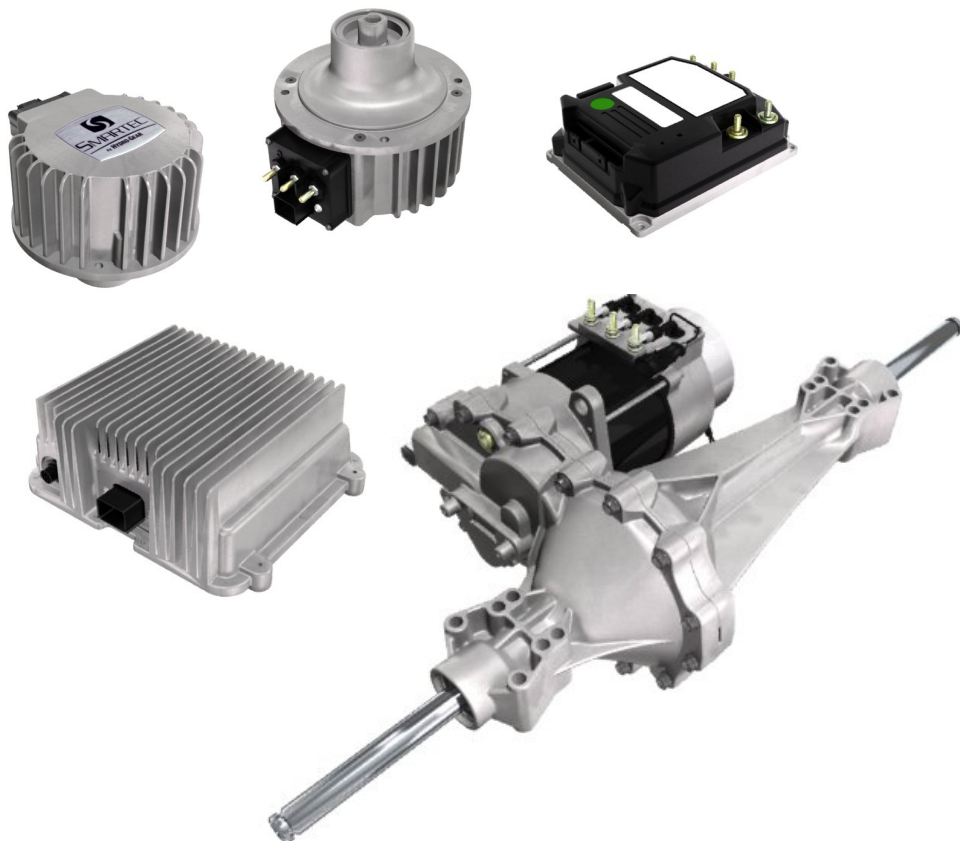




SMARTEC™

by **HYDRO-GEAR**

Smart Technology Made Simple



Integrated Electric LT Drive System Service and Repair Manual

BLN-0033
April 2010

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FOREWORD

Headquartered in Sullivan, Illinois, Smartec is a world leader in the design, manufacture, and service of quality electric drive systems for the lawn care industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Smartec Integrated Electric Zero-Turn Transaxle drive system. Also included is a glossary of terms that are frequently used throughout the industry and in Smartec service publications. Understanding terminology is very important!

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Internal repair procedures require that the transaxle unit be removed from the vehicle.

This is not a certification, test or study guide for a certification test. If a technician is interested in certification, they should contact an agent representing the EETC (Equipment and Engine Training Council) at (262) 367-6700 or their Central Service Distributor. Many distributors will be hosting certification testing. These study guides will cover most of the products and manufacturers in our industry.

For more information about Smartec or our products, please see www.hydro-gear.com for phone listings to contact your Central Service Distributor, or call our Customer Service Department at (217) 728-2581.

DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Smartec Integrated Electric LT (Lawn-Tractor) Transaxle and deck system. This manual includes the Smartec general descriptions, electrical schematics, technical specifications, servicing and troubleshooting procedures.

Other than recommended external maintenance, the transaxle and deck system normally will not require servicing during the life of the vehicle in which it is installed. Should other servicing be required, the exterior of the machine will need to be thoroughly cleaned before beginning most procedures. **Do not use a pressure washer to clean the transaxle or system components.**

General Description

The Smartec Integrated Electric LT Transaxle and deck system is designed to provide a complete drive and cutting solution in an integrated electric only machine. It is a true drive by wire system, with no mechanical linkages for steering, braking or propulsion. It provides an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

Lead acid batteries supply power to the 48 volt system. The Smartec Integrated Electric LT drive system utilizes two electