lower dash panels. See Body section.
2. Remove steering column covers. See Body section.
3. Disconnect wire connections and note orientation.
4. Looking from rear, push tabs in and press out front side.
5. To install new switch from front, insert switch in proper orientation and press firmly. Switch will snap into place.
6. Connect wires and reassemble.

KEY SWITCH REPLACEMENT

1. Remove upper and lower dash panels. See Body section.
2. Remove RH and LH POD covers. See Pod Covers in Body section.
3. Disconnect electrical connector.
4. Loosen retaining nut and remove key switch.
5. Reverse removal procedure to install.

ACCESSORY WIRING CHART

NOTE: For electrical connections, refer to PSDM in this section.

Switched 12-Volt:

S1=F3

S2=F2

S3=F8

S4=F6

S5=FLASHER HAZARD (JUMP TO S4)

Unswitched 12-Volt:

S6=F10

Switched 72-Volt:

SA=F12

SB=F11

TURN SIGNAL SWITCH REPLACEMENT

1. Remove upper and lower dash panels. See Body section.
2. Remove RH and LH POD covers. See Pod Covers in Body section.
3. Remove two screws.
4. Disconnect electrical connector and remove turn signal switch.
5. Reverse removal procedure to install.

ROCKER SWITCH REPLACEMENT

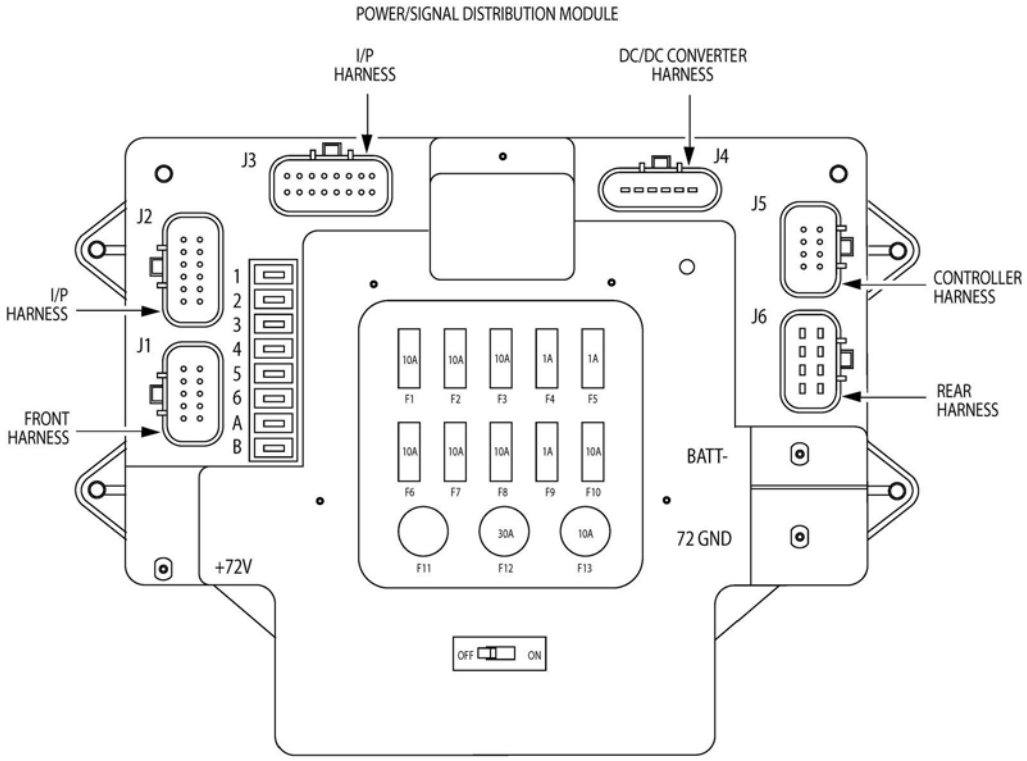
1. Remove upper and lower dash panels. See Body section.
2. See Body Panels and Accessories.
3. Remove RH and LH POD covers. See Pod Covers in Body section.
4. Mark wires to aid in installation.
5. Disconnect wires from backside of rocker switch.
6. Release tabs and remove rocker switch.
7. Reverse removal procedure to install.

9924112 - 2013 GEM Service Manual

WIRING DIAGRAMS

HARNESS TYPE	ABBREVIATION
DC/DC Converter Harness	DCCH
Headlight Harness	HH
Front Harness	FH
Instrument Panel Harness	IP
Controller Harness	CH
Rear Harness	RH
Tail Light Harness	TLH
Charger Wiring	C
Battery Temperature Sensor Wiring	BTS

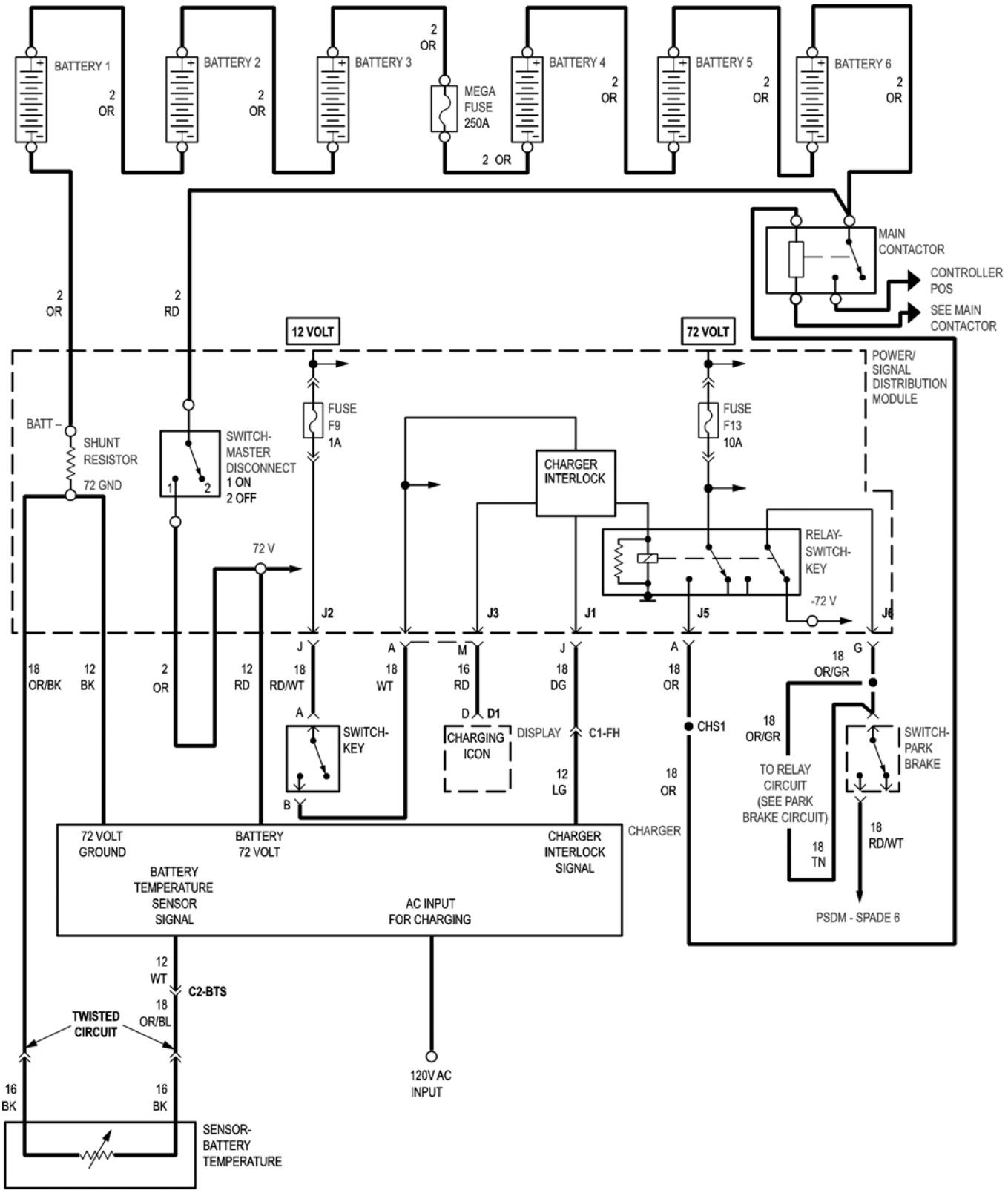
POWER DISTRIBUTION



FUSES

FUSE NO.	AMPS	FUNCTION
1	10A	HEAD AND TAIL LIGHTS
2	10A	HEATER SWITCH (COIL POWER)
3	10A	RADIO POWER SWITCH
4	1A	ODOMETER SWITCH
5	1A	DISPLAY
6	10A	BLINKERS AND BRAKE LEVEL SWITCH
7	10A	WIPER
8	10A	POWER OUTLET AND LIGHT BAR
9	1A	KEY SWITCH TO CHARGER INTERLOCK AND DISPLAY
10	10A	RADIO MEMORY/POWER
11	-	SPARE
12	30A	HEATER CONTACTOR POWER
13	10A	72V SYSTEM POWER

CHARGING SYSTEM



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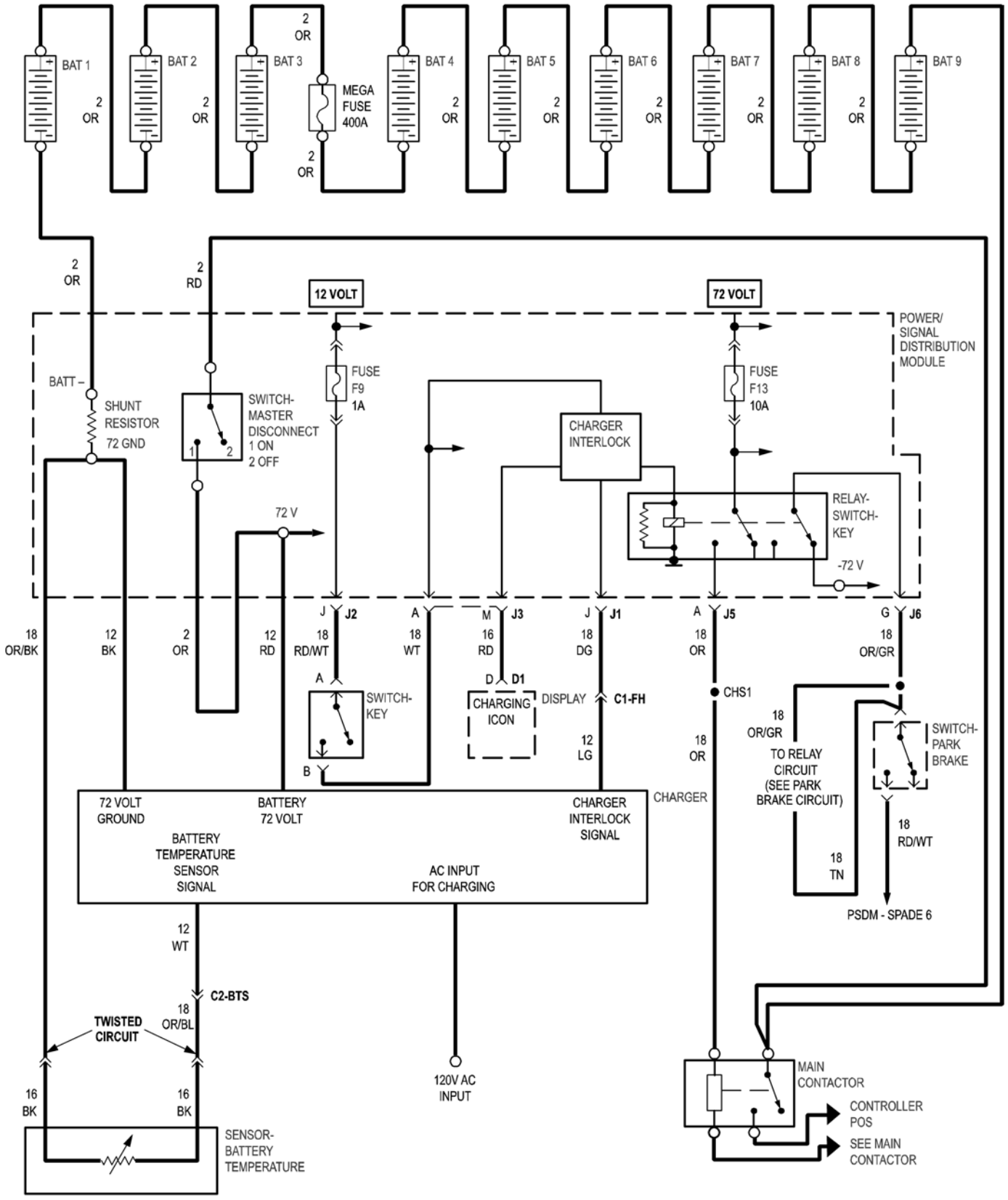
CHARGING SYSTEM (CONTINUED) GEM e6® & GEM eL XD



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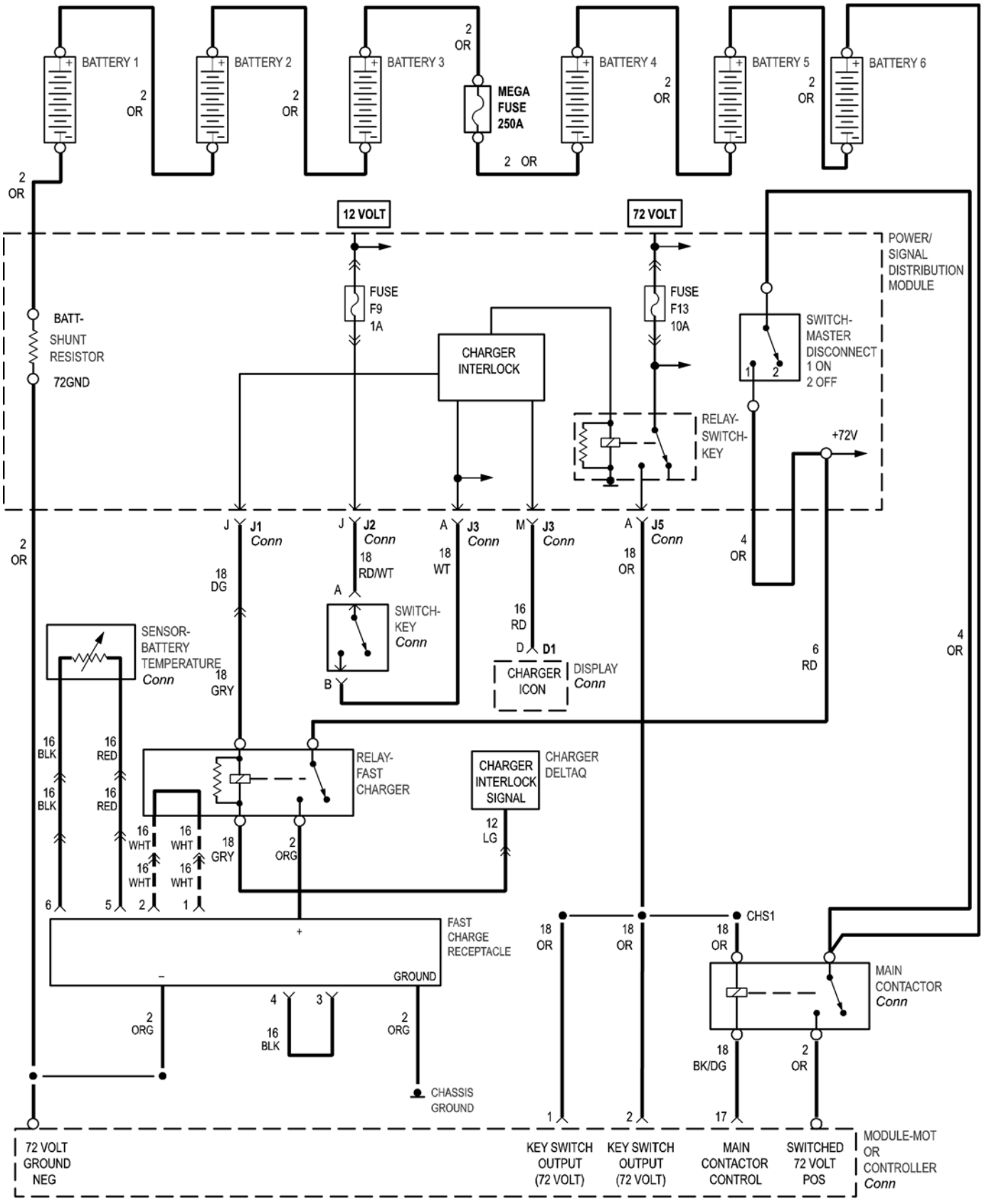
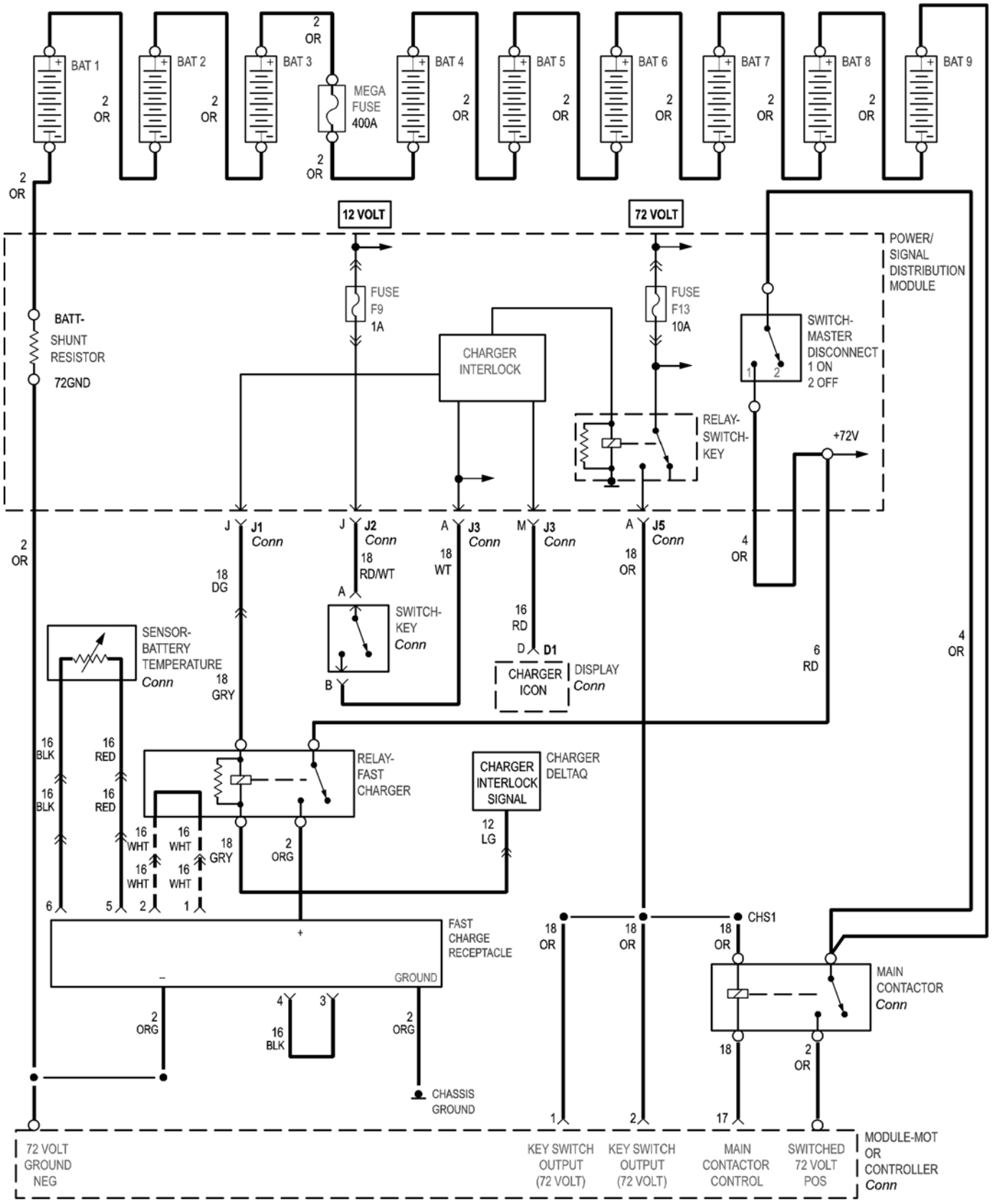
FAST CHARGING SYSTEM



FAST CHARGING SYSTEM (CONTINUED) GEM e6® & GEM eL XD



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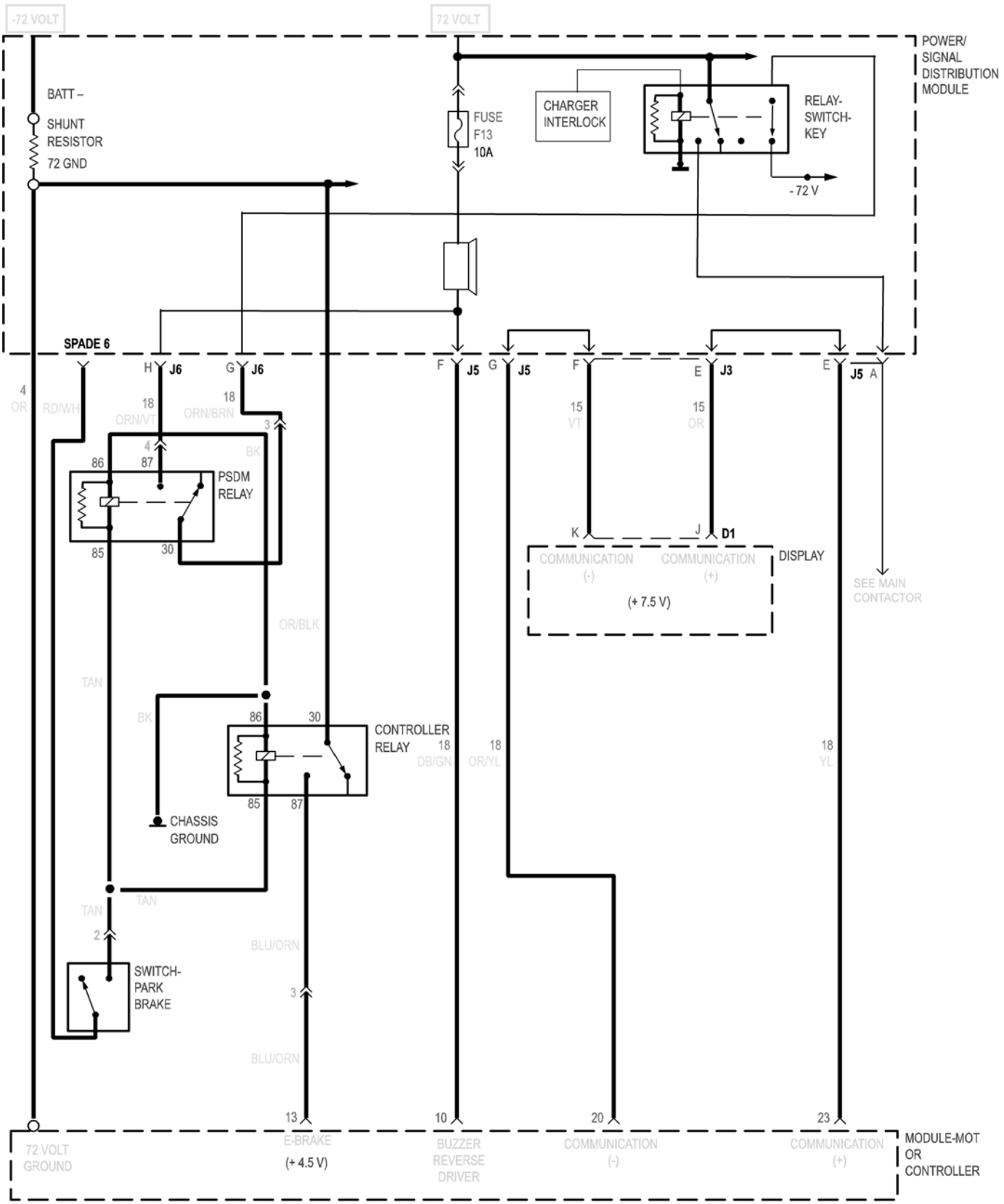
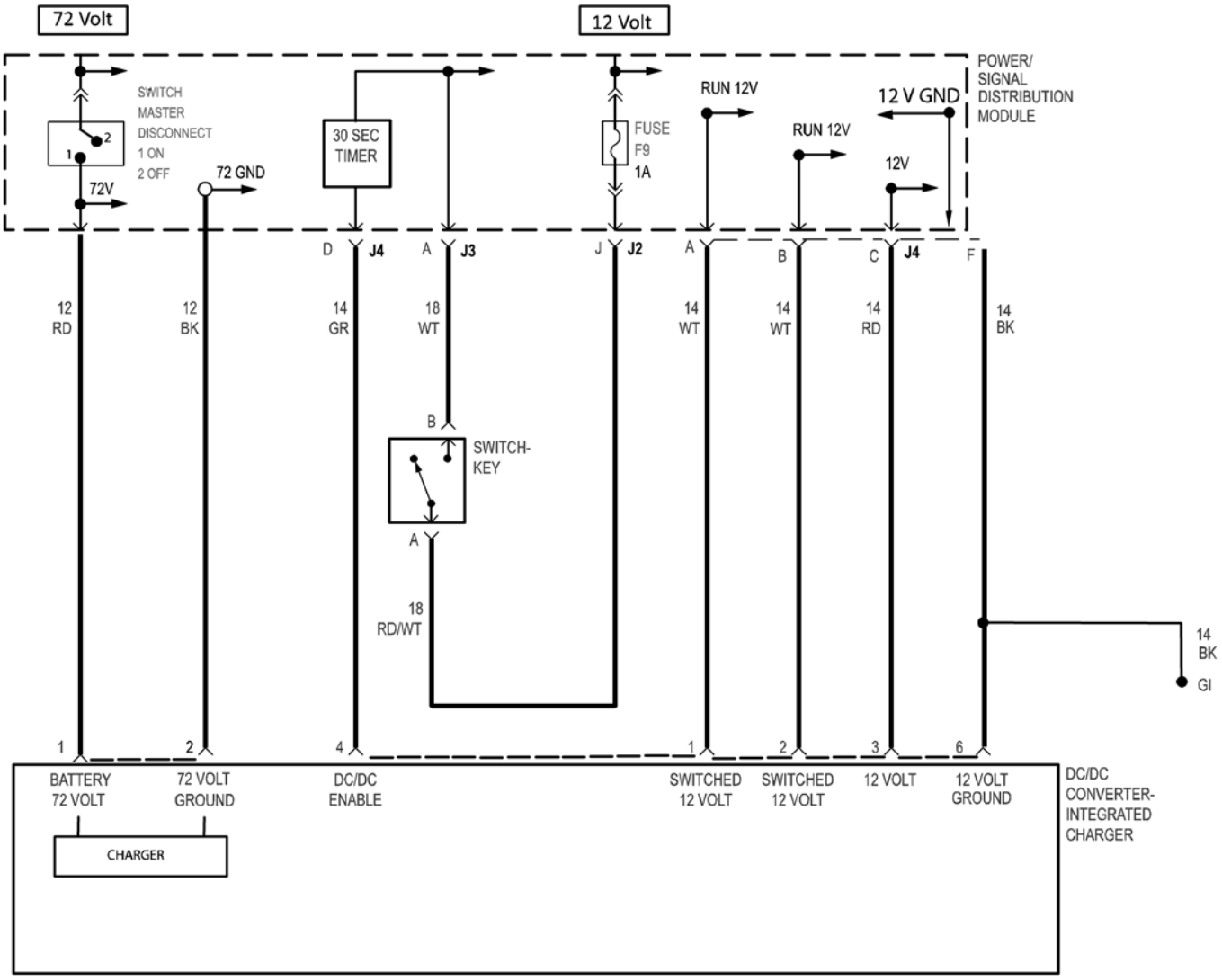
PARK BRAKE CIRCUIT



DC/DC CONVERTER - INTEGRATED CHARGER



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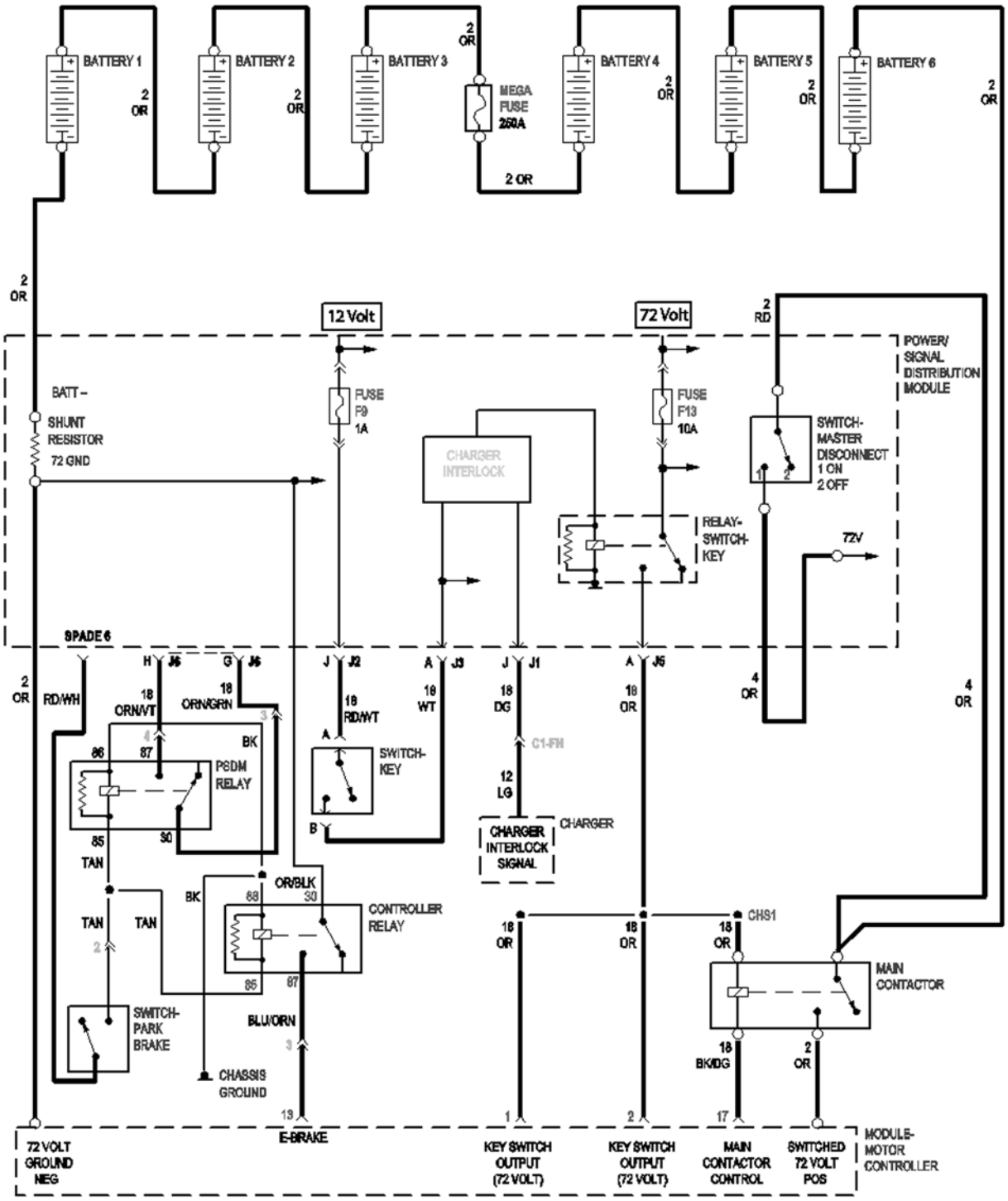
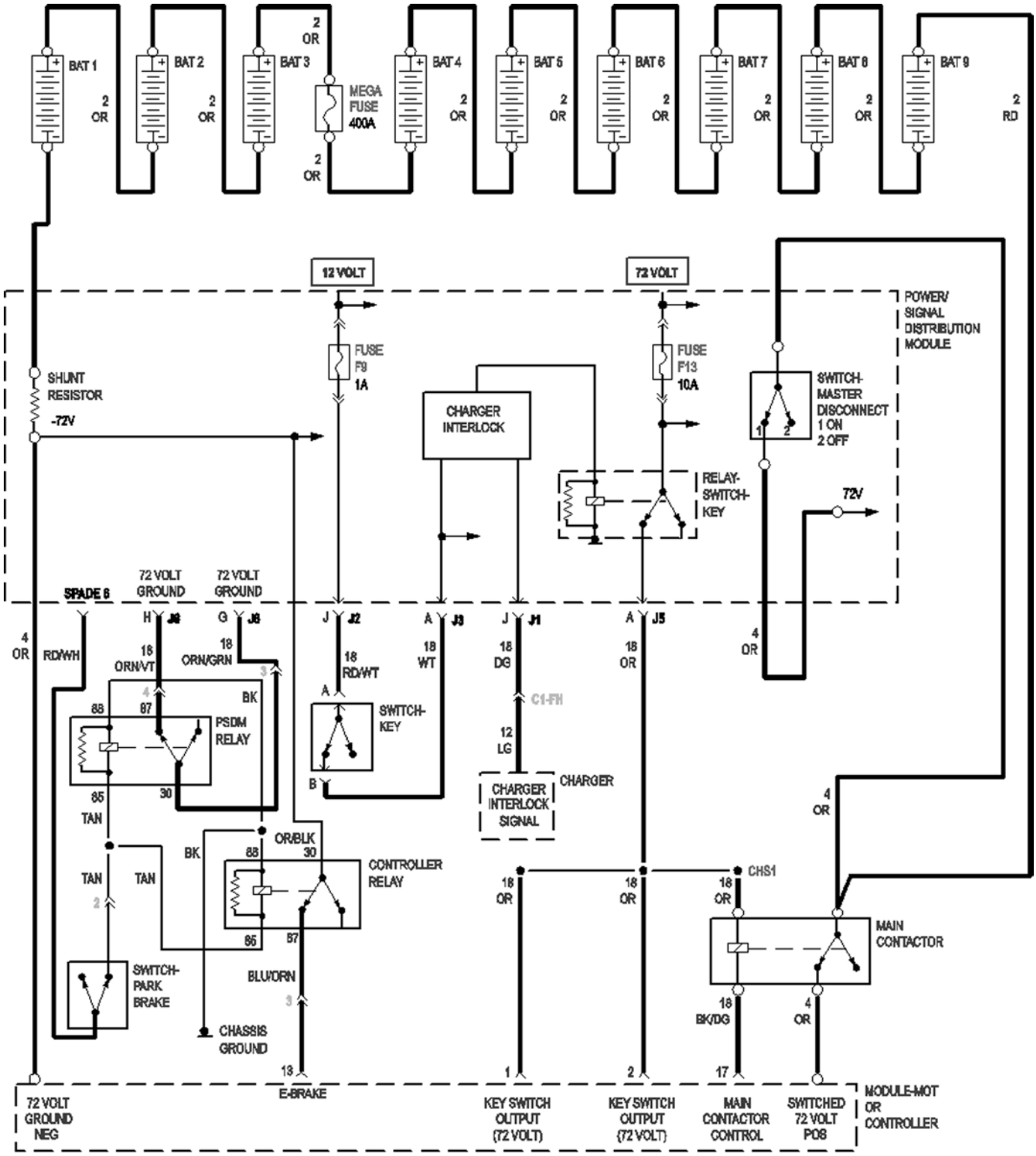
MAIN CONTACTOR



MAIN CONTACTOR (CONTINUED) GEM e6® & GEM eL XD W/9-8 VOLT BATTERY OPTION



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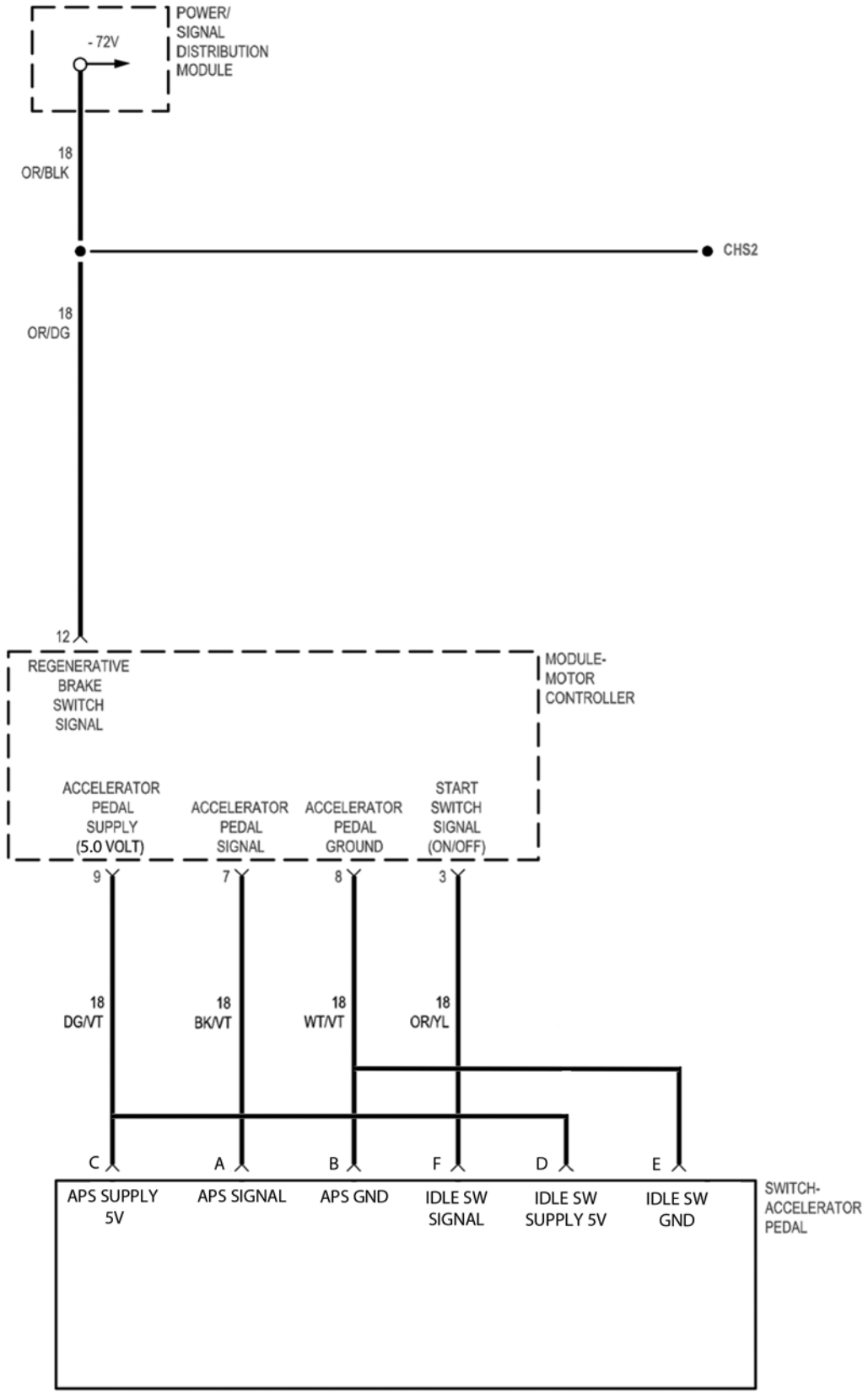
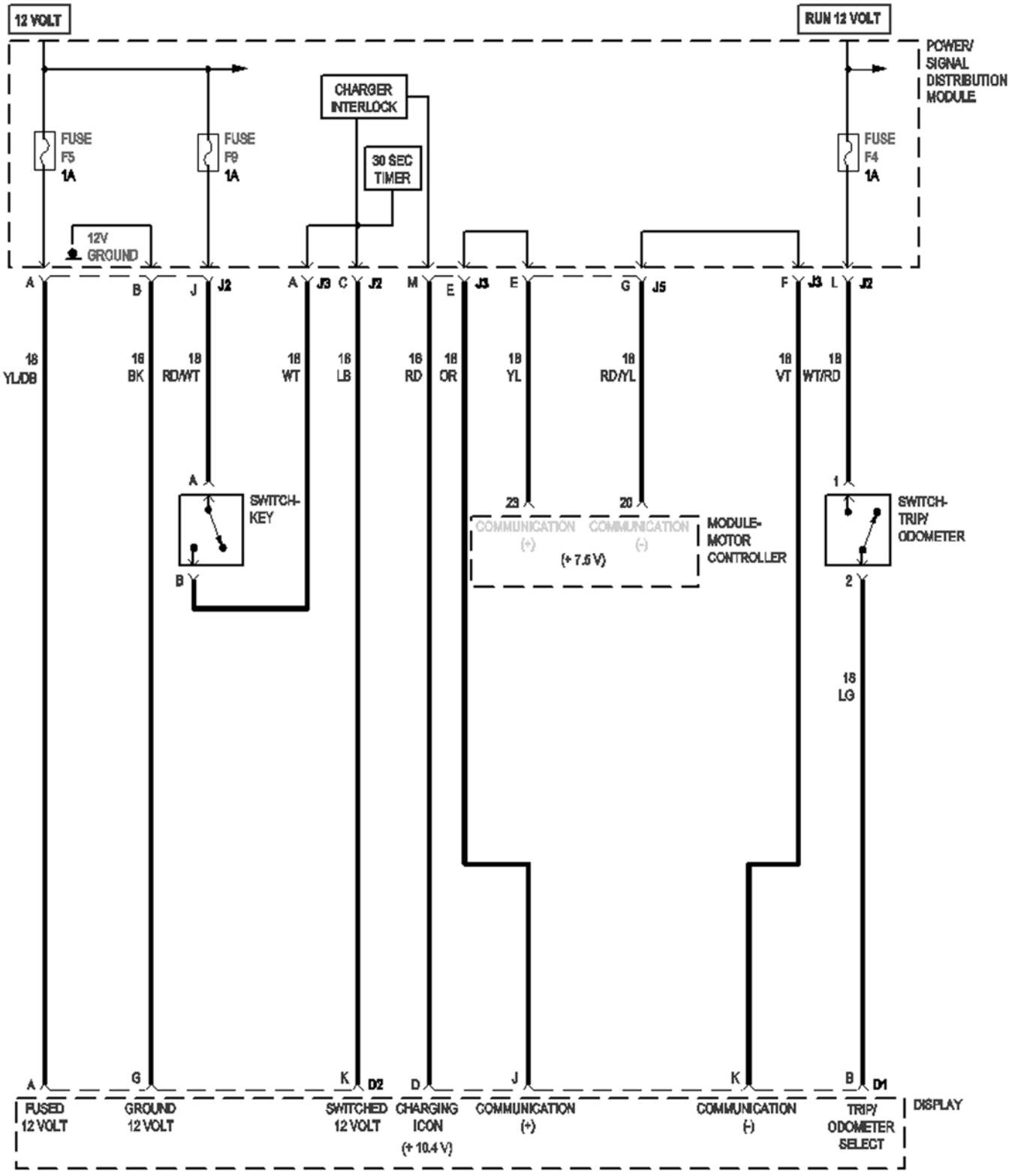
MOTOR CONTROLLER SYSTEM



DISPLAY



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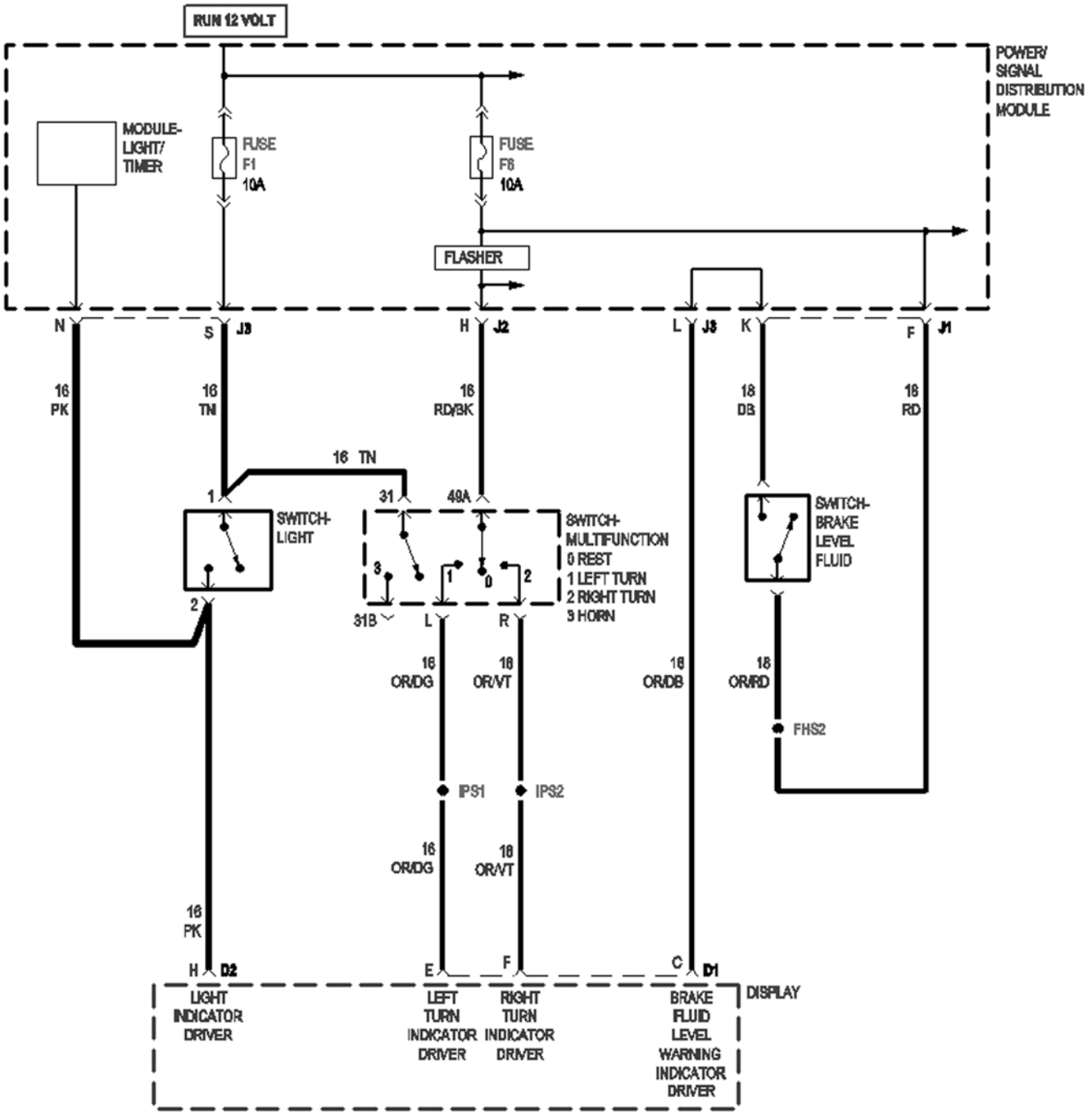
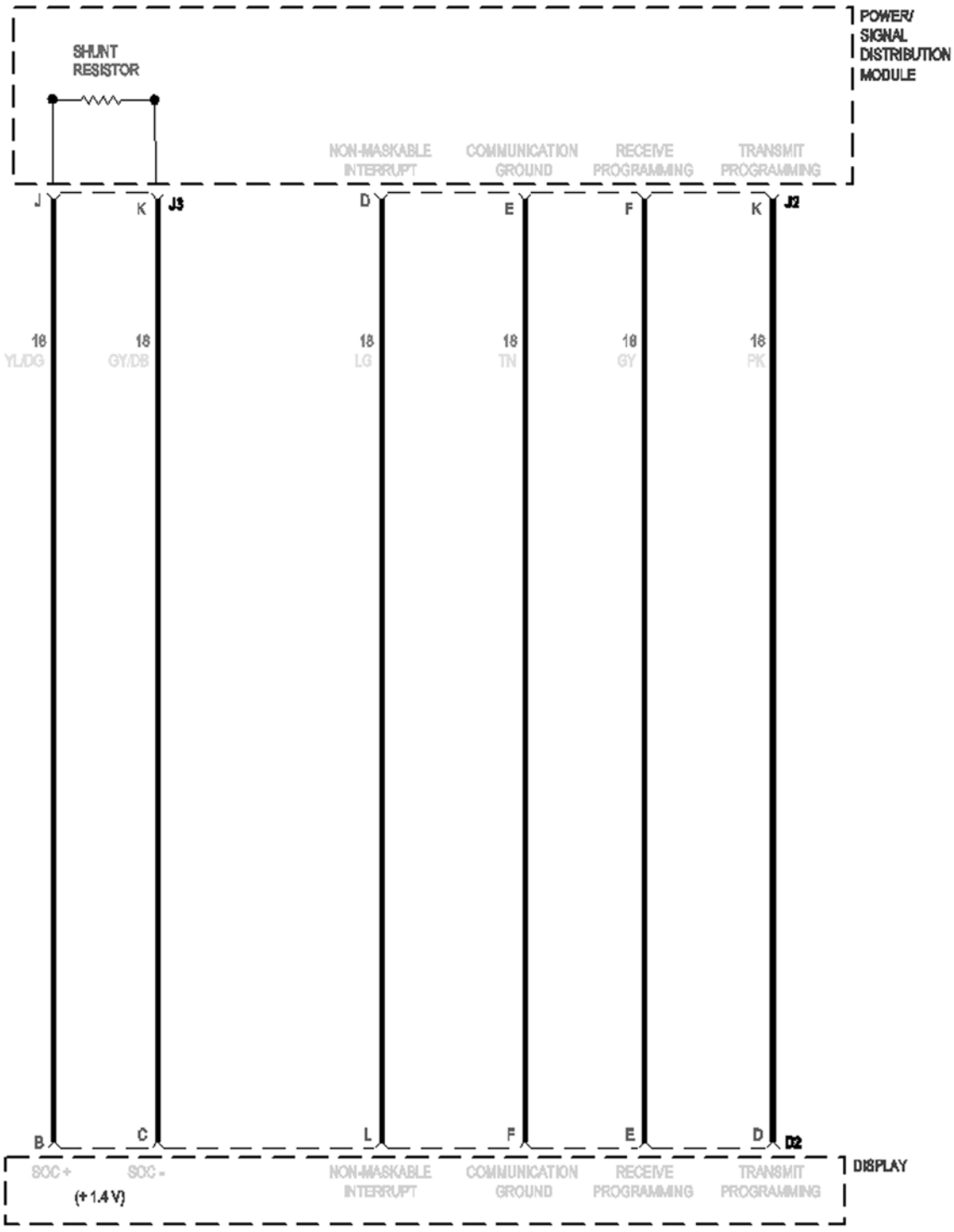


DISPLAY (CONTINUED)



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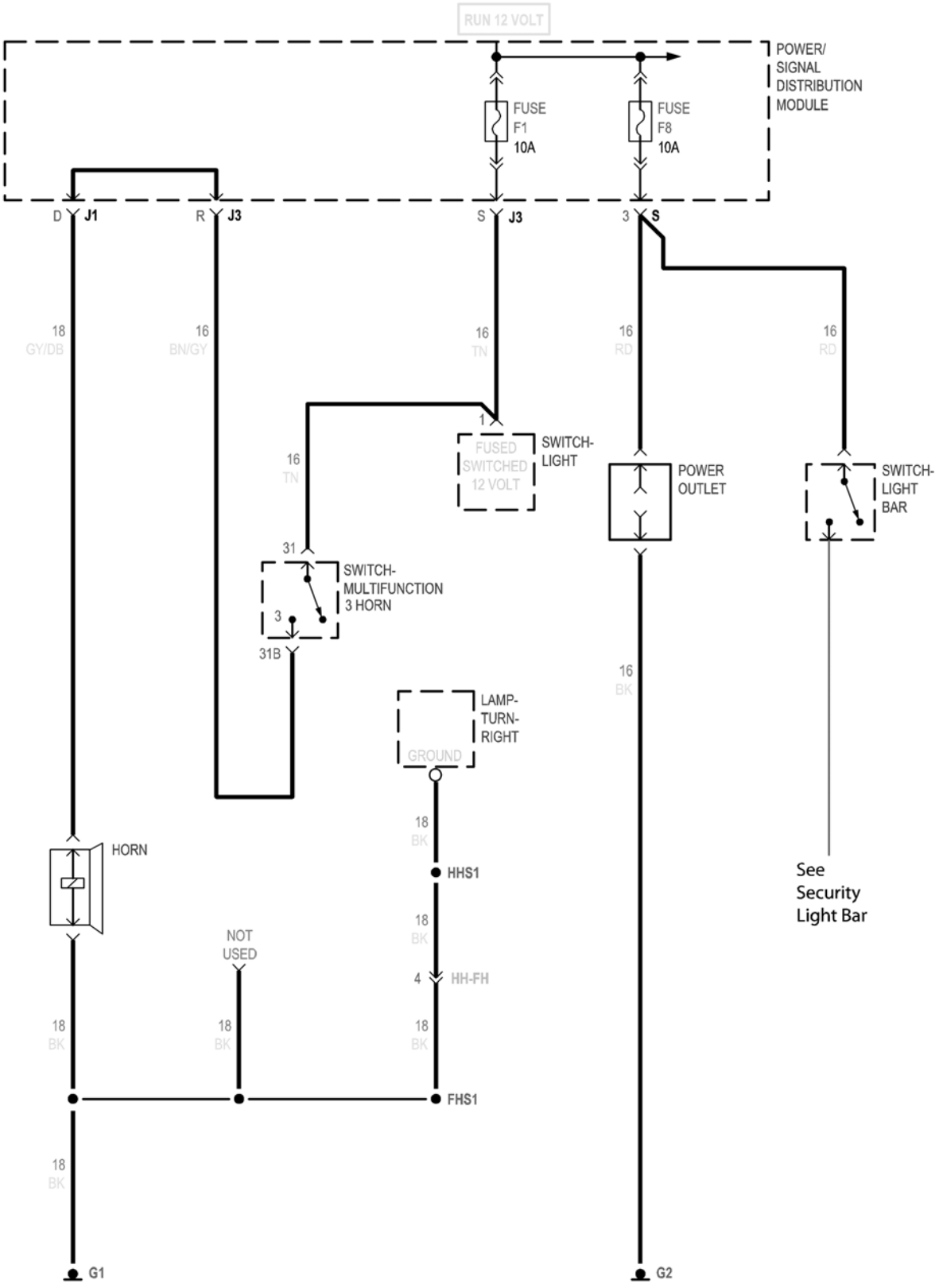
HORN / POWER OUTLET



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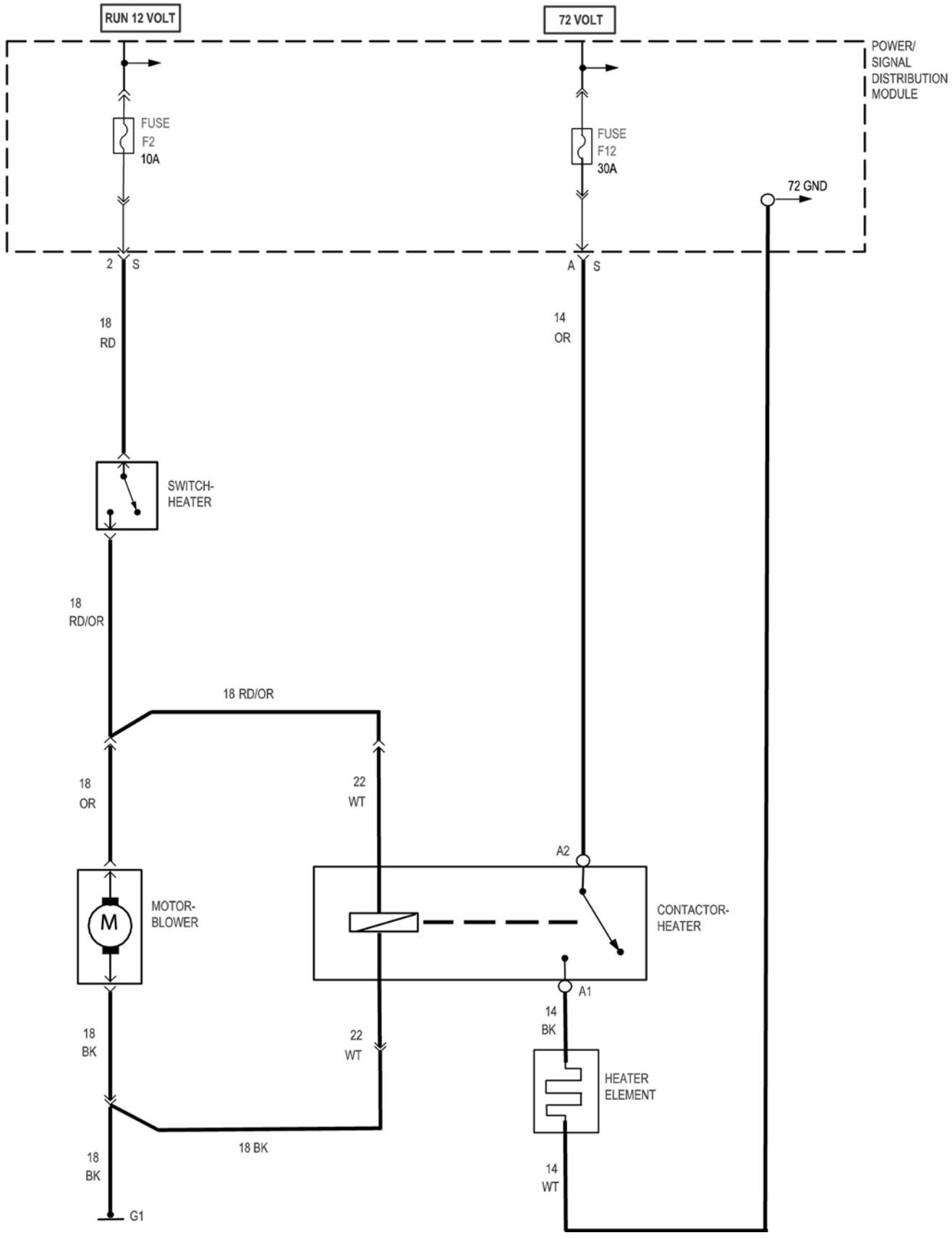
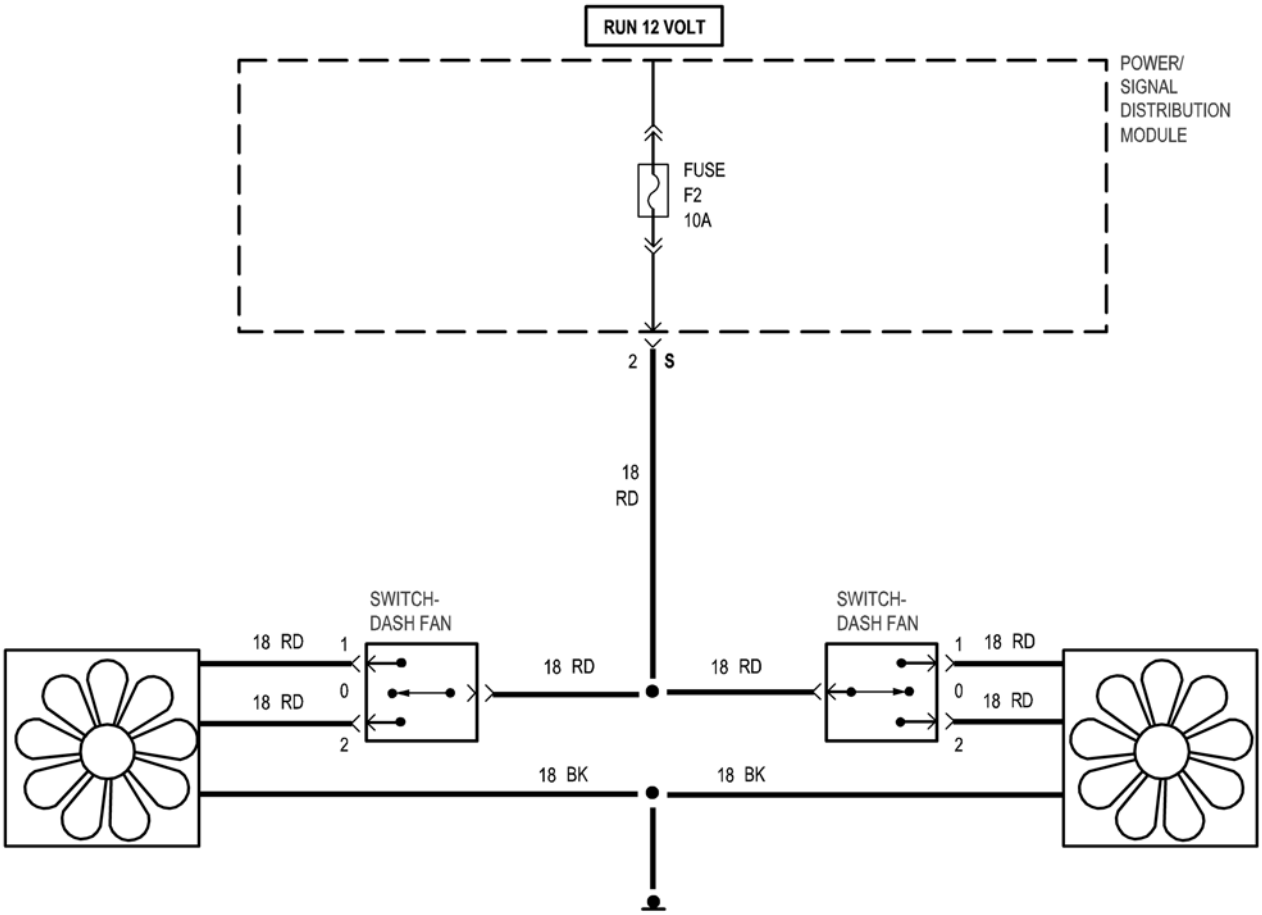
HEATER / DEFOGGER



DASH FAN



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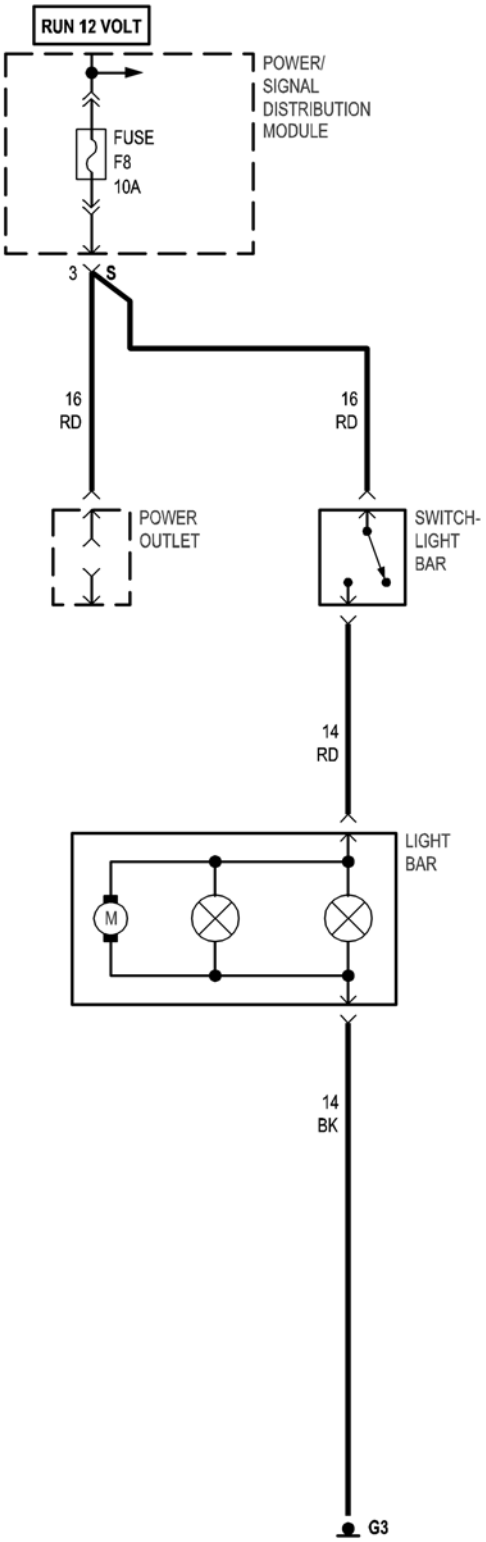
SECURITY LIGHT BAR



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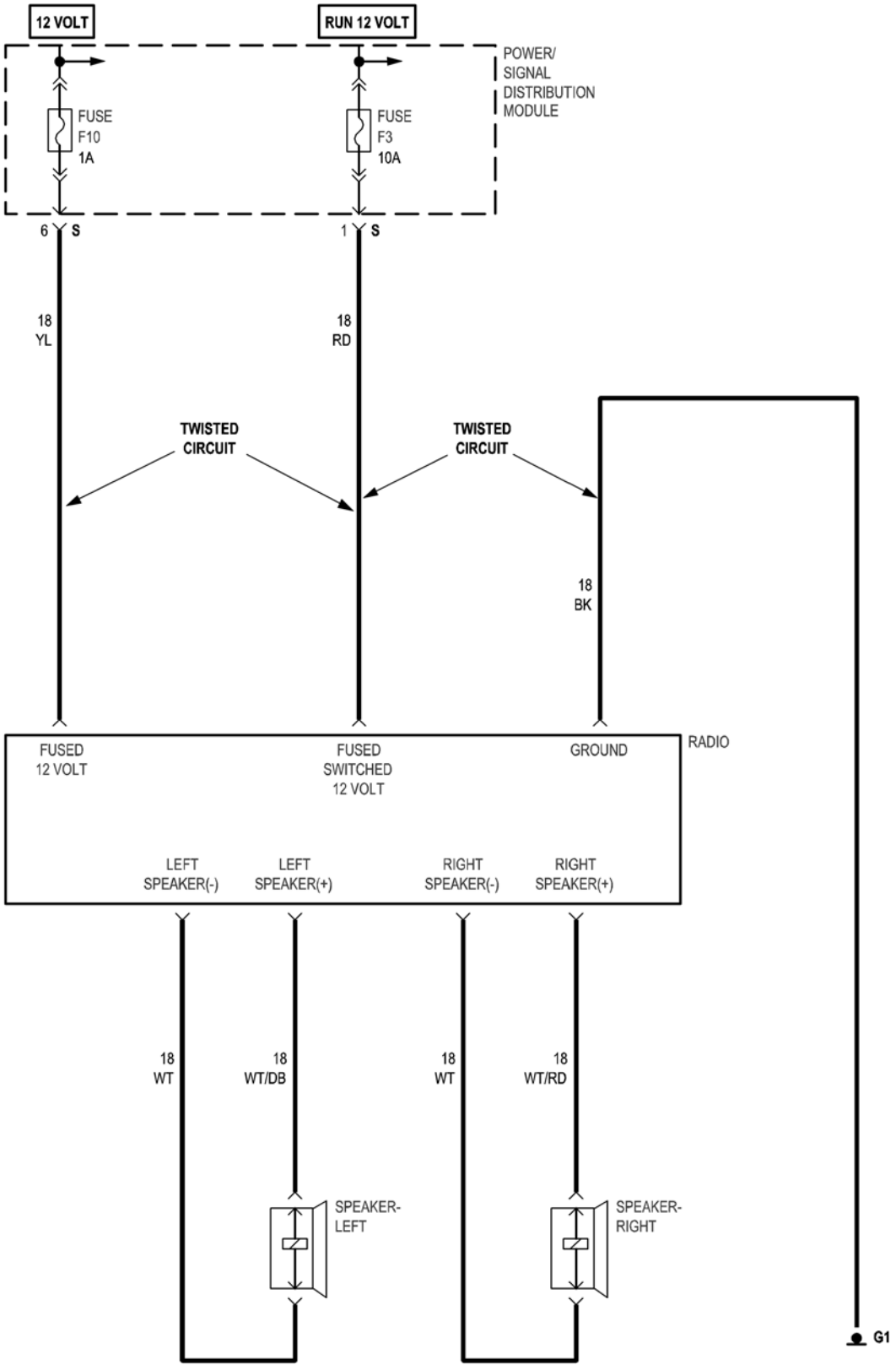
AUDIO SYSTEM



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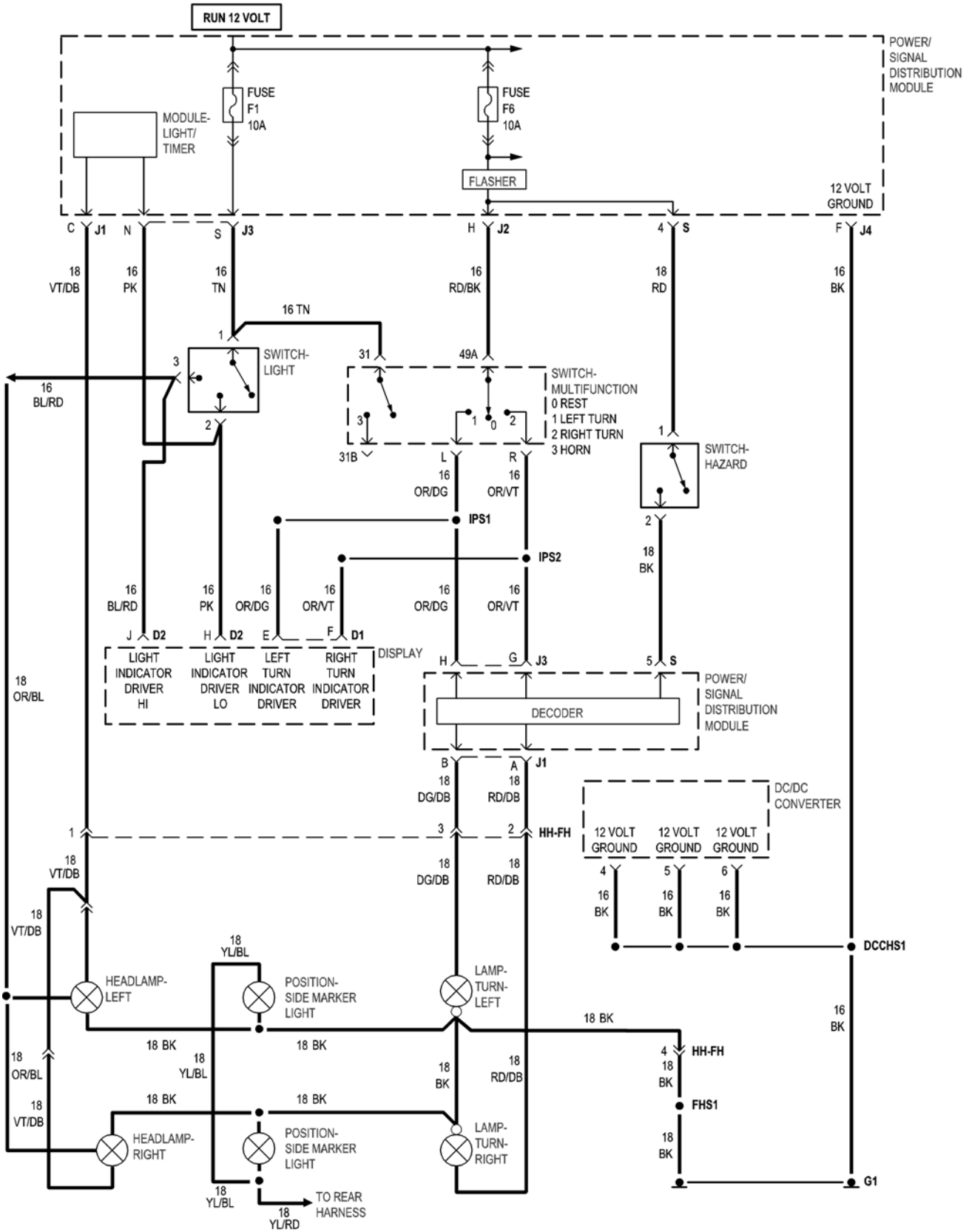
FRONT LIGHTING - HI/LO BEAM



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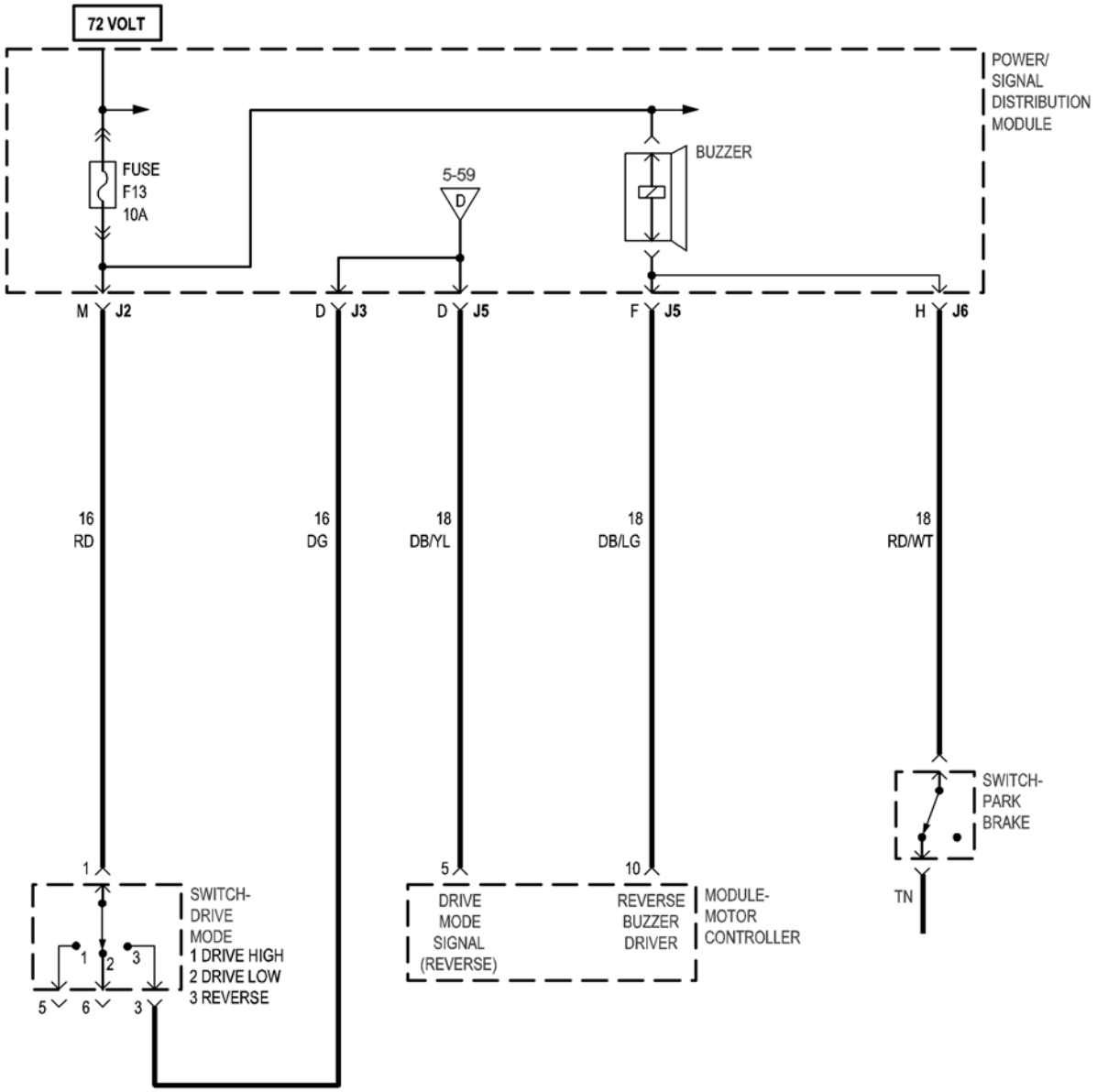
REAR LIGHTING



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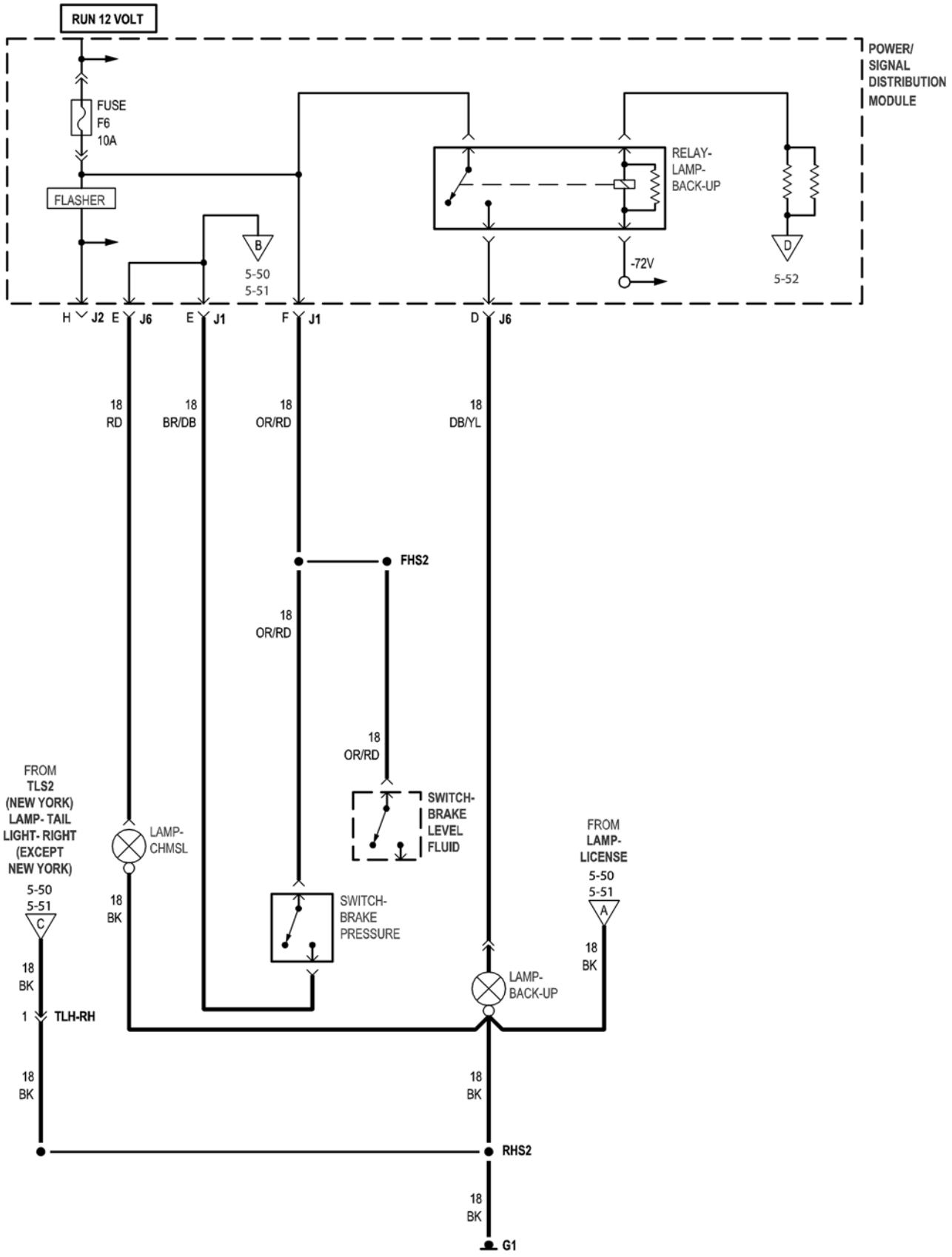
REAR LIGHTING (CONTINUED)



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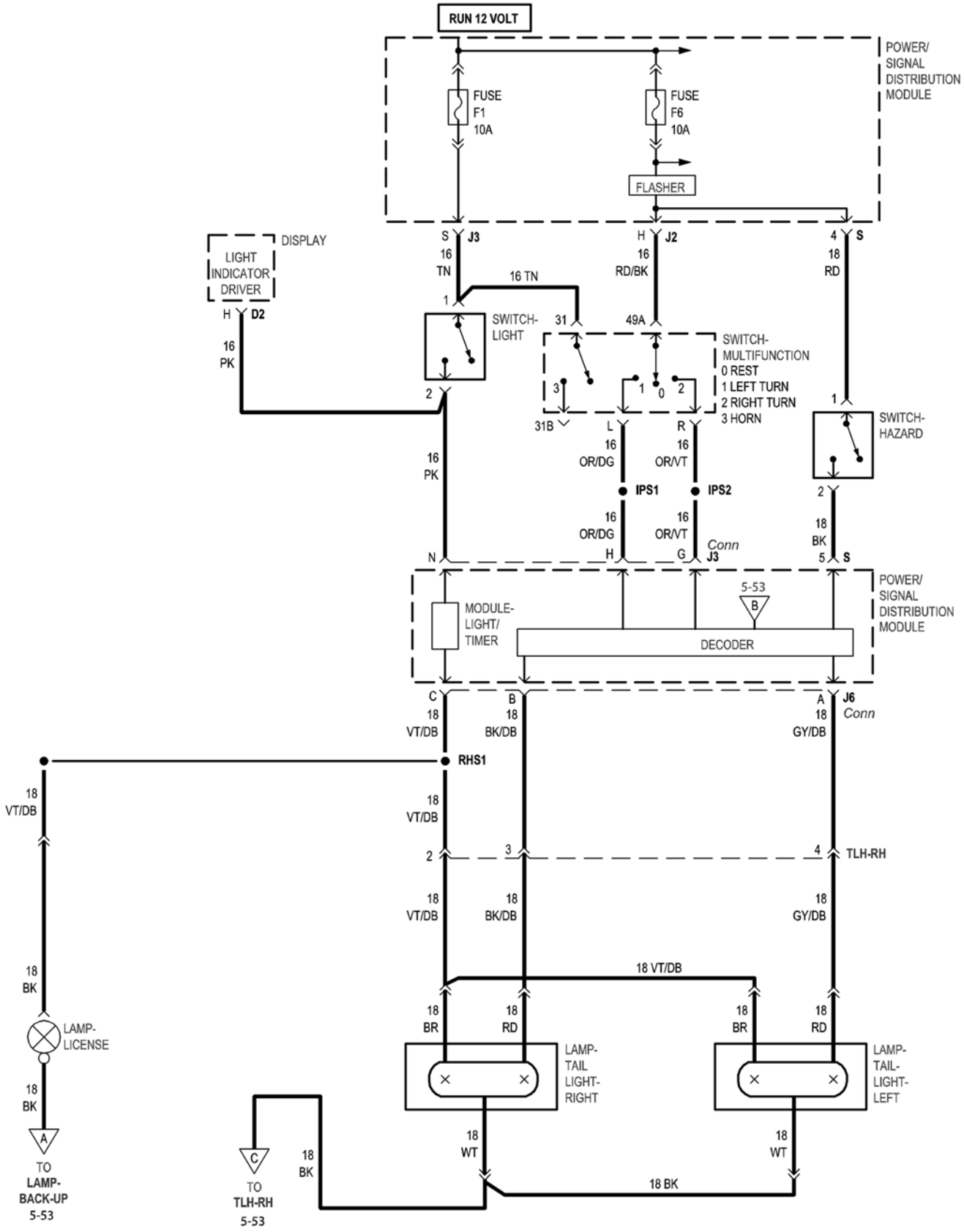
REAR LIGHTING - EXCEPT NEW YORK



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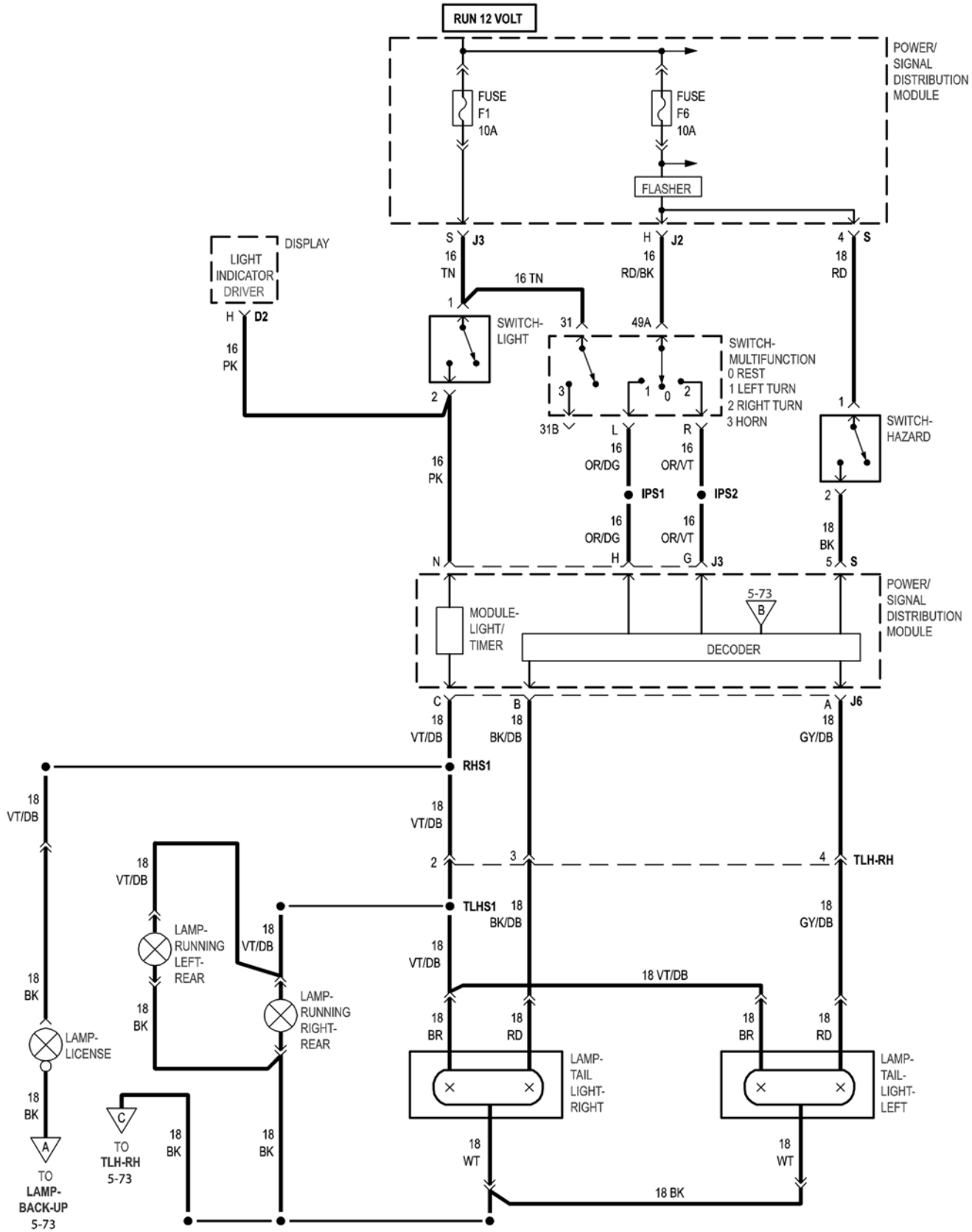
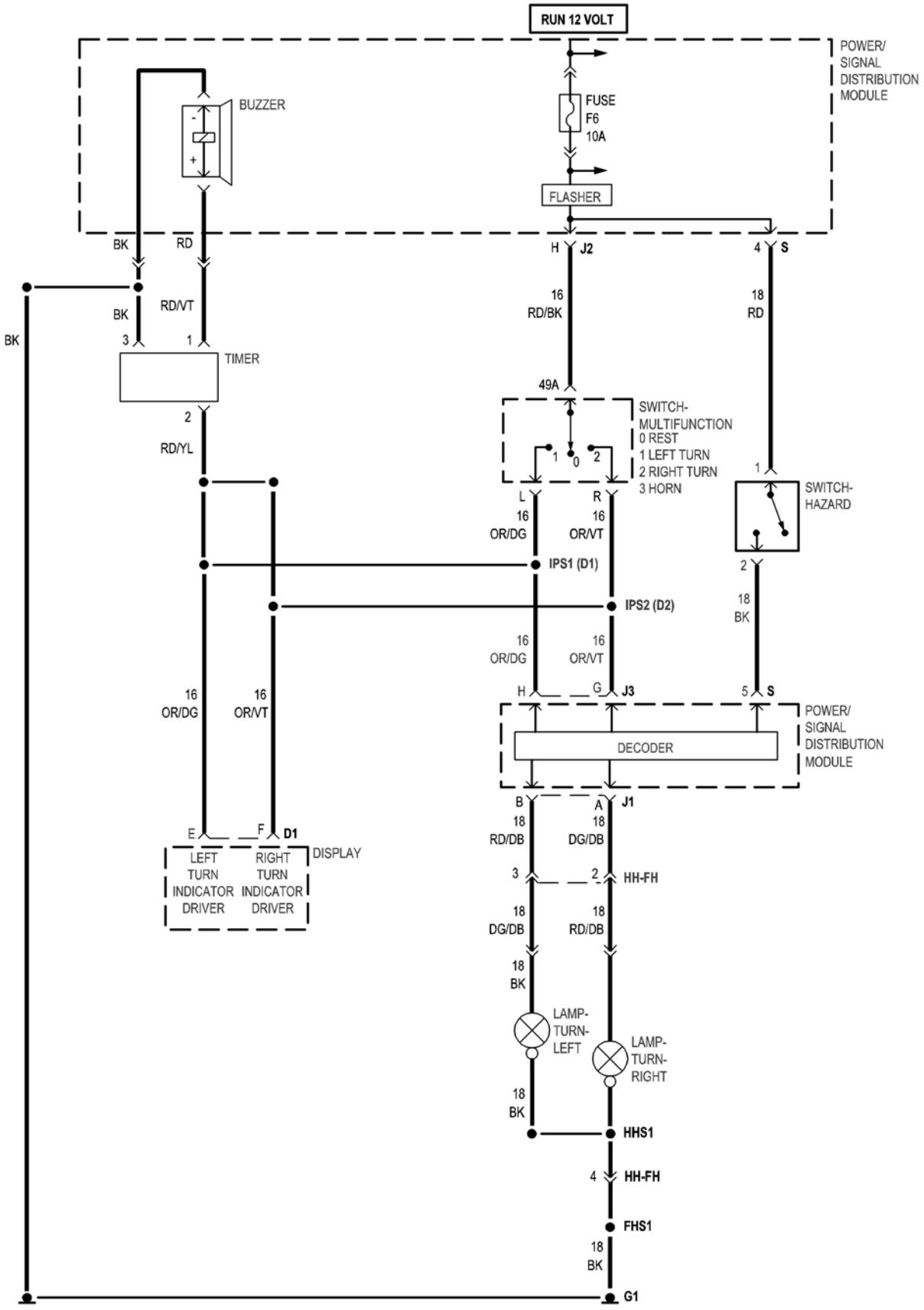
REAR LIGHTING - NEW YORK



TURN SIGNAL REMINDER



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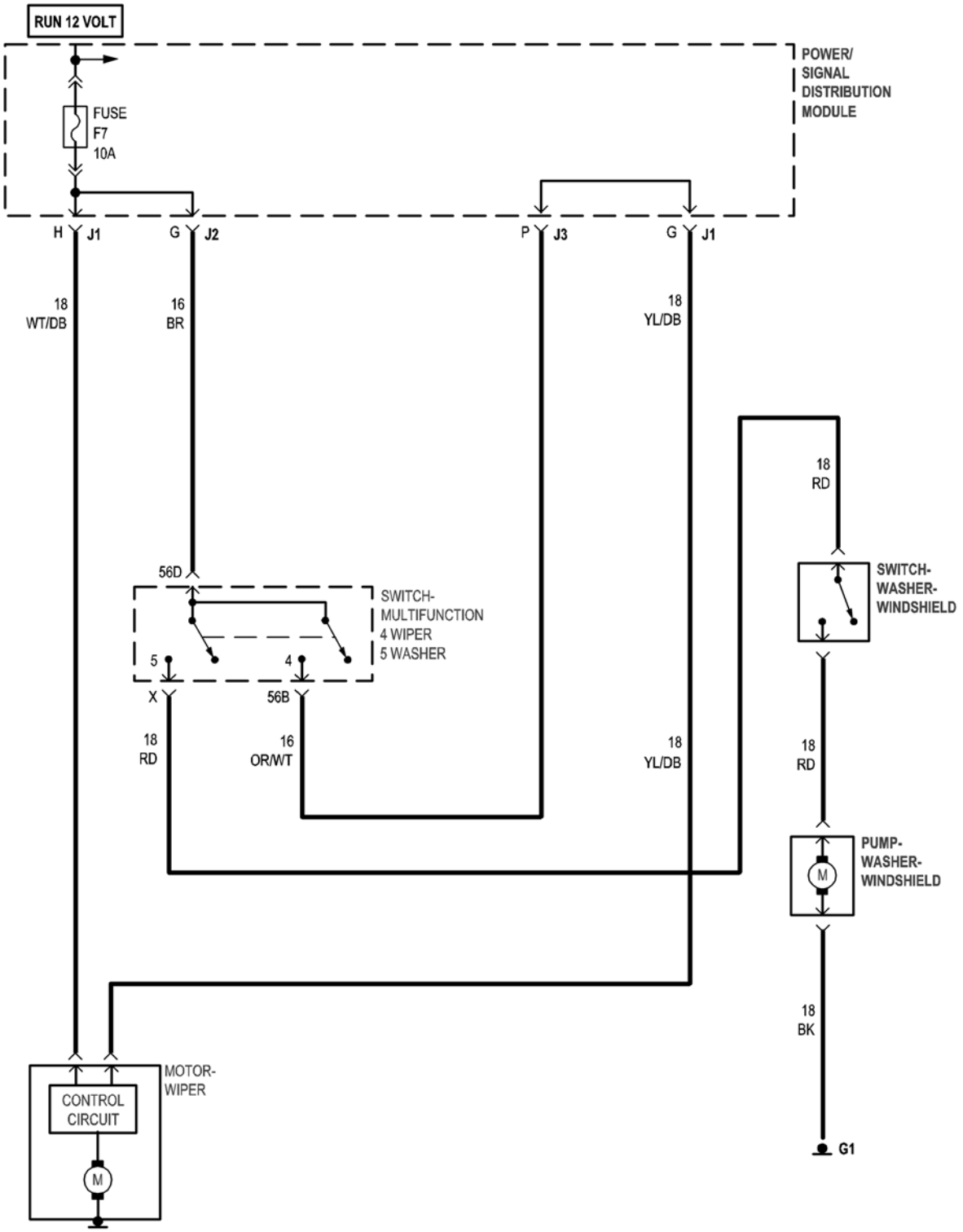
WIPER / WASHER



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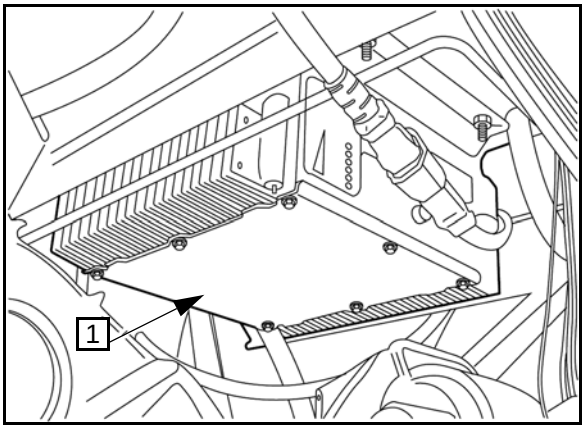
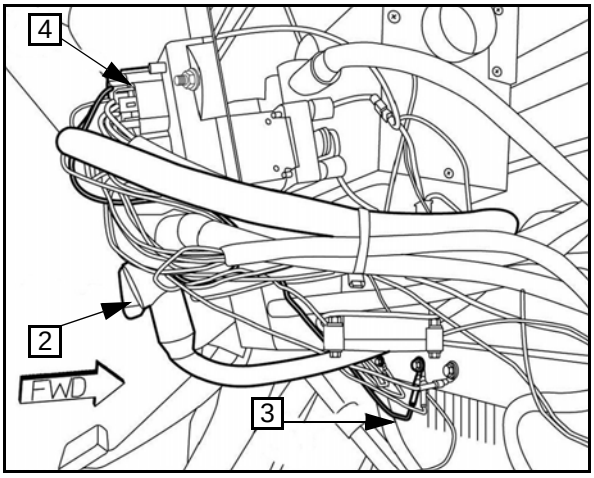
HARNESS AND CONNECTOR DRAWINGS

CONVERTER HARNESS





CONVERTER HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	DC/DC Converter/Charger	12
2,3	72 Volt Ground, 12 Volt Ground	1
4	PSDM J4	6

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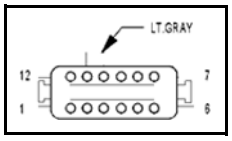
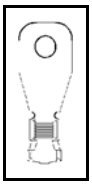
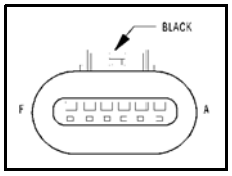
PIN LOCATIONS FOR CONVERTER HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	DC/DC Converter	12
	2, 3	72 Volt Ground, 12 Volt Ground	1
	4	PSDM J4	6

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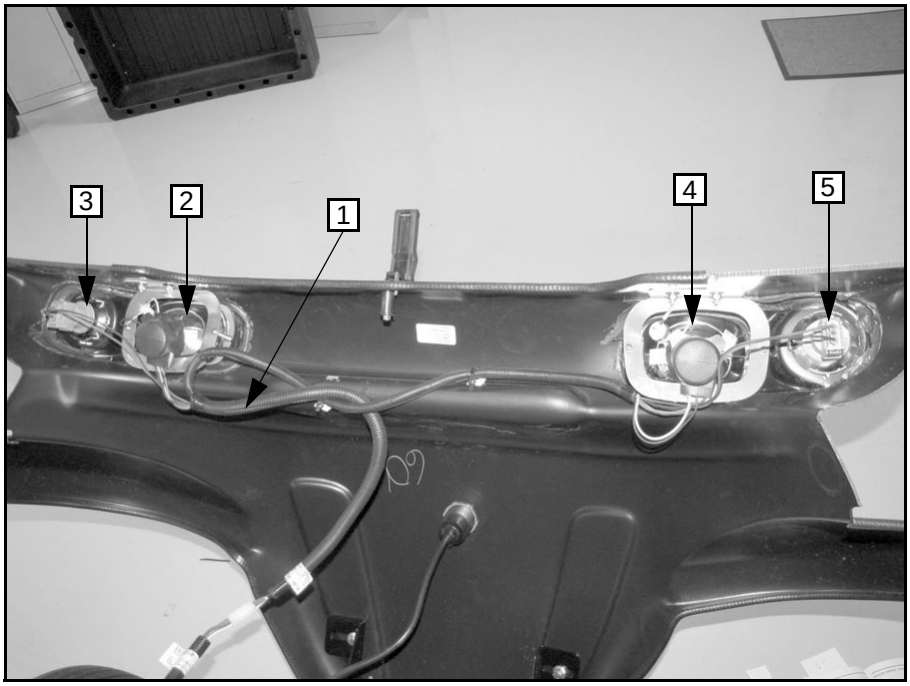
HEADLIGHT HARNESS - STANDARD US DOMESTIC LOW BEAM



HEADLIGHT HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	Headlight Harness	6
2	Head lamp-Left	1
3	Lamp-Turn-Left	1
4	Head lamp-Right	1
5	Lamp-Turn-Right	1

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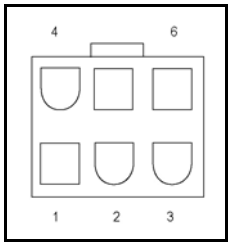
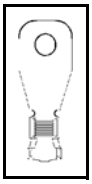
PIN LOCATIONS FOR CONVERTER HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	Headlight Harness	6
	2, 4	Headlights (Power)	1
	3, 5	Turn Lamps (Power)	1
	3, 5	Turn Lamps (Ground)	1

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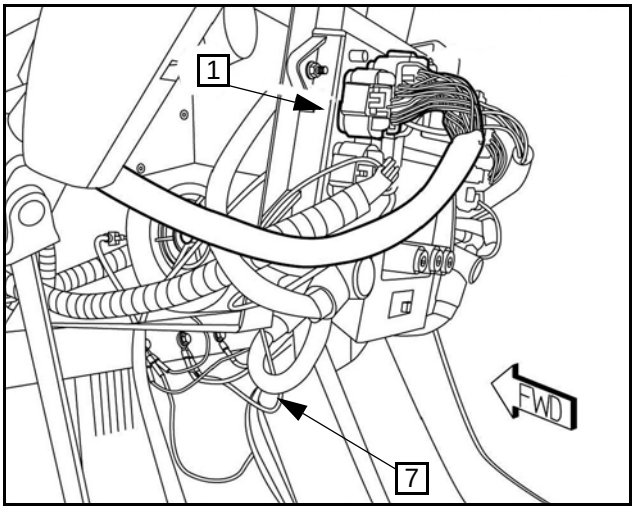
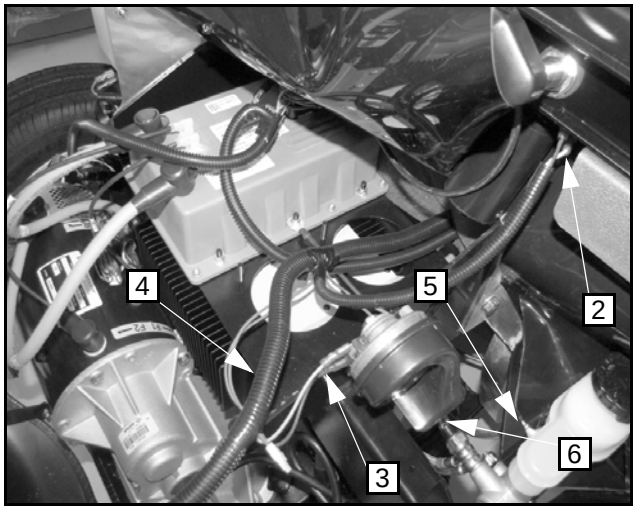
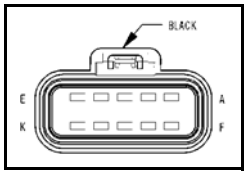
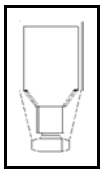
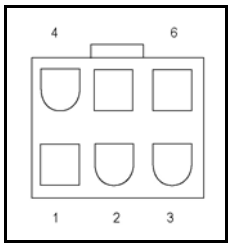
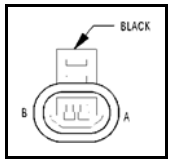
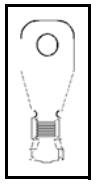
FRONT HARNESS





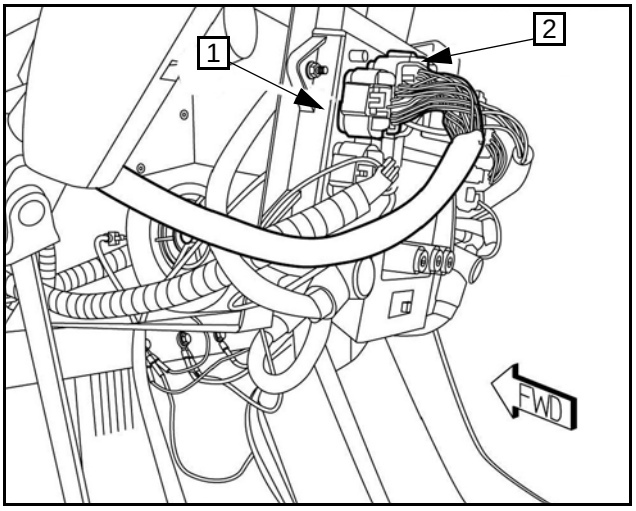
FRONT HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	PSDM J1	10
2 (qty. 3)	Motor-Wiper	1
3 (qty. 2)	Horn	1
4	Front Harness	6
5	Switch-Brake Level Fluid	2
6 (qty. 2)	Switch-Brake Pressure	1
7	12 Volt Ground	1

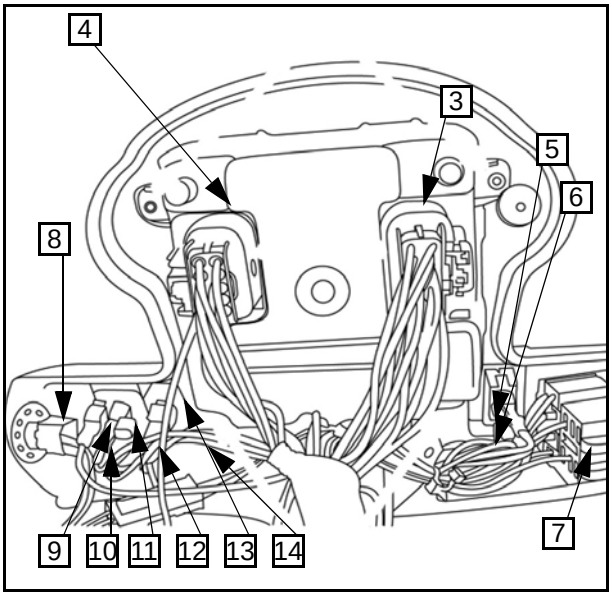
9924112 - 2013 GEM Service Manual

PIN LOCATIONS FOR FRONT HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	PSDM J1	10
	2,3,4,5,6,9,10,11	Horn, Motor-Wiper Switch-Brake Pressure, Charger	1
	7	Front Harness	6
	8	Switch-Brake Level Fluid	2
	11	12 Volt Ground	1

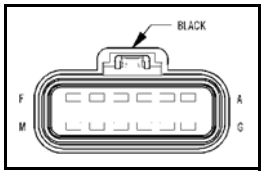
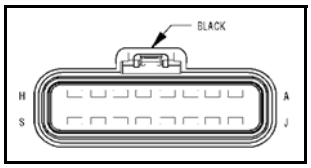
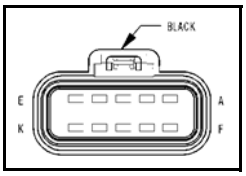
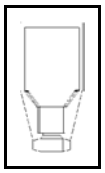
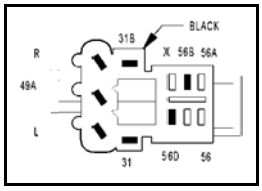
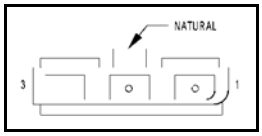
9924112 - 2013 GEM Service Manual

INSTRUMENT PANEL HARNESS





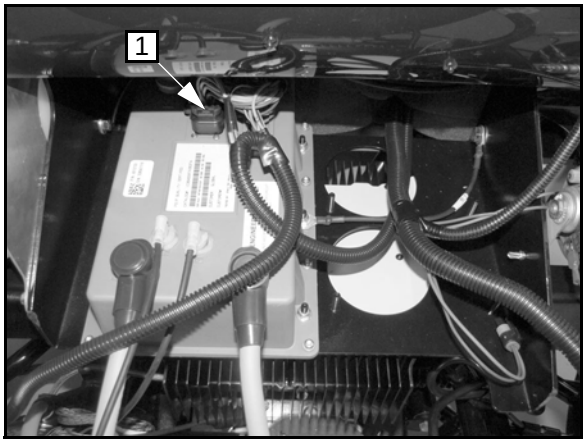
IP HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	PSDM J2	12
2	PSDM J3	16
3	Display D2	12
4	Display D1	10
5,6	Switch-Light	1
7	Switch-Multifunction	10
8	Switch-Key	3
9,10, 11, 12	Switch-Drive Mode	1
13,14	Switch-Trip/Odometer	1

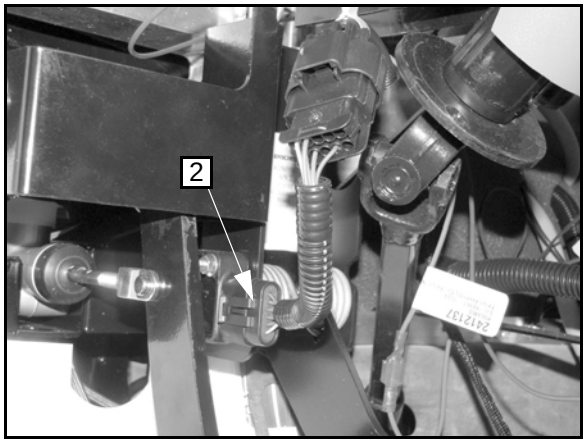
PIN LOCATIONS FOR IP HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1,3	Display D2, PSDM J2	12
	2	PSDM J3	16
	4	Display D1	10
	5,6,9,10,11,12,13,14	Switch-Drive Mode, Switch-Trip Odometer, Switch-Light	1
	7	Switch-Multifunction	10
	8	Switch-Key	3

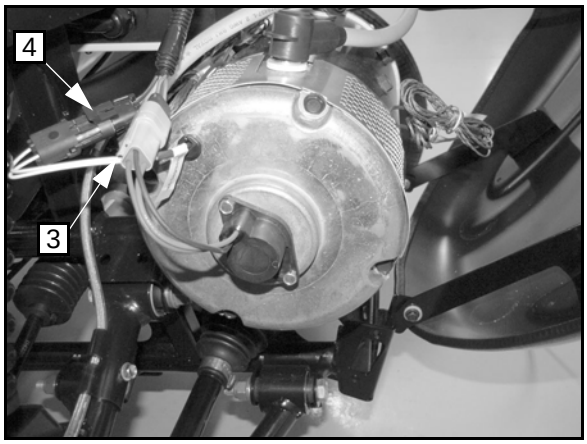
5

9924112 - 2013 GEM Service Manual

CONTROLLER HARNESS

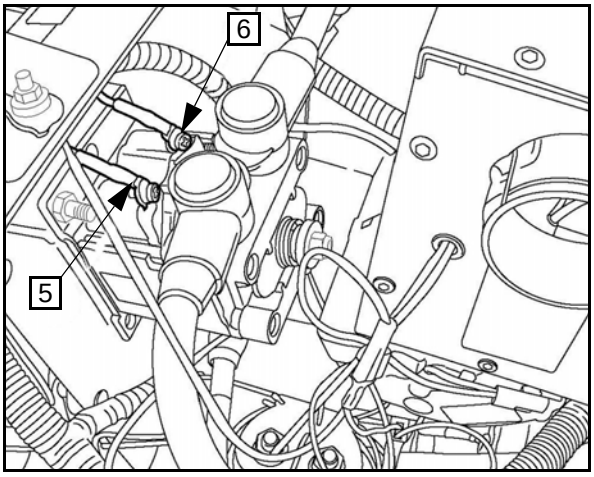


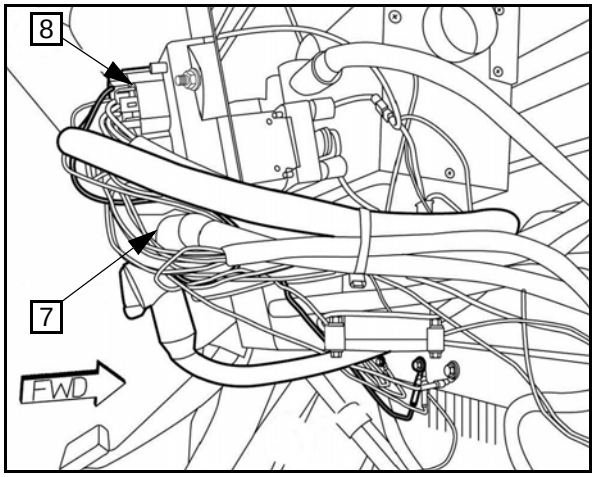




CONTROLLER HARNESS CONNECTIONS		
Connector Number	**Connects to**	**Number of Pins in Connector**
1	Module-Motor Controller	23
2	Switch-Accelerator Pedal	10
3	Tachometer	3
4	Sensor, Motor Temperature	2

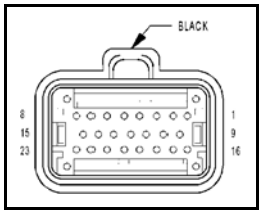
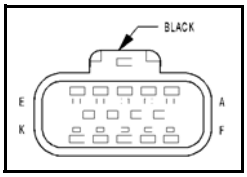
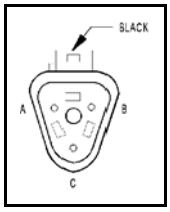
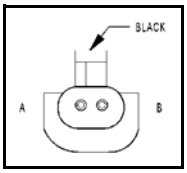
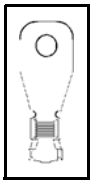
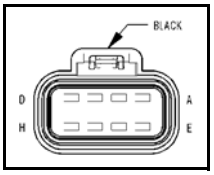
CONTROLLER HARNESS (CONTINUED)





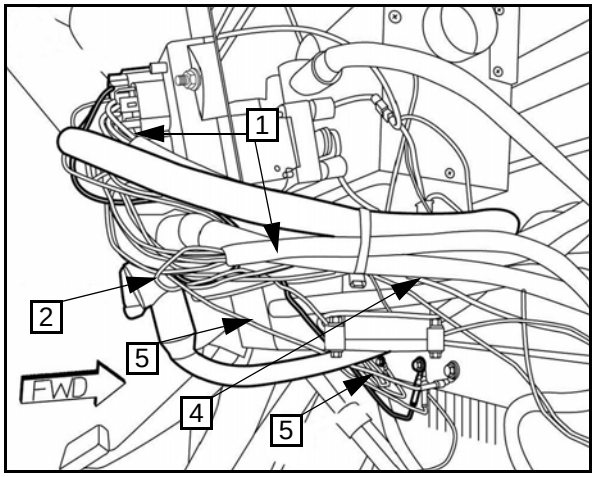
CONTROLLER HARNESS CONNECTIONS		
Connector Number	**Connector to**	**Number of Pins in Connector**
5, 6	Main Contactor (Coil)	1
7	PSDM 72 Volt Ground	1
8	PSDM J5	8

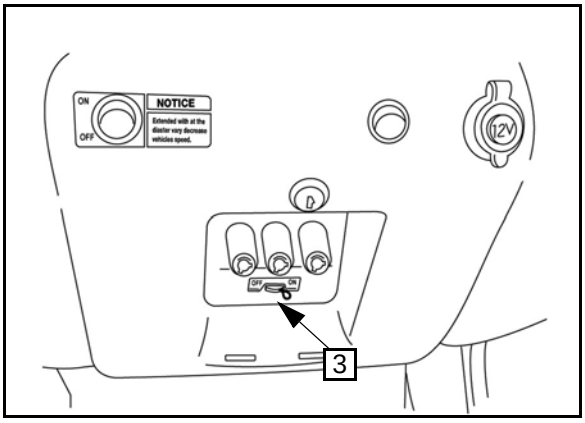
9924112 - 2013 GEM Service Manual

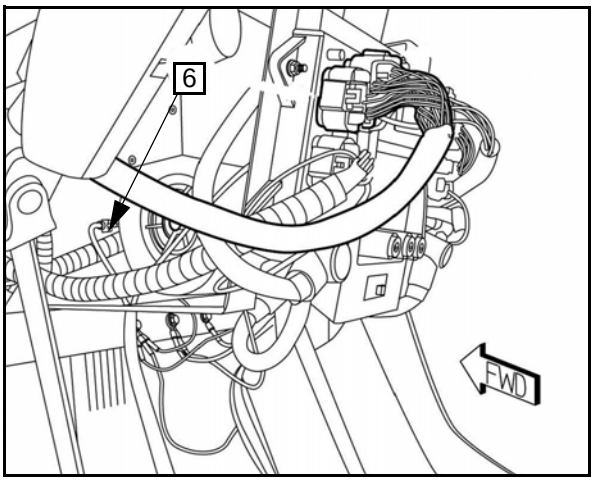
PIN LOCATIONS FOR CONTROLLER HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	Module-Motor Controller	23
	4	Switch-Accelerator Pedal	10
	5	Tachometer	3
	6	Switch-Motor Temperature	2
	9	PSDM 72 Volt Ground	1
	10	PSDM J5	8

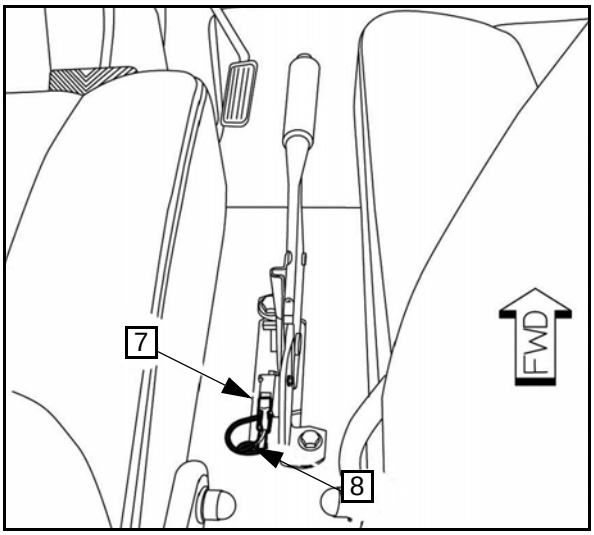
9924112 - 2013 GEM Service Manual

MAIN HARNESS





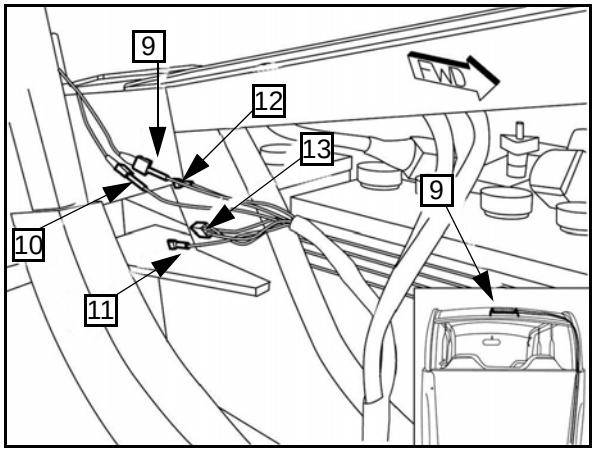


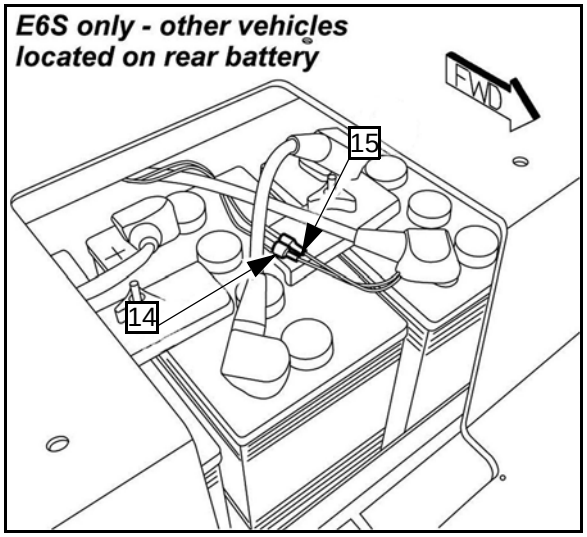


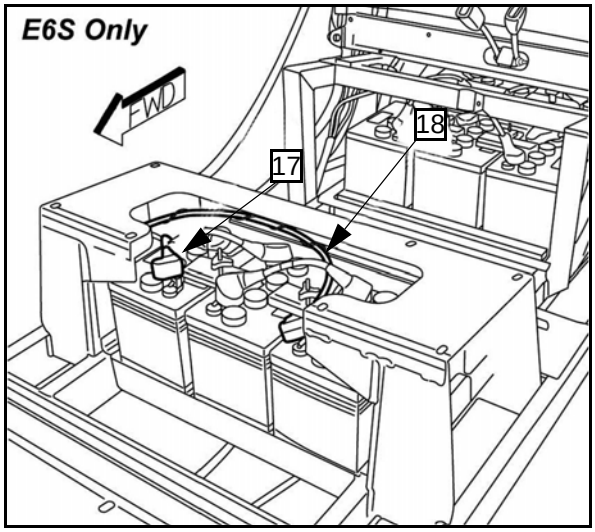
PASSENGER REAR HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	PSDM J6	8
2	72 Volt Ground	1
3	PSDM-Disconnect Switch	1
4	PSDM-BATT(-)	1
5	12 Volt Ground	1
6	Charger - Battery Temp Sensor	1
7,8	Switch-Park Brake	1

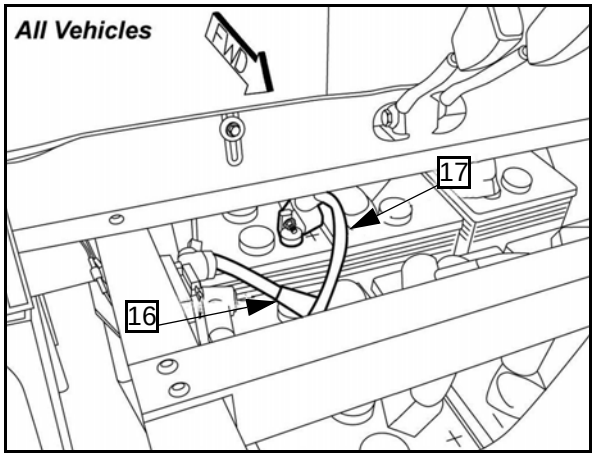
9924112 - 2013 GEM Service Manual

MAIN HARNESS (CONTINUED)



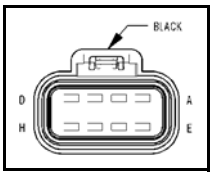
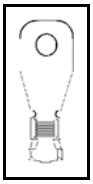
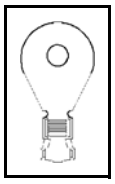
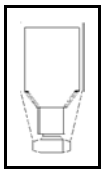
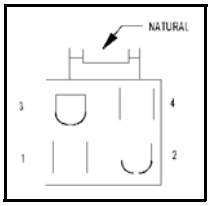






PASSENGER REAR HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
9	Lamp-CHMSL	1
10	Lamp-CHMSL (Ground)	1
11	Lamp-License	1
12	Lamp-Back-Up	1
13	Taillight Harness	4
14,15	Battery Temperature Sensor	1
16	BATT (-)	1
17	BATT (+)	1
18	Main Harness	1

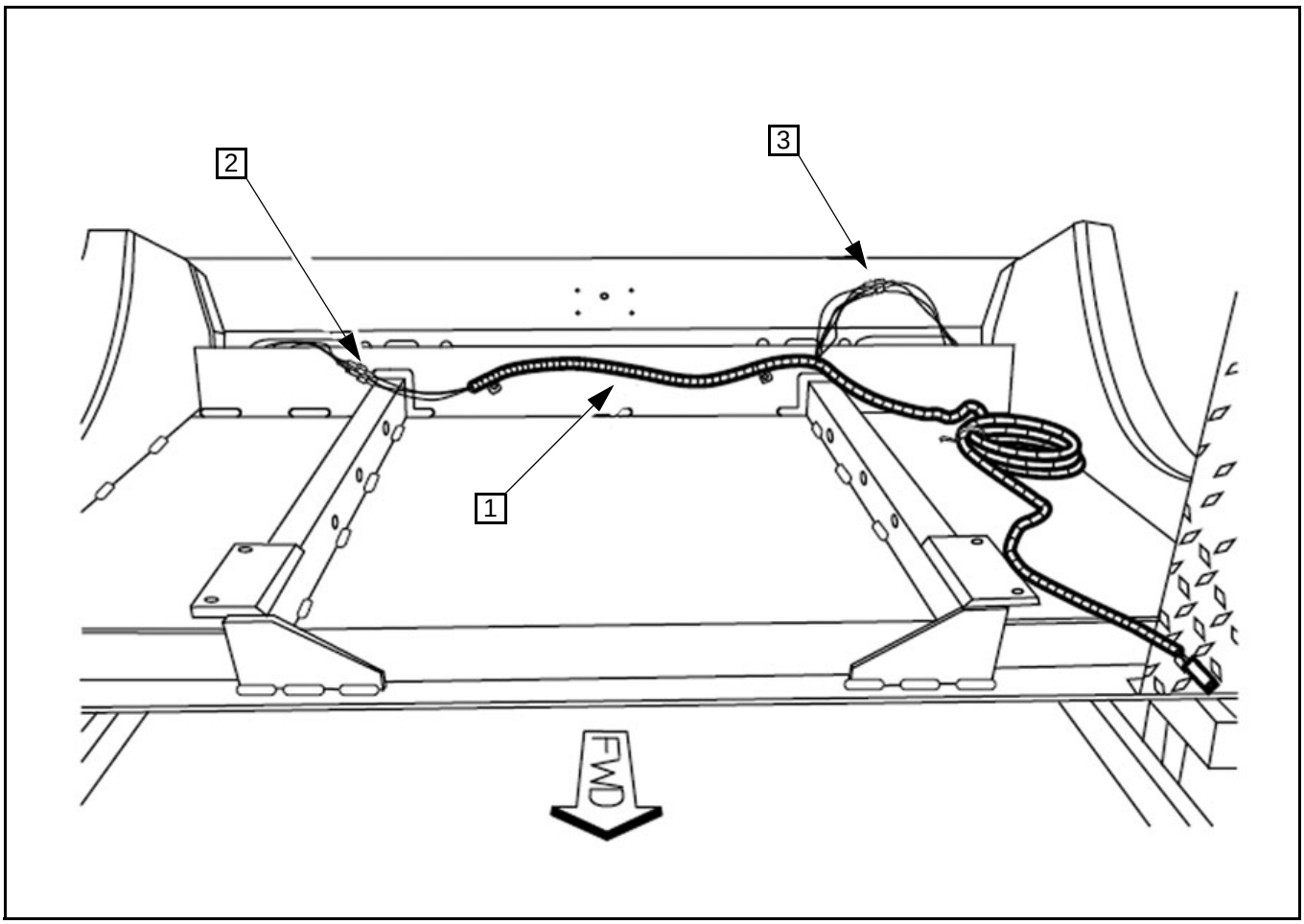
9924112 - 2013 GEM Service Manual

PIN LOCATIONS FOR MAIN HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	PSDM J6	8
	2,5	12 Volt Ground, 72 Volt Ground	1
	3,4,16,17	PSDM-Disconnect Switch, PSDM-BATT(-), BATT 1(-), BATT 6(+)	1
	6,7,8,9,10,11,12,14,15	Charger for BTS, Switch-Park Brake, Lamp-CHMSL, Lamp-License, Lamp- Back-Up, Lamp-License (Ground), Battery Temperature Sensor	1
	13	Taillight Harness	4

5

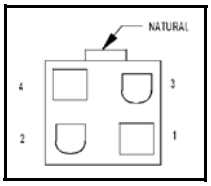
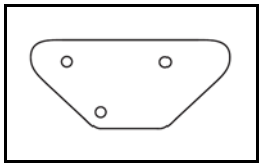
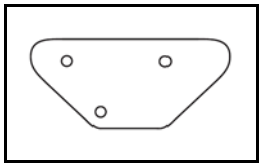
9924112 - 2013 GEM Service Manual

TAIL LIGHT HARNESS



TAIL LIGHT HARNESS CONNECTIONS		
Connector Number	**Connects To**	**Number of Pins in Connector**
1	Rear Harness	4
2	Lamp-Taillight-Left	3
3	Lamp-Taillight-Right	3

9924112 - 2013 GEM Service Manual

PIN LOCATIONS FOR TAIL LIGHT HARNESS CONNECTORS			
Connector Illustration	**Connector Number**	**Connects To**	**Number of Pins in Connector**
	1	Rear Harness	4
	2	Lamp-Taillight-Left, Lamp-Taillight-Right	3
	3	Lamp-Taillight-Left, Lamp-Taillight-Right	3

9924112 - 2013 GEM Service Manual

DIGITAL WRENCH® OPERATION

DIGITAL WRENCH® DIAGNOSTIC SOFTWARE OVERVIEW

The Digital Wrench® diagnostic software allows the technician to perform the following tasks:

- View or clear trouble codes
- Review trouble code definitions and troubleshooting
- View or set the tire size
- View or set the odometer miles

Special Tools

DIGITAL WRENCH® DIAGNOSTIC SOFTWARE	PART NUMBER
Digital Wrench® Software	PU-48731
GEM Communication Cable with Power Adapter	PL-51023
USB-Serial Adapter Cable	PU-50621
Laptop or Desktop Computer	Commercially Available (refer to diagnostic software user manual or HELP section for minimum requirements)

DIAGNOSTIC SOFTWARE VERSION

Always use the most current version of the Digital Wrench® software to ensure you have the latest updates or enhancements. New reprogramming files and guided diagnostic procedures are added to these updates as they become available. For information on how to determine if you have the latest update available, refer to “Digital Wrench® Version and Update ID”.

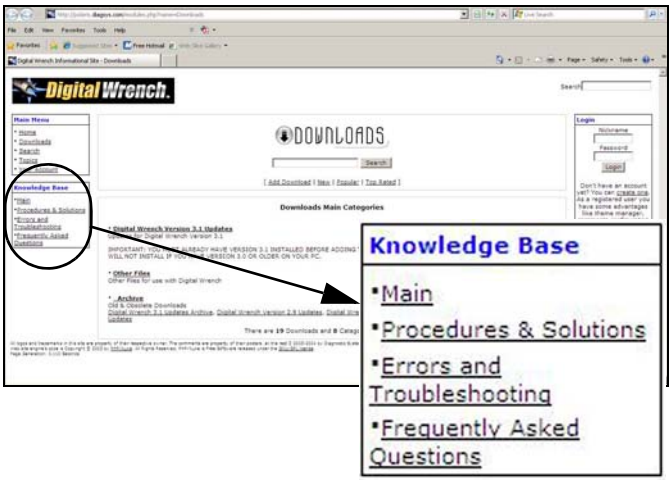
CONTROLLER REPLACEMENT

Although the need for controller replacement is unlikely, a specific replacement procedure is required to ensure that the new controller is programmed properly, and the correct odometer miles are entered.

When a new controller is being programmed for a vehicle, the appropriate tire size must be selected, and the "Apply Selection" button MUST be clicked. This will ensure that the controller is programmed for the proper configuration, per the vehicle selected.

DIGITAL WRENCH® COMMUNICATION ERRORS

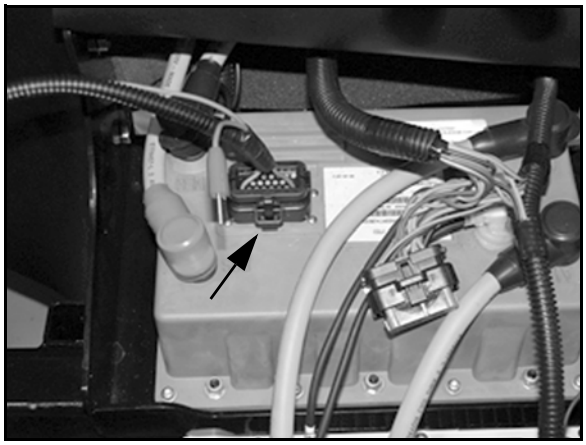
If you experience problems connecting to a vehicle or any Digital Wrench® related problem, visit the Digital Wrench® Knowledge Base for the most current troubleshooting information, FAQs, downloads and software updates at: ***http://polaris.diagsys.com/.***



COMMUNICATION CABLE CONNECTION

Follow these steps to connect the communication cable to a controller installed in a vehicle to allow Digital Wrench® use:

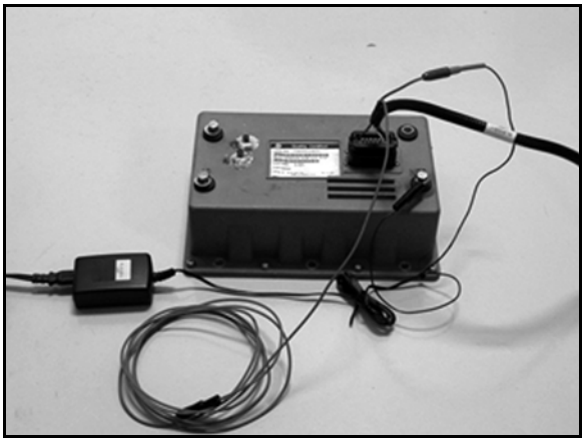
1. Turn the Master Disconnect Switch to the OFF position.
2. Locate and disconnect the 23-pin connector from the motor controller located under the hood.
3. Connect the 23-pin connector of the communication cable to the vehicle's controller.



4. Remove the upper and lower dash assemblies, and connect the alligator clip, from the long RED jumper wire of the communication cable, to the main 72 volt positive terminal on the PSDM.
5. Turn the Master Disconnect Switch to the ON position, select the appropriate vehicle and wait for the status to display ‘Connected’ in the lower left corner of the screen.
6. Once connected, proceed with using Digital Wrench®.

Follow these steps to connect the communication cable to a controller not installed in a vehicle to allow Digital Wrench® use:

1. Connect the 23-pin connector of the communication cable to the controller.



2. Connect the mating banana plug connectors from the power adapter (included with communication cable), and the communication cable.
3. Connect the black alligator clip from the power adapter to the main negative "NEG" terminal on the controller.
4. Plug the power adapter into a standard 110 volt AC wall outlet, select the appropriate vehicle and wait for the status to display ‘Connected’ in the lower left corner of the screen.
5. Once connected, proceed with using Digital Wrench®.

DIGITAL WRENCH® SERIAL NUMBER LOCATION

Open the configuration screen by clicking on the wrench icon. The serial number is located on the right side of the screen.

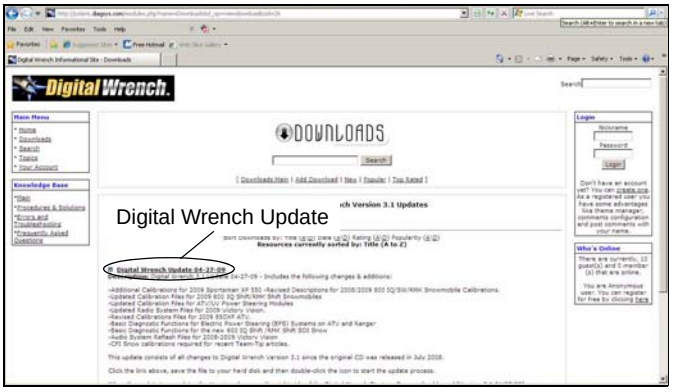
DIGITAL WRENCH® VERSION AND UPDATE ID

Knowing what Digital Wrench® version and update is installed will help determine which updates are required.

NOTE: Versions and updates are subject to change.

1. Open the Digital Wrench® software. Locate the version ID shown on the lower right side of the Digital Wrench® start-up screen.

2. Proceed to ***http://polaris.diagsys.com*** to see if a newer update is available.



3. If a newer update is available, it should be downloaded before using Digital Wrench® (see "Digital Wrench® Updates").

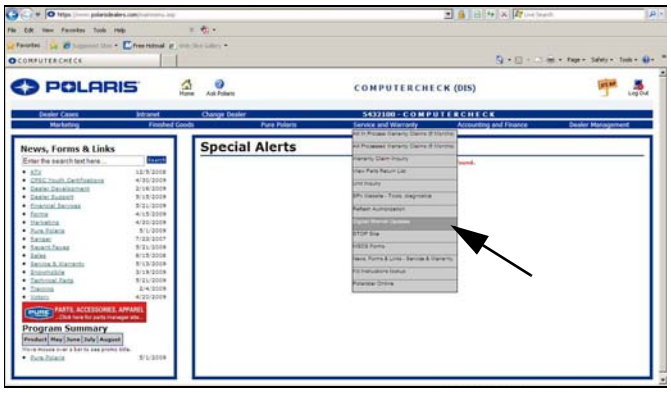
IMPORTANT: Always operate with the latest update.

DIGITAL WRENCH® UPDATES

Updates are released for Digital Wrench® via the Internet at: ***http://polaris.diagsys.com***. The Digital Wrench® website can also be accessed through the dealer website at: ***www.polarisdealers.com***.

NOTE: Only authorized Polaris dealers and distributors can access the dealer website.

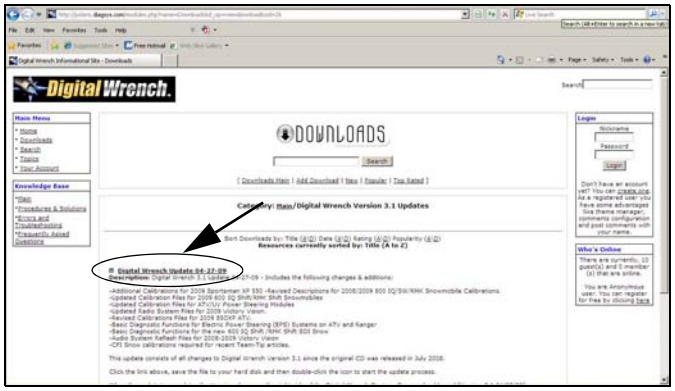
1. Log on to ***www.polarisdealers.com***.
2. Locate the "**Service and Warranty**" drop-down menu.
3. Click on "**Digital Wrench Updates**".



4. The Digital Wrench® portal website should appear in a new web browser.
5. Click on "**Digital Wrench Version Updates**".

IMPORTANT: You must already have the current version installed before adding an update. Updates will not install if you are using an older version loaded on your PC.

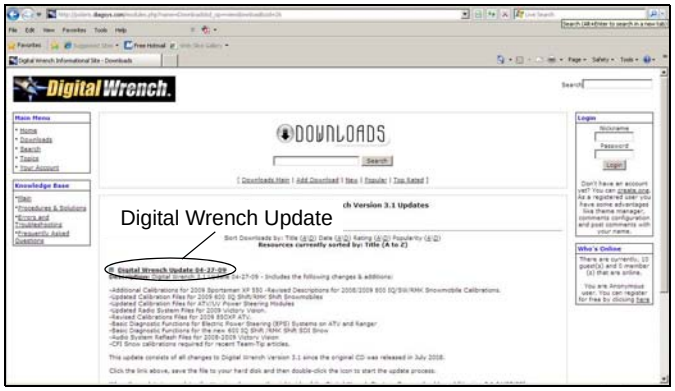
6. If the update file date listed is newer than your current version and update (see “Digital Wrench® Version and Update ID”), download the file.

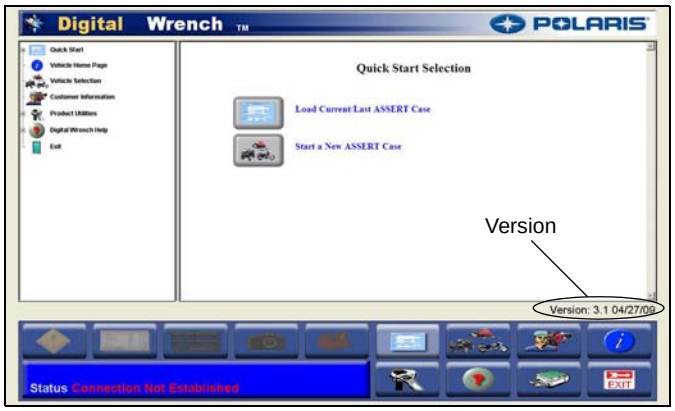


7. Click on the link shown above, save the file to your hard disk and then double-click the icon to start the update process.

NOTE: Do not "run" or "open" the file from where they are. Select "save" and download them to your PC before running the install.

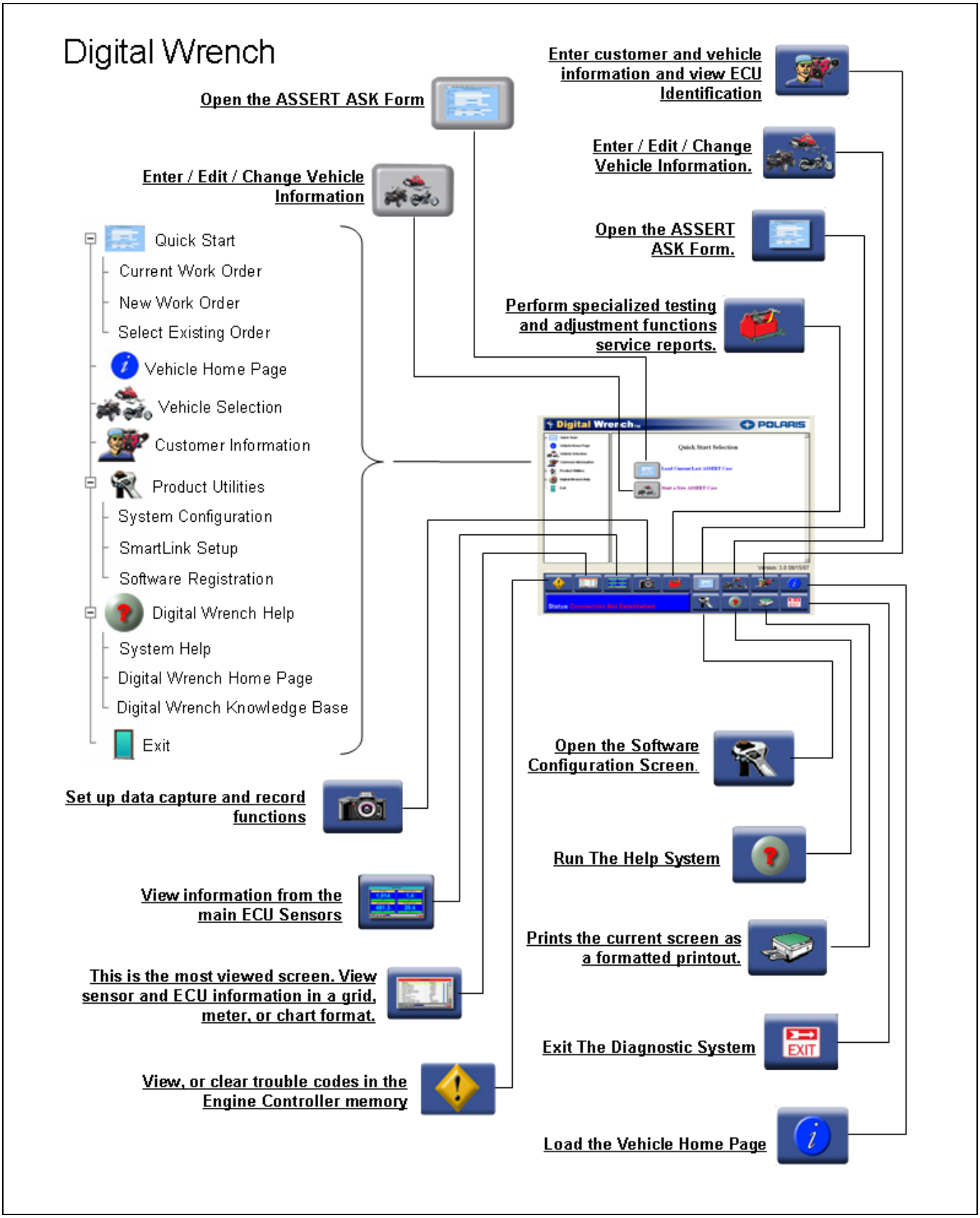
8. When the update is complete, the version shown on the right side of the Digital Wrench® start-up screen should match the update you just downloaded.





NOTE: Versions and updates are subject to change.

DIGITAL WRENCH® FEATURE MAP



9924112 - 2013 GEM Service Manual

VEHICLE SELECTION

Click on the "Vehicle Selection" button to access the diagnostic menu for the vehicle. Use the drop-down boxes to select the year, product line and vehicle description. After selecting the vehicle, the connection status will change from NOT CONNECTED to CONNECTED if the communications cable is connected to the laptop and motor controller. If the status does not change, verify the correct vehicle is selected, and recycle the master on/off switch.

DIAGNOSTIC TROUBLE CODES (DTCs)

Click on the DTC icon to display a list of current and active trouble codes. Click on the "?" button to display the trouble code description. Click on the "Eraser" button to clear all of the trouble codes.

SPECIAL TESTS / CONTROLLER PROGRAMMING

Click on the "Red Toolbox" button to display the special tests menu. Under this menu you can perform the following tasks:

- View or set the tire size
- View or set the odometer miles
- Display vehicle information

GEM PERSONALITY CONFIGURATION

The Personality Configuration menu allows the technician to review and program the motor controller settings.

- View or set the tire size
- View or set the odometer miles

NOTE: Every time a new controller is to be programmed for a vehicle, the appropriate tire size should be selected, and the "Apply Selection" button MUST be clicked. This will ensure that the controller is programmed for the proper configuration, per the vehicle selected. If the odometer miles were able to be read from the old controller, they should be entered in the new controller by typing them in at the "Odometer Miles" section, and then clicking, "Set Odometer."

5

VEHICLE INFORMATION

Click on the vehicle information button to display motor controller information such as software version number.

CHAPTER 6
Wheels and Tires

9924112 - 2013 GEM Service Manual

GENERAL SPECIFICATIONS

DESCRIPTION

The GEM e-series uses steel and aluminum wheels with a 4 bolt pattern, and tires in four different sizes as shown in the charts below:

WHEEL CHART

	Standard	Turf (Option)	Premium (Option)
Construction	Steel	Aluminum	Aluminum
Diameter	12″	12″	14″
Width	4″	7″	6″
Backspace	2-1/8″	3 ½″	3-3/4″
Bolt Pattern	4 x 4″	4 x 4″	4 x 4”
Capacity	900 lbs	1200 lbs	1047 lbs
Torque (ft-lbs)	65	90	95

TIRE CHART

	Standard	Turf (Option)	Premium (Option)
Tire	Nankang NY 361	Innova Driver	Duro
Size	165/70R12 77T	215/50 R12	185/60R14 82H
Construction	Steel belt radial	Nylon	Steel belt radial
Ply Rating	4	2	4
Load Range	B	B	B
Rim Width	4.5″	8″	6″
Max Section Width	6.5″	8.5″	7.75″
Overall Diameter	21″	20.5″	22.75″
Maximum Load	795 lbs	910 lbs	1047 lbs
Approx. weight	13 lbs	12 lbs	18 lbs
Revs. Per Ml	942	985	880
Air Pressure	32 psi	30 psi	36 psi

TIRES

DESCRIPTION

Tires are designed and engineered for each specific vehicle. They provide the best overall performance for normal operation. The ride and handling characteristics match the vehicle's requirements. With proper care they will give excellent reliability, traction, skid resistance, and tread life.

Driving habits have more effect on tire life than any other factor. Careful drivers will obtain in most cases, much greater mileage than severe use or careless drivers. A few of the driving habits, which will shorten the life of any tire, are:

- Rapid acceleration
- Severe brake applications
- Excessive speeds on turns
- Striking curbs and other obstacles

Radial-ply tires are more prone to irregular tread wear. It is important to follow the tire rotation interval. This will help to achieve a greater tread life.

RADIAL - PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance. They must always be used in sets of four.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. The use of tires from different manufacturers on the same vehicle is not recommended. The proper tire pressure should be maintained on all four tires.

INFLATION PRESSURES

Proper tire inflation pressure is essential to the safe and satisfactory operation of the vehicle. Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure.

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks. Both under and over inflation affect the stability of the vehicle and can produce a feeling of sluggish response or over-responsiveness.

Unequal tire pressures can cause steering problems, resulting in loss of control of the vehicle. For proper tire pressure specification, refer to the VIN/Certification Label at the left rear of the roof panel. The label also lists proper wheel and tire size for the vehicle. (See VIN/Certification Label in Introduction section.)

Tire pressures have been chosen to provide safe operation, vehicle stability, and a smooth ride. Tire pressure should be checked cold once a month. Tire pressure decreases as the ambient temperature drops. Checks tire pressure frequently when ambient temperature varies widely.

Specified tire inflation pressures are cold inflation pressures. The vehicle must sit for at least 3 hours to obtain the correct cold inflation pressure reading, or be driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. Do not reduce this normal pressure build-up.

⚠ WARNING

Over or under inflated tires can affect vehicle handling and tread wear. This may cause the tire to fail suddenly, resulting in loss of vehicle control.

9924112 - 2013 GEM Service Manual

REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:

- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommended that tires equivalent to the original equipment tires be used when replacement is needed.

⚠ WARNING

Do not use a tire size other than that specified. Improper size tires can cause vehicle components to wear out prematurely and may change the vehicle's ride, handling and steering behavior. In addition, it may affect the accuracy of the speedometer/odometer. Using tire sizes other than specified could cause loss of control, resulting in serious personal injury or death.

⚠ WARNING

Never use a tire smaller than the size specified. Using a smaller tire could result in tire overloading and failure.

⚠ WARNING

Overloading the tires is dangerous. Like under inflation, overloading can cause tire failure. Use tires of the recommended load capacity, and never overload the vehicle

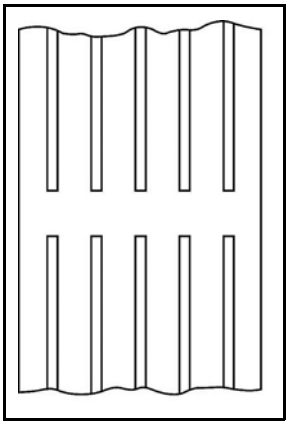
DIAGNOSIS AND TESTING - PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

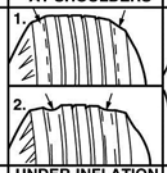
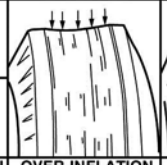
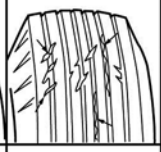
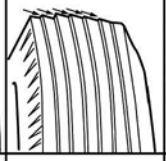
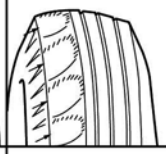
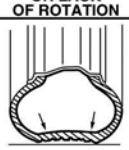
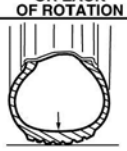
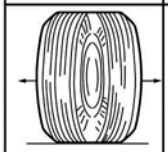
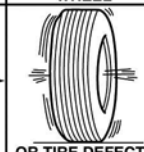
DIAGNOSIS AND TESTING - TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread depth is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band.

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.



DIAGNOSIS AND TESTING - TIRE WEAR PATTERNS

CONDITION	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
EFFECT						
CAUSE	UNDER-INFLATION OR LACK OF ROTATION 	OVER-INFLATION OR LACK OF ROTATION 	UNDER-INFLATION	INCORRECT TOE 	UNBALANCED WHEEL  OR TIRE DEFECT *	LACK OF ROTATION OF TIRES OR WORN OR OUT-OF-ALIGNMENT SUSPENSION.
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL ROTATE TIRES			ADJUST TOE-IN TO SPECIFICATIONS	DYNAMIC OR STATIC BALANCE WHEELS	ROTATE TIRES AND INSPECT SUSPENSION SEE GROUP 2

* HAVE TIRE INSPECTED FOR FURTHER USE.

DIAGNOSIS AND TESTING - TIRE NOISE AND VIBRATION

Radial-ply tires are sensitive to force impulses caused by improper mounting, vibration, wheel defects, or possibly tire imbalance.

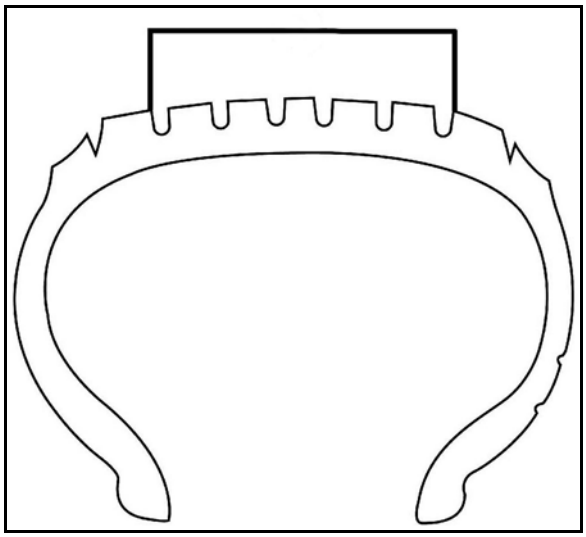
To find out if tires are causing the noise or vibration, drive the vehicle over a smooth road at varying speeds. Note the noise level during acceleration and deceleration. The motor and differential noises will change as speed varies, while the tire noise will usually remain constant.

REPAIRING LEAKS

For proper repairing, a radial tire must be removed from the wheel. Repairs should only be made if the defect, or puncture, is in the tread area. The tire should be replaced if the puncture is located in the sidewall.

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges that could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.



9924112 - 2013 GEM Service Manual

TIRE ROTATION

Tires on the front and rear operate at different loads and perform different steering, driving, and braking functions. For these reasons they wear at unequal rates and tend to develop irregular wear patterns. Rotating the tires at 500 miles or as needed. The benefits of tire rotation are:

- Increase tread life
- Maintain traction levels
- A smooth, quiet ride

The suggested method of tire rotation is shown below. Other rotation methods can be used, but they will not provide all the tire longevity benefits.

WHEELS

DESCRIPTION

All models use stamped steel wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps.

Initial inflation of the tire forces the bead over these raised sections. In case of rapid loss of air pressure, the raised sections help hold the tire on the wheel.

The wheel nuts are designed for this specific application. Do not use replacement nuts with a different design or lesser quality.

DIAGNOSIS AND TESTING - WHEEL INSPECTION

Inspect wheels for:

- Excessive run out
- Dents or cracks
- Damaged wheel lug nut holes
- Air leaks from any area or surface of the rim

NOTE: Do not attempt to repair a wheel by hammering, heating or welding.

If a wheel is damaged an original equipment replacement wheel should be used. When obtaining replacement wheels, they should be equivalent in load carrying capacity. The diameter, width, offset and bolt circle of the wheel should be the same as the original wheel.

⚠ WARNING

Failure to use equivalent replacement wheels may adversely affect the safety and handling of the vehicle. Used wheels are not recommended. The service history of the wheel may have included severe treatment or very high mileage. The rim could fail without warning.

WHEEL REMOVAL

NOTE: The wheel studs and nuts are designed for this vehicle. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design.

1. Remove hubcap.
2. Loosen four wheel lug nuts.
3. Raise and support vehicle on suitable hoist.
4. Remove four wheel lug nuts, and tire and wheel assembly.

⚠ CAUTION

Never use oil or grease on studs or nuts.

Wheels must be replaced if they:

- Have excessive run-out,
- Are bent or dented,
- Leak air through welds, or
- Have damaged bolt holes.

Wheel repairs employing hammering, heating, or welding are not allowed. Original equipment wheels are available through your dealer. Replacement wheels from any other source should be equivalent in:

- Load carrying capacity
- Diameter
- Width
- Offset
- Mounting configuration

WHEEL INSTALLATION

⚠ WARNING

Failure to use equivalent replacement wheels may adversely affect the safety and handling of the vehicle. Used wheels are not recommended. The service history of the wheel may have included severe treatment or very high mileage. The rim could fail without warning.

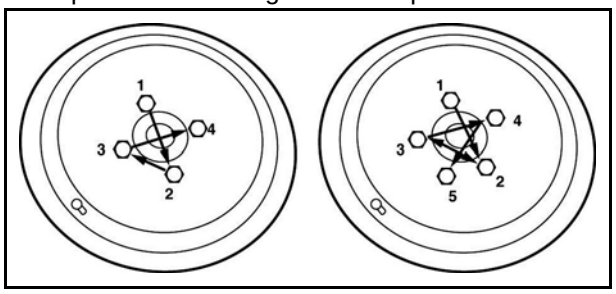
Failure to properly install tires may result in failure of vehicle control and result in damage to vehicle.

⚠ CAUTION

Never use oil or grease on studs or nuts.

NOTE: The wheel studs and nuts are designed for this vehicle. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design.

1. Inspect wheel mounting surfaces to ensure cleanliness and corrosion does not exist.
2. Install wheel and tire assembly, and hand tighten four wheel lug nuts.
3. Lower vehicle to floor.
4. Torque four wheel lug nuts in sequence.



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Wheel Lug Nuts - 12″ (steel):
65 ft-lbs (88 Nm)
Wheel Lug Nuts - 12″, 14″ (aluminum):
95 ft-lbs (129 Nm)

5. Install hubcap.

9924112 - 2013 GEM Service Manual

NOTES

CHAPTER 7
Body

9924112 - 2013 GEM Service Manual

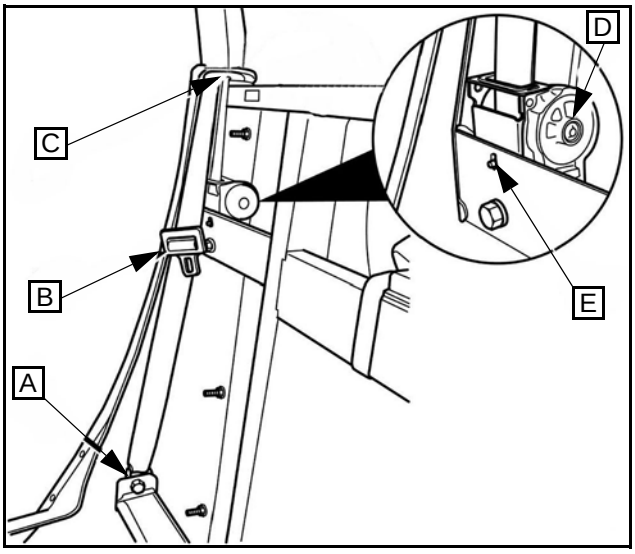
SEAT BELTS

DESCRIPTION

Three-point automotive shoulder/lap belts are used with bench and bucket seats. The seat belt is anchored to a flange at the lower outboard end of the seat back support frame. The seat belt passes through a D-ring mounted at the upper outboard edge of the seat back support frame, into a retractor assembly mounted to the seat back frame approximately six inches below the D-ring. A seat belt latch assembly is mounted at the lower center of the seat back support frame.

Seat belts should be inspected monthly for the following signs of wear:

1. Frayed edges on web.
2. Scores across web.
3. Obvious signs of wear on web at buckle.
4. Corrosion of any of metal parts or fasteners. If any of these signs are present, locate and correct cause, and replace seat belt assembly.



A. Seat belt anchor
B. Buckle assembly
C. D-ring
D. Retractor assembly
E. Locating tab

SEAT BELT REMOVAL

1. Position master disconnect switch OFF.
2. Remove lower seat cushion. See Bench Seats in this section.
3. Remove seat back assembly. See Bench Seats in this section.
4. Remove body back panel. See Body Back Panel in this section.
5. Remove bolt from D-ring to seat back support.
6. Remove bolt attaching retractor assembly to seat back support.
7. Remove body foot bracket attaching seat back support and body support arm.
8. Remove seat belt assembly.
9. Remove bolt attaching seat belt latch assembly to seat back support.
10. Remove seat belt latch assembly.

SEAT BELT INSTALLATION

1. Attach seat belt latch assembly to seat back support with mounting bolt. Torque to specification.
2. Attach D-ring to seat back support, ensuring straight portion of D-ring faces forward. Torque mounting bolt to specification.
3. Attach retractor assembly to seat back support. Torque mounting bolt to specification.

IMPORTANT: Tab on retractor assembly must engage locating hole on seat back support.

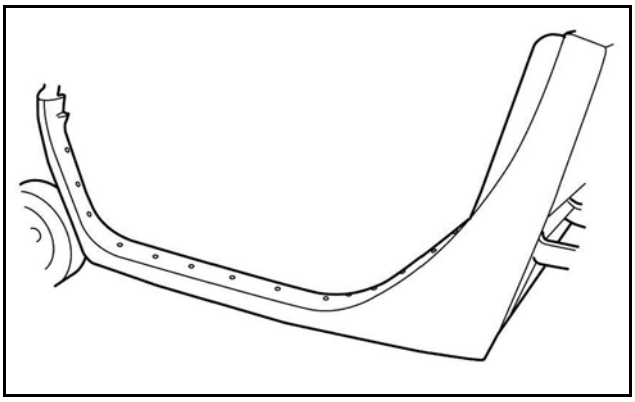
4. Feed seat belt end through D-ring, back to front, and attach to flange at lower outboard end of seat back support. Torque mounting bolt to specification.
5. Install body back panel. See Body Back Panel in this section.
6. Install body side panel. See Body Side Panel in this section.
7. Install seat back assembly. See Bench Seats in this section.
8. Install lower seat cushion. See Bench Seats in this section.
9. Position master disconnect switch ON.

9924112 - 2013 GEM Service Manual

BODY SIDE PANEL

DESCRIPTION

The body side panel is made of molded plastic and is mounted to the floor panel and back panel by Torx® bolts with nuts on the inside.



SIDE PANEL REMOVAL

1. Remove upper dash. See Dash in this section.
2. Remove lower dash. See Dash in this section.
3. Remove mudguards. See Mudguards in this section.
4. Remove rear bench seat and seat back. See Bench Seat in this section.
5. Remove spat or utility box. See Spat or Utility Box in this section.
6. Remove front upper attaching screw, and three lower attaching screws and speed nuts.
7. Remove scuff guard (sill plate) (if equipped). See Scuff Guards in this section.
8. Remove seven bottom body side bolts.
9. Remove 10 Torx bolts, 10 nuts, and body back panel.
10. Remove side panel.

SIDE PANEL INSTALLATION

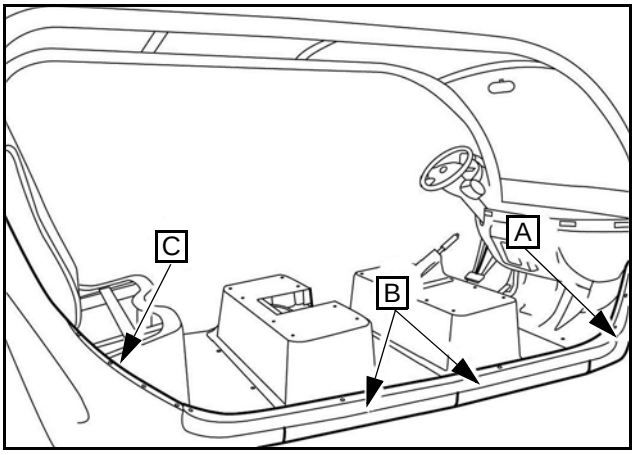
1. If replacing panel, remove front and rear trim locks and transfer them to new side panel.
2. Position side panel on tub/floor pan, ensure holes match up, and attach back trim lock to back panel.
3. Install side panel to body back panel with 10 Torx bolts and 10 nuts.
4. Install seven bottom body side bolts.
5. Install three lower screws and speed nuts on back/bottom, and front upper attaching screw.
6. Install scuff guard (sill plate), (if equipped). See Scuff Guards in this section.
7. Install front upper screws to hold body panel to frame.
8. Install spat or utility box. See Spat or Utility Box in this section.
9. Install rear bench seat and seat back. See Bench Seat in this section.
10. Attach mudguards. See Mudguards in this section.
11. Install lower dash. See Dash in this section.
12. Install upper dash. See Dash in this section.

9924112 - 2013 GEM Service Manual

BODY SIDE PANEL (E6)

DESCRIPTION

The GEM car body side panel is molded of white plastic.



A. Front panel
B. Middle panel
C. Rear panel

FRONT PANEL

1. Remove upper dash. See Dash in this section.
2. Remove lower dash. See Dash in this section.
3. Remove mudguards. See Mudguards in this section.
4. Remove scuff guard (sill plate), (if equipped). See Scuff Guards in this section.
5. Remove seven body side rivets.
6. Remove side panel. See Side Panel Removal in this section.
7. To install reverse this procedure.

MIDDLE PANEL

1. Remove scuff guard (sill plate), (if equipped).
2. Remove 10 body side rivets.
3. Remove center side panels.
4. To install reverse this procedure.

REAR PANEL

1. Remove swivel pack or utility box. See Swivel Pak or Utility Box.
2. Remove rear bench seat cushion. See Bench Seat in this section.
3. Remove scuff guard (sill plate), (if equipped). See Scuff Guards in this section.
4. Using drill, remove five rivets from back body panel.
5. Using drill, remove seven body side rivets.
6. Remove side panel. See Side Panel Removal in this section.
7. To install, reverse this procedure. Using rivet tool, install new rivets.

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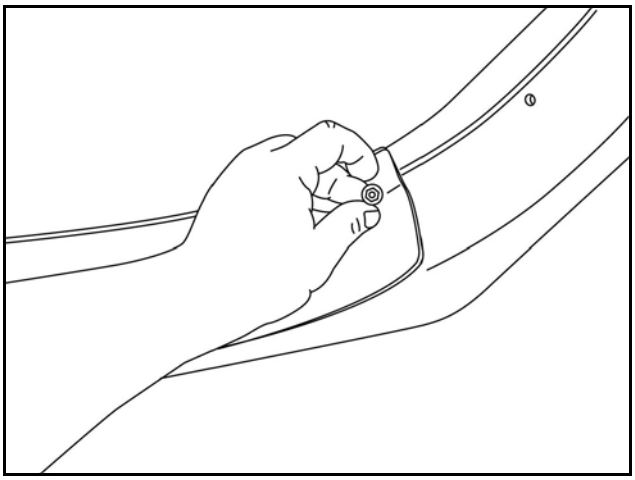
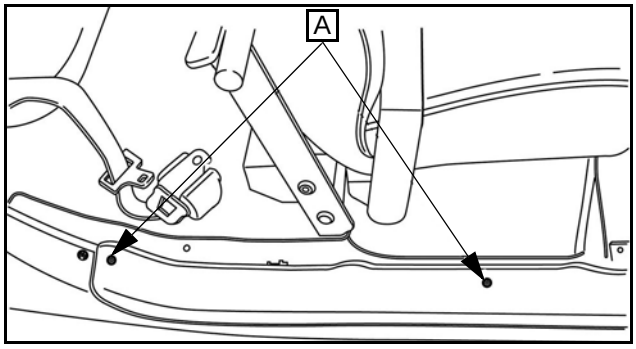
SCUFF GUARDS

DESCRIPTION

The GEM car Scuff Guards are durable black plastic formed guards that will help protect the body panels on your GEM vehicle from scuff marks and scratches.





A. Mounting bolts

SCUFF GUARD REMOVAL / INSTALLATION

GEM e6® MODELS:

1. Remove four Torx screws, four hex keps lock retainer nuts, and scuff guard.
2. Install scuff guard, four retainer nuts, and four Torx screws.

GEM e4 MODELS:

1. Remove three Torx screws, three hex keps lock retainer nuts, and scuff guard.
2. Install scuff guard, three retainer nuts, and three Torx screws.

GEM e2, GEM eS, GEM eL, GEM eL XD MODELS:

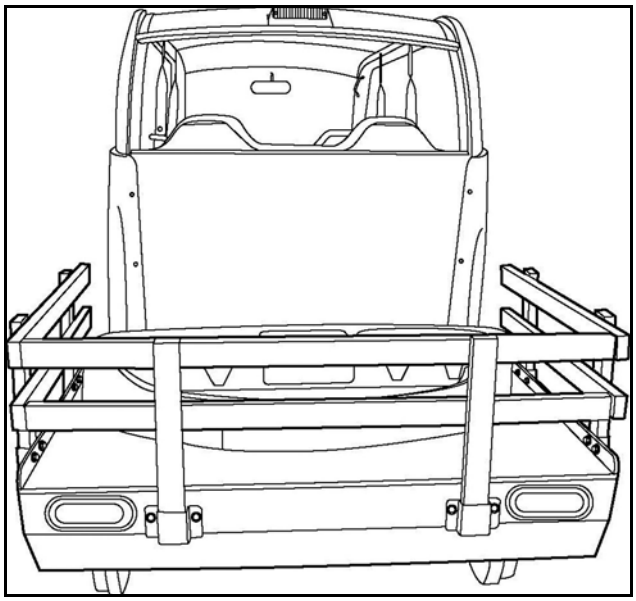
1. Remove two Torx screws, two hex keps lock retainer nuts, and scuff guard.
2. Install scuff guard, two retainer nuts, and two Torx screws.

9924112 - 2013 GEM Service Manual

BODY BACK PANEL

DESCRIPTION

The body back panel is made of molded plastic. The two, four and six passenger models have a cut out to accommodate the TrunkBack / LinksBack / Clip-In StakeBack latch assembly.



BACK PANEL REMOVAL

1. Remove spat or utility bed. See Spat or Utility Bed in this section.
2. Remove TrunkBack / LinksBack / Clip-In StakeBack handle (if equipped).

NOTE: Not available on GEM eS, GEM eL, GEM eLXD and e6® models. See TrunkBack / LinksBack / Clip-In StakeBack Handle in this section.

3. Using drill, remove rivets, or remove rear bolts (if equipped).
4. Remove body side panels. See Body Side Panel in this section.
5. Remove bench seat base and seat back. See Bench Seats in this section.
6. Remove two screws holding mounting brackets to back panel attached to frame rails.
7. Disconnect taillight/brake light electrical, if necessary, for brake chimsel light and taillights.
8. Remove body back panel.

BACK PANEL INSTALLATION

1. Install body back panel.
2. Connect taillight/brake light electrical, if necessary, for brake chimsel light and taillights.
3. Install two screws holding mounting brackets to back panel attached to frame rails.
4. Install bench seat base and seat back. See Bench Seats in this section.
5. Install body side panels. See Body Side Panel in this section.
6. Install the TrunkBack / LinksBack / Clip-In StakeBack handle and adjust as necessary. See TrunkBack / LinksBack / Clip-In StakeBack Handle Adjustment in this section.

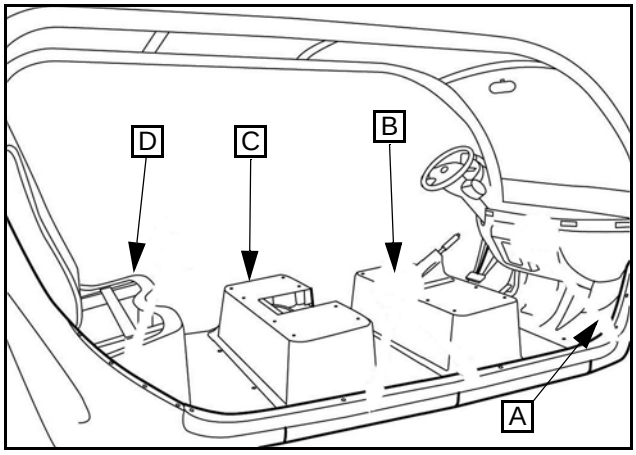
NOTE: Not available on GEM eS, GEM eL, GEM eLXD and e6® models. See TrunkBack / LinksBack / Clip-In StakeBack Handle in this section.

7. Install Spat. See Spat or Utility Box in this section.
8. Using rivet gun, install rivets, or install rear bolts (if equipped).

FLOOR PANELS (E6)

DESCRIPTION

The GEM car floor panels are molded of white plastic.



A. Front
B. Middle front
C. Middle rear
D. Rear

FRONT

1. Remove front side panels. See Body Side Panel in this section.
2. Remove front floor mat.
3. Using drill, remove two rivets.
4. Remove two bolts.
5. Remove floor panel.
6. To install, reverse this procedure. Use rivet gun to install rivets.

MIDDLE FRONT

1. Remove lower bolts and position aside front side panels.
2. Remove center side panels.
3. Remove front and middle floor mats.
4. Remove bolt from seat belt D-Ring.
5. Remove front seats. See bucket Seat in this section.
6. Remove park brake lever assembly. See in Brake System.
7. Using drill, remove four rivets.
8. Remove floor panel.
9. To install, reverse this procedure. Use rivet gun to install rivets.

MIDDLE REAR

1. Remove center side panels.
2. Remove middle and rear floor mats.
3. Remove bolt from seat belt D-ring.
4. Remove front seats. See Bucket Seat in this section.
5. Remove floor access panel.
6. Using drill, remove six rivets.
7. Remove floor panel.
8. To install, reverse this procedure. Use rivet gun to install rivets.

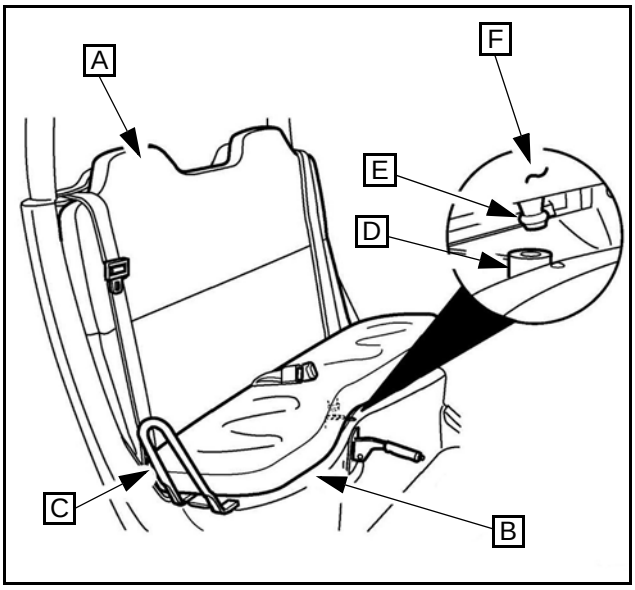
REAR

1. Remove rear side panels. See Body Side Panel in this section.
2. Remove rear floor mat.
3. Remove rear seat. See Bench Seats in this section.
4. Using drill, remove four rivets.
5. Remove floor panel.
6. To install, reverse this procedure. Use rivet gun to install rivets.

BENCH SEAT

DESCRIPTION

The GEM car uses bench seats in all models. The four and six passenger models have bucket seats in the driver and passenger front and middle positions and the bench seat in the rear. The bench seat is comprised of a seat cushion and a seat back. The cushion is attached to the raised portion of the floor panel by a friction latch consisting of a male probe mounted on the seat cushion that mates to a female grommet mounted to the seat support. A hand hold is attached to each outboard end of the seat cushion. The seat back is attached to the back panel and seat back support by screws through the bottom of the seat back.



A. Bench seat back
B. Bench seat cushion
C. Hand hold
D. Friction latch (female)
E. Friction latch (male)
F. Seat cushion

BENCH SEAT REMOVAL

1. Pull up on front edge of seat cushion until friction latch is disengaged.
2. Lift seat cushion up and away to remove.
3. Remove two screws (located on lower section of seat back).
4. Remove bench seat back, lift up, and pull away.

BENCH SEAT INSTALLATION

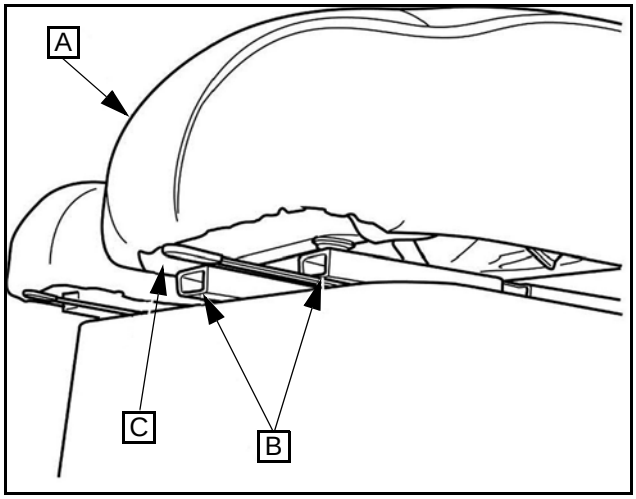
1. Position bench seat back against upper seat support frame.
2. Install two screws through lower section of seat back into seat back support frame.
3. Position bench seat cushion and push down to attach.

9924112 - 2013 GEM Service Manual

BUCKET SEAT

DESCRIPTION

The driver and passenger front and middle seats in the four and six passenger models are bucket seats. Each seat assembly consists of a seat cushion, built-in seat back and the seat is adjustable. A handle under the front of the seat cushion releases a latch, allowing the seat to move forward or backward on two tracks, (front driver's seat only on 6-passenger models).



A. Bucket seat
B. Adjuster rails
C. Adjuster lever

BUCKET SEAT REMOVAL

GEM e4 MODELS:

1. From beneath vehicle, remove nuts from four bucket seat anchoring bolts.
2. Remove bucket seat assembly.

GEM e6 MODELS:

1. For front bucket seats, see 4-passenger procedure above.
2. For the middle row, from beneath vehicle remove nuts from 3-bucket seat anchor ring bolts.
3. Remove front battery access cover from middle row bucket seat area.
4. Remove remaining bolts.
5. Remove three-point seat belt D-ring from hanger of rear rail.
6. Remove bucket seat assembly.

BUCKET SEAT INSTALLATION

GEM e4 MODELS:

1. Position bucket seat assembly over seat belt bracket, aligning rear-mounting holes of seat over mounting holes of seat belt bracket.
2. Insert four mounting bolts through bucket seat track and seat belt bracket into mounting holes in raised front seat portion of floor panel.
3. From underneath vehicle, install lock washers and nuts to mounting bolts.

GEM e6 MODELS:

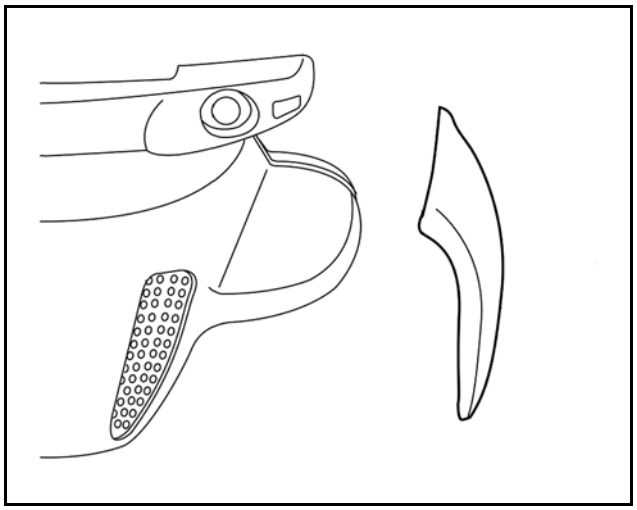
1. For front bucket seats, see 4-passenger procedure above.
2. Position bucket seat assembly over seat belt bracket, aligning rear-mounting holes of seat over mounting holes of seat belt bracket.
3. Insert three mounting bolts through bucket seat track, aligning seat belt bracket over mounting holes in raised front seat portion of floor panel.
4. Install remaining bolt.
5. From underneath vehicle, install lock washers and nuts to mounting bolts.
6. Attach and install 3-point seat belt D-ring to hanger of roof rail.
7. Install battery access cover.

9924112 - 2013 GEM Service Manual

MUD GUARD

DESCRIPTION

The mud guards are color keyed to match the hood. They are attached to the body side panel to form the trailing portion of the front fenders.



MUD GUARD REMOVAL

1. Remove four bolts and four speed nuts attaching mud guard to body side panel.
2. Remove mudguard.

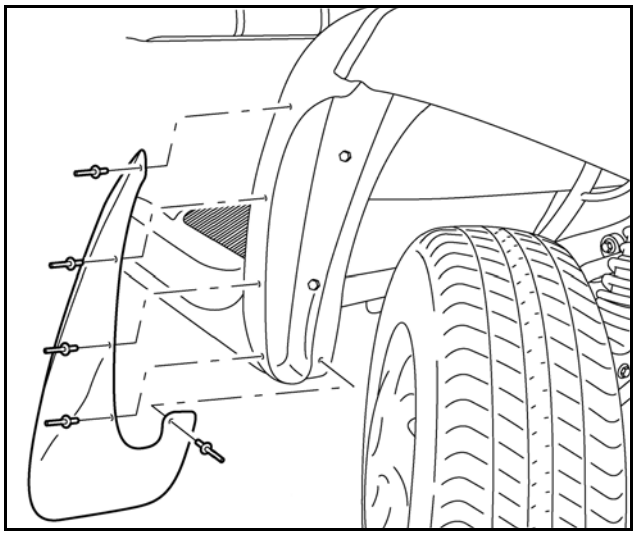
MUD GUARD INSTALLATION

1. If installing new mudguard, using drill, drill four 1/4-inch holes through mud guard, if necessary. Use old mud guard to determine hole locations.
2. With hood closed, position mud guard against body side panel to form clean line and fit with fender portion of hood assembly.
3. Install mud guard and install four speed nuts and four bolts.

MUD FLAP

DESCRIPTION

The mud flaps are attached to the mudguards that are positioned behind the front fenders. They help deflect road debris and add an attractive, sporty accent to the lower body of the vehicle.



MUD FLAP REMOVAL

Using drill, remove rivets (if equipped) and mud flap.

MUD FLAP INSTALLATION

1. Check fit of mud flap to vehicle.
2. Ensure mud flap fits with no gaps larger than 1/8 inch. Trim as necessary for proper fit.
3. Mark first hole one inch from top. Space remaining holes five inches apart starting from top hole.
4. Ensure all holes on mud flap are spaced evenly from edge.

NOTE: If the vehicle originally had mud flaps, use the existing holes in the vehicle to mark the mud flaps.

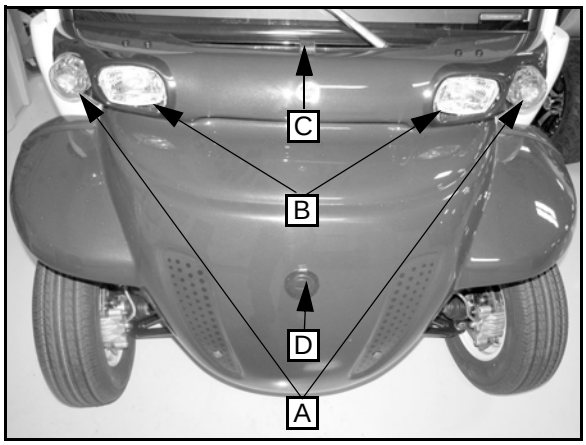
5. Using 3/16-inch drill bit, drill holes in mud flap.
6. Using suitable clamp, secure mud flap to vehicle.
7. Using drill, drill bottom hole.
8. Install bottom rivet from inside.
9. Drill and install remaining rivets working from bottom up, installing top rivet from front.

HOOD

DESCRIPTION

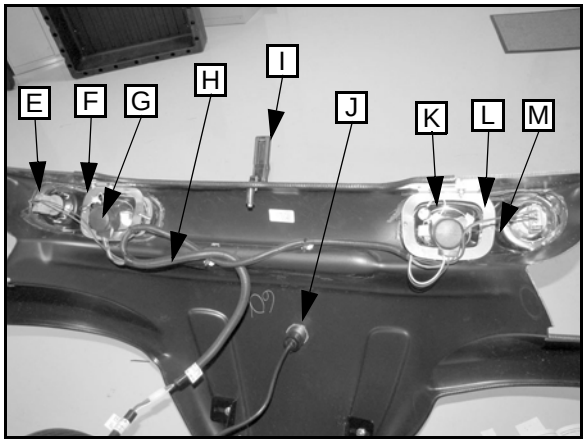
The hood assembly forms the hood and upper part of the front fenders. The head lamps and turn signal lamps are mounted in the hood. Hinges to the front suspension support frame attach the hood. On newer models, a latch at the center of the upper edge of the hood holds it secured when hood is closed.

Exterior Hood Assembly:



A. Turn signal assemblies
B. Head lamp assemblies
C. Hood latch
D. Charge Receptacle

Interior Hood Assembly:



E. Left turn signal lamp assembly
F. Left headlamp mounting bracket
G. Left headlamp assy
H. Headlamp wire harness
I. Hood Latch
J. Charge receptacle
K. Right headlamp assy
L. Right headlamp mounting bracket
M. Right turn signal assy

HOOD REMOVAL

1. Unlatch and open hood.
2. Disconnect electrical connector.
3. Cut and remove tie strap from charge cord.
4. Disconnect charge cord.
5. While supporting hood, remove two bolts, two nylon washers (bolt side), two regular washers (nut side), two nylock nuts, and two hinge brackets.
6. Remove hood.

HOOD INSTALLATION

NOTE: Bolts should be loose enough to allow adjustment of hood for fit, but tight enough to hold hood in adjusted position

1. While supporting hood, attach two hinge brackets to hood with two mounting bolts, two washers (nut side), and two nylock nuts.
2. Adjust hood latch mounting brackets until latch is properly aligned with striker plate on hood. Carefully tighten two mounting bolts.
3. Close hood and latch.

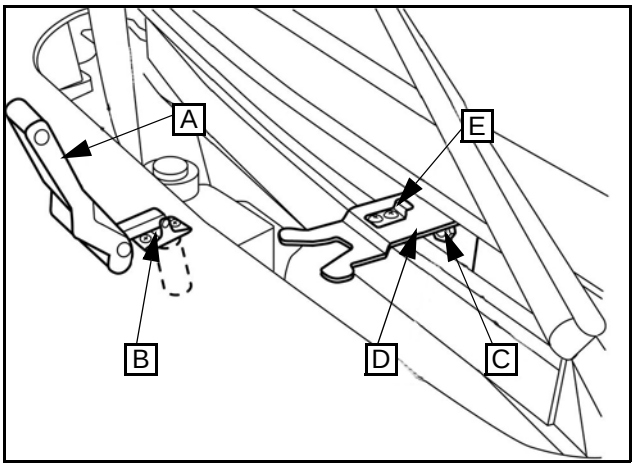
NOTE: Alignment adjustment of hood for proper fit can only be made at the lower hood bracket. Move hood brackets forward or back until proper fit of hood is attained, then tighten the hood bracket mounting bolts. It may be necessary to perform alignment of headlights after this procedure. See Accessory Component Replacement in Electrical Section.

9924112 - 2013 GEM Service Manual

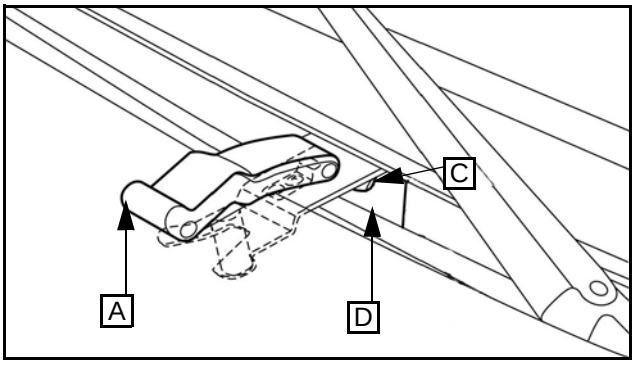
HOOD LATCH ASSEMBLY

DESCRIPTION

The hood latch assembly consists of a bracket, mounted to the center of the lower windshield support, holding a striker plate and an eccentrically pivoting latch handle mounted to the center of the hood trailing edge.



A. Hood latch
B. Hood latch mounting bracket
C. Torx screw
D. Striker plate
E. Hood latch plate



OPERATION

To unlatch the hood, pull up on leading end of latch handle to release tension on the striker plate, allowing disengagement of the striker. To latch the hood, engage handle on striker plate, then press down on leading end of handle to lock in place.

HOOD LATCH REMOVAL

1. Unlatch and open hood.
2. Noting location of longest screw, remove two screws, bushing, two lock washers, two nuts.
3. Remove the hood latch, and hood latch mounting bracket from hood.

HOOD LATCH INSTALLATION

1. Install hood latch mounting bracket and hood latch, two screws, bushing, two lock washers, and two nuts onto hood.
2. Close and latch hood.

STRIKER PLATE REMOVAL

1. Remove upper dash panel. See Dash in this section.
2. Remove Torx screw and striker plate.

STRIKER PLATE DISASSEMBLY

1. Remove two screws, two lock washers and two nuts retaining the hood latch plate to the striker plate.
2. To reassemble, reverse the disassembly procedure.

STRIKER PLATE INSTALLATION

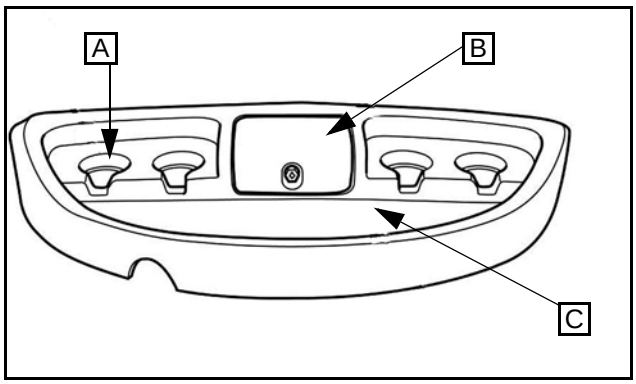
1. Install striker plate and Torx screw.
2. Install upper dash panel. See Dash in this section.

9924112 - 2013 GEM Service Manual

DASH UPPER PANEL

DESCRIPTION

The upper dash panel is constructed of molded plastic. It contains cup holders for both driver and passenger sides, and a locking glove compartment in the center. The panel is secured by two Torx® head screws through the lower windshield support, and by Velcro® strips where it mates with lower dash panel.



A. Molded cup holder(s)
B. Locking glove box door
C. Storage tray

DASH UPPER REMOVAL

1. Unlatch and open hood.
2. Remove two screws located immediately below windshield toward outer edges.
3. Slowly, lift upper dash assembly out and towards passenger side, taking care to disconnect any electrical connections if applicable.
4. Disconnect heater ducts at heater assembly (if equipped).

NOTE: Take care not to scratch steering column/ instrument pod covers.

DASH UPPER INSTALLATION

1. Connect heater ducts at heater assembly (if equipped).
2. Connect electrical connections if applicable.
3. Position upper dash assembly on lower dash assembly.

NOTE: Take care not to scratch steering column/ instrument pod covers.

⚠ CAUTION

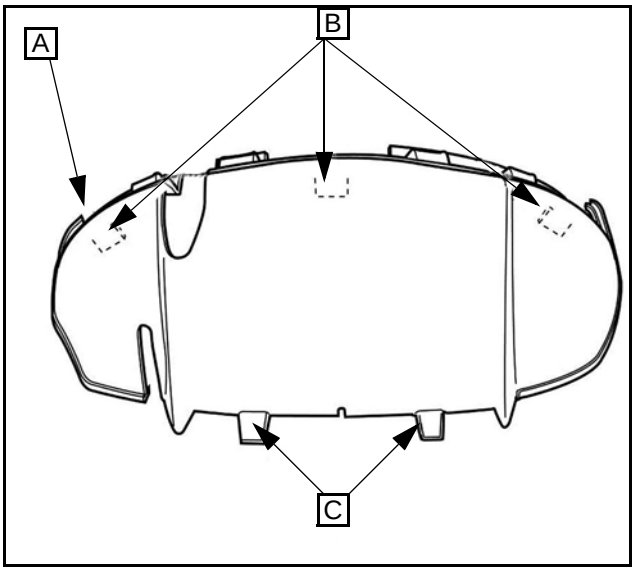
Take care not to cross-thread bolts, or jack nuts on dash panel will strip.

4. Attach upper dash to lower windshield support with two screws.
5. Close hood and latch.

DASH LOWER PANEL

DESCRIPTION

The lower dash panel is constructed of molded plastic. It is secured in place by tabs fitting into slots in the floor panel, and three Tek screws into the dash support frame.



A. Lower dash panel
B. Upper mounting tabs
C. Floor tabs

DASH LOWER REMOVAL

1. Remove upper dash panel. See Dash Upper Panel in this section.
2. Remove three screws on top surface mounting tabs.
3. Slowly lift lower dash panel out taking care to tag and disconnect any electrical connections and heater ducts. Then up, until lower tabs are clear of the slots in the floor pan.

NOTE: Take care not to scratch steering column/ instrument pod covers.

DASH LOWER INSTALLATION

1. Insert panel lower tabs into slots in floor pan.
2. Remove tags and connect any electrical connections, then slowly rock lower panel forward into place.

NOTE: Take care not to scratch steering column/ instrument pod covers.

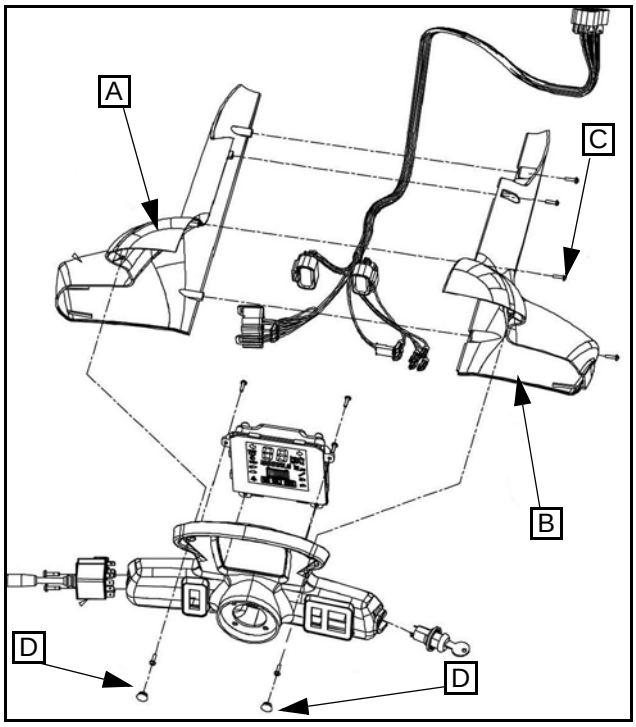
3. Install three screws on top surface mounting tabs.
4. Install upper dash panel. See Dash Upper Panel in this section.

9924112 - 2013 GEM Service Manual

POD COVERS

DESCRIPTION

The Pod Covers are used to protect and house the components of the steering column. They are secured in place by six screws, four on the RH side of the steering column and two on the front surface.



A. Cowl left hand
B. Cowl right hand
C. Screw
D. Plug, screw cover

POD COVER REMOVAL

1. Remove upper dash assembly. See Upper Dash in this section.
2. Remove lower dash assembly. See Lower Dash in this section.
3. Remove two screw covers on front of instrument pod.
4. Remove two front pod cover screws.
5. Remove four screws located on sides and remove pod covers.

POD COVER INSTALLATION

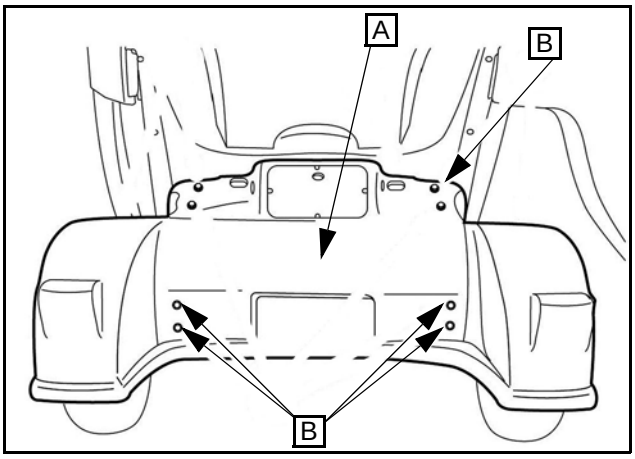
1. Install four screws in located on sides and remove pod covers.
2. Install two front pod cover screws.
3. Install two screw covers on front of instrument pod.
4. Install lower dash assembly. See Lower Dash in this section.
5. Remove upper dash assembly. See Upper Dash in this section.

9924112 - 2013 GEM Service Manual

SPAT

DESCRIPTION

A Spat is an assembly that acts as fenders over the rear wheels of the GEM e2, GEM e4, GEM e6® vehicles. It is color keyed to match hood color.



A. Spat
B. Torx head mounting bolts (10)

SPAT REMOVAL

1. Remove TrunkBack™/LinksBack™ (if equipped). See TrunkBack™/LinksBack™ in this section.
2. If equipped with license plate light and tail lights,
   - Remove bench seat cushion.
   - Follow wires to connectors located under bench seat cushion, above rear batteries, and disconnect.
3. Remove 10 plastic caps from bolts.
4. Carefully remove 10 bolts and spat.

SPAT INSTALLATION

1. Carefully position spat on vehicle.
2. Install 10 bolts attaching spat assembly to mounting brackets.
3. Install 10 plastic caps onto bolts.
4. If vehicle is equipped with license plate light and tail lights,
   - Route two wires over rear suspension frame to connectors above rear batteries and connect.
   - Install bench seat cushion.
5. Install TrunkBack™/LinksBack™ (if equipped). See TrunkBack™/LinksBack™ in this section.

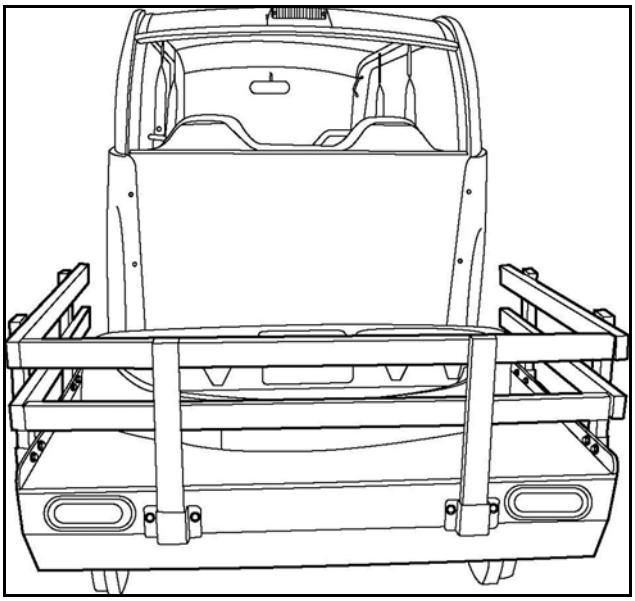
9924112 - 2013 GEM Service Manual

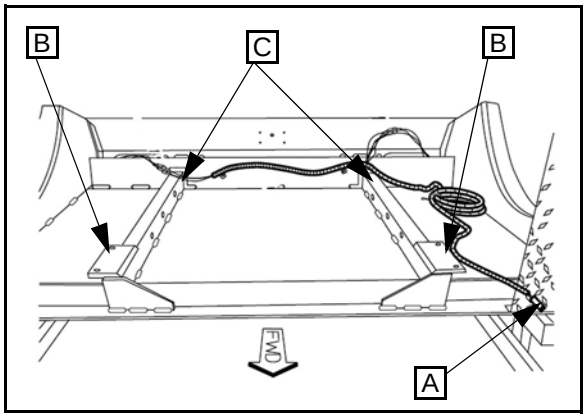
UTILITY BED

DESCRIPTION

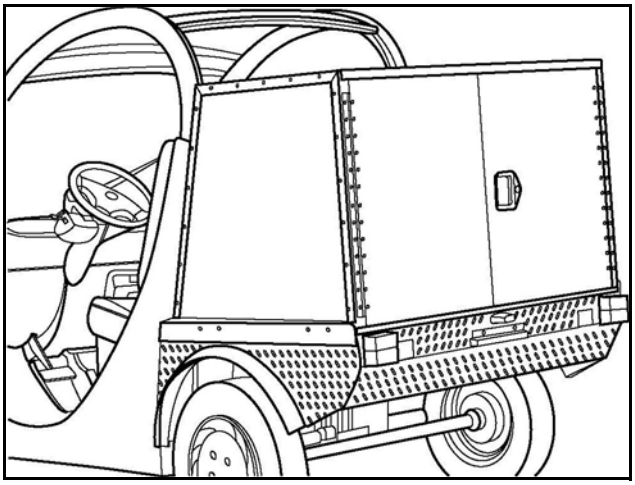
GEM e4, GEM eS, GEM eL, GEM e6®:

The Utility Bed is an assembly designed to transport various objects from one location to another. It consists of three retaining rails, flat bed and a rear wiring harness assembly.





A. Front bolts (4)
B. Utility bed support bracket bolts (6)
C. Rear tail light wire harness connector



UTILITY BED REMOVAL

1. Remove enclosed cargo carrier or bed cover (if equipped).
2. Remove rear seat cushion if applicable. See Bench Seat in this section.
3. Disconnect rear tail light wire harness and license plate light.
4. Remove four front bolts from each side.
5. Remove three bolts from each side of utility bed support bracket.
6. With help of assistant, remove utility bed.

UTILITY BED INSTALLATION

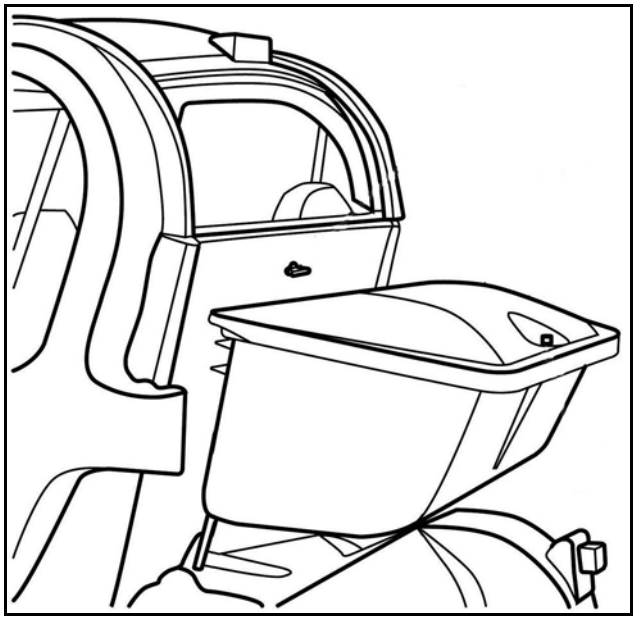
1. With help of assistant, position utility bed.
2. Install three bolts into each side of utility bed support bracket.
3. Install four front bolts into each side.
4. Connect rear tail light wire harness and license plate light.
5. Install rear seat cushion if applicable. See Bench Seat in this section.
6. Install enclosed cargo carrier or bed cover (if equipped).

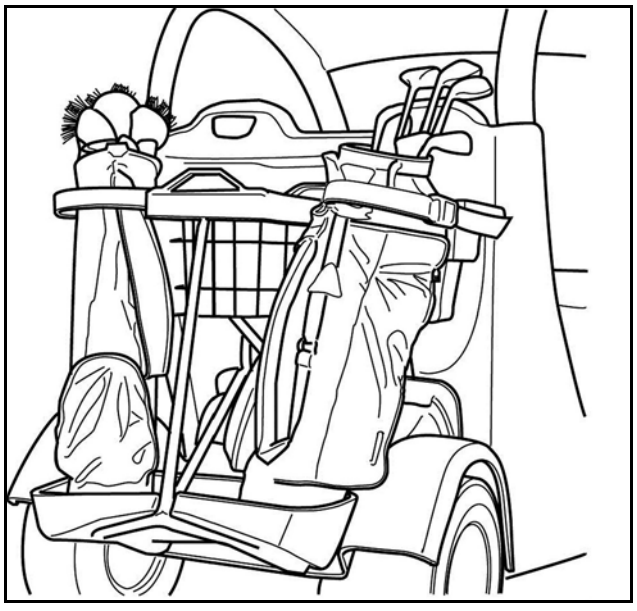
9924112 - 2013 GEM Service Manual

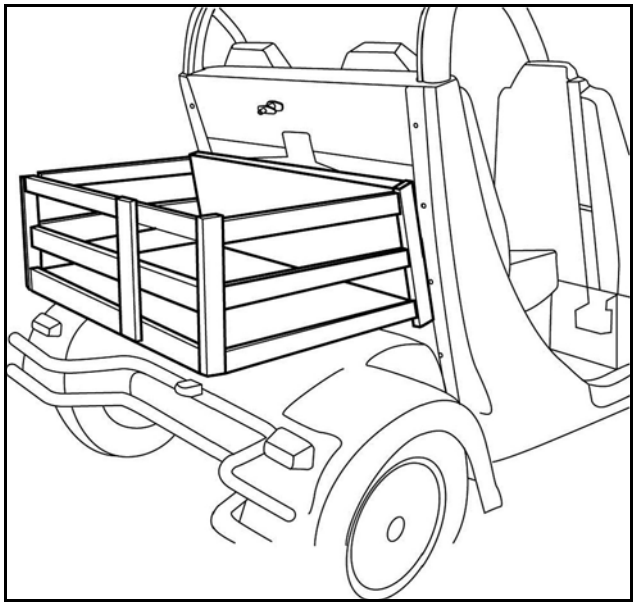
TRUNKBACK™/LINKSBACK™/ CLIP-IN STAKEBACK™

DESCRIPTION

The LinksBack™ is a unit designed to carry two sets of golf clubs. The TrunkBack™ is a molded plastic box with a hinged locking lid. The Clip-In StakeBack™ is a versatile bed unit designed with a hinged rear tailgate and acceptable of carrying loads up to 150 pounds. All available back options can be used on the 2-, 4-, and 6-passenger models. They are not available on the short bed or long bed utility models. All back units have two legs that fit into pockets mounted on each frame rail. Each attaches to a locking latch assembly mounted at the top of the body back panel.







REMOVAL

1. Using key, unlock latch handle.
2. Unlatch unit by turning handle counterclockwise.
3. Lift unit up to free legs from pockets and remove.

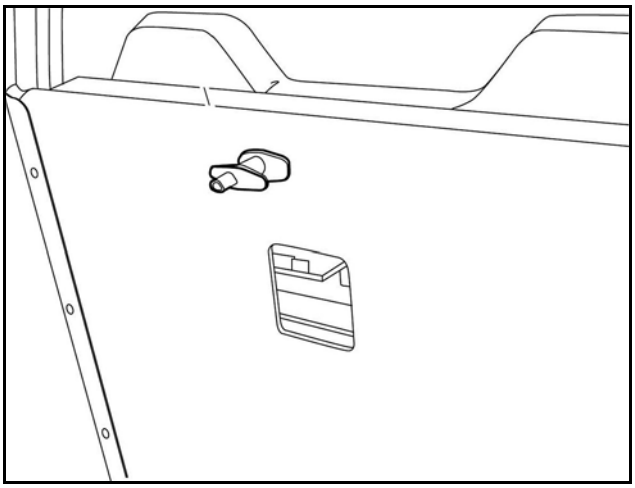
INSTALLATION

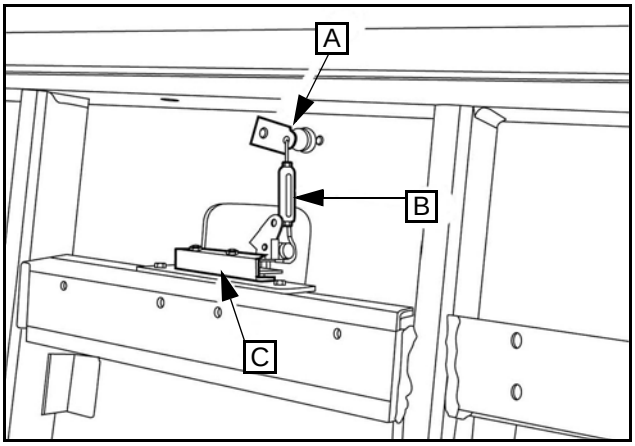
1. Install legs in pockets.
2. Apply the Velcro®, hook, or buckle-type safety strap.
3. Rock unit forward until latch is engaged, and pack is secured.

PACK LATCH ASSEMBLY

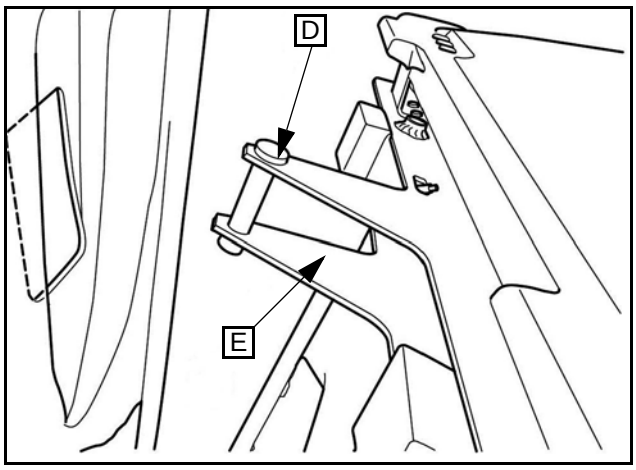
DESCRIPTION

The pack latch assembly consists of a locking handle connected to a latch by threaded rods and a turnbuckle. The handle is mounted to the back of the body back panel. The latch is mounted to a plate that, in turn, is mounted to the bench seat back/body back panel support frame.





A. Turnbuckle bracket
B. Turnbuckle
C. Latch assembly



D. Latch striker
E. Latch striker bracket

OPERATION

The keyed locking mechanism in the handle prevents unauthorized unlatching of the pack unit for removal. When unlocked, turning the handle pulls on the threaded rods and turnbuckle to release the latch. Pushing the latch bracket on the pack unit into the latch mechanism causes it to close.

PACK LATCH ADJUSTMENT

When turning the latch handle, there should be little or no play detected before the latching mechanism disengages the latch bar. Excessive play can result in the latching mechanism failing to disengage when the handle is turned. If the latching mechanism is not properly lined up with the latch bracket on the pack unit, it may be difficult or impossible to engage and lock the unit in place.

To adjust the play in the latch handle:

1. Remove bench seat cushion and back. See Bench Seat in this section.
2. Rotate turnbuckle until play is sufficiently reduced.

To adjust latch alignment:

1. Remove bench seat cushion and back. See Bench Seat in this section.
2. Loosen two bolts attaching latching mechanism to mounting plate.
3. Adjust latch assembly from side to side until proper alignment is attained.
4. Tighten mounting bolts.
5. Install bench seat.

PACK LATCH REMOVAL

1. Remove bench seat. See Bench Seat in this section.
2. Remove nut attaching turnbuckle assembly bracket to handle, then disengage bracket from handle.
3. Remove two screws attaching handle assembly to body back panel.
4. Remove handle.
5. Remove two self-drilling screws attaching latch mounting bracket to seat back/body back panel support frame. Remove latch assembly.

PACK LATCH INSTALLATION

1. Position latch mounting plate on seat back/body back panel support frame and install two self-drilling screws.
2. Insert latch handle into body back panel and install mounting screws.
3. Attach turnbuckle bracket to handle with nut.

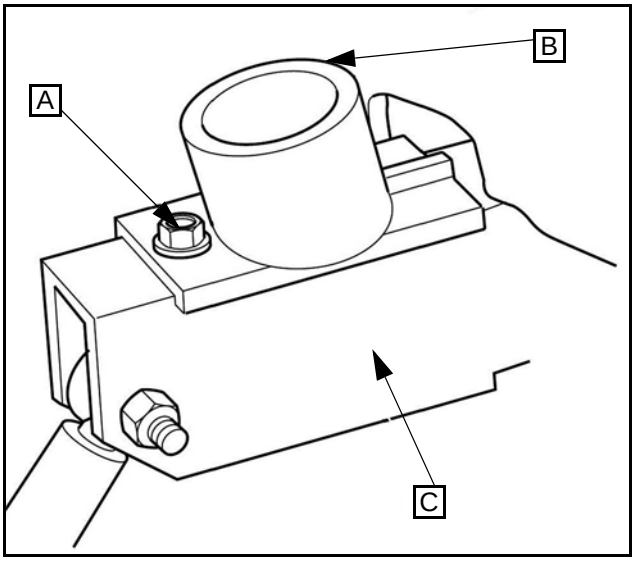
NOTE: End of turnbuckle bracket (where threaded eye-bolt is attached) must be aligned toward latching mechanism.

4. Adjust latch mechanism position for proper alignment.
5. Adjust turnbuckle for proper play in handle.
6. Install bench seat back and cushion.

TRUNKBACK™ / LINKSBACK™ / CLIP-IN STAKEBACK™ LEG POCKET

DESCRIPTION

The TrunkBack™/LinksBack™/Clip-In-StakeBack™ has two legs that fit into pockets mounted on each frame rail.



A. Mounting bolt
B. Pocket
C. Frame rail

LEG POCKET REMOVAL

1. Remove TrunkBack™ / LinksBack™ / Clip-In StakeBack™. See TrunkBack™ / LinksBack™ / Clip-In StakeBack™ in this section.
2. Remove two screws attaching pocket to upper rear frame rail.
3. Remove pocket.

LEG POCKET INSTALLATION

1. Position pocket on upper rear frame rail.
2. Install two screws.
3. Install TrunkBack™ / LinksBack™ / Clip-In Stake Back™. See TrunkBack™ / LinksBack™ / Clip-In StakeBack™ in this section.

MIRROR - CENTER REAR VIEW

DESCRIPTION

The center rear view mirror assembly is mounted in the center of the upper windshield support. It is not serviceable and is replaced as a unit.

MIRROR REMOVAL

1. Remove two screws from mounting bracket.
2. Remove short screw from center of mounting bracket.
3. Remove mirror assembly.

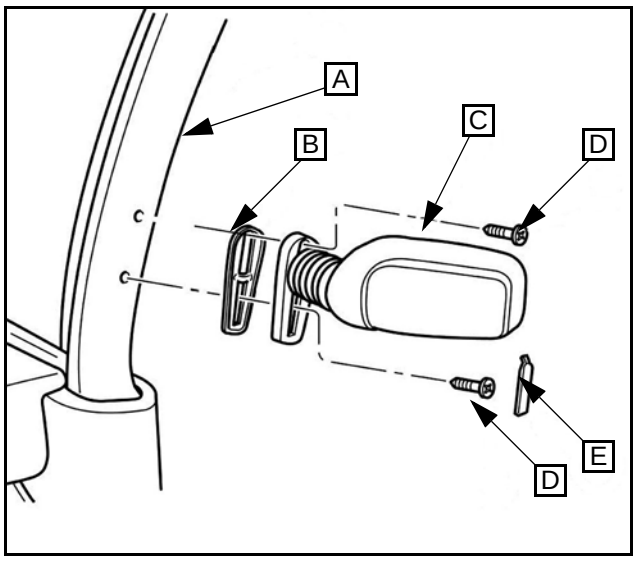
MIRROR INSTALLATION

1. Position mirror assembly on upper windshield support.
2. Install short screw in center hole of mounting bracket.
3. Install two long screws into mounting bracket.

MIRROR - SIDE REAR VIEW

DESCRIPTION

A driver's side rear view mirror is standard on all vehicles. Passenger side mirrors are optional. Side mounted rear view mirrors are attached to the front portion of the roof rail. If vehicle is ordered with optional hard doors, the mirrors are mounted on the doors. Damaged mirrors must be replaced, as they are not serviceable.



A. Roof rail
B. Mounting gasket
C. Mirror assembly
D. Screws - mounting, phillips head
E. Screw cover plate

MIRROR REMOVAL

1. Pry out lower screw cover on base of mirror.
2. Position rubber boot to access the upper mounting screw.
3. Remove two screws attaching mirror to roof rail/door.
4. Remove mirror assembly and mounting gasket.

MIRROR INSTALLATION

1. Install mirror assembly and mounting gasket.
2. Install two screws attaching the mirror to roof rail/door.
3. Reposition rubber boot to original position.
4. Install lower screw cover on mirror base.

9924112 - 2013 GEM Service Manual

NOTES

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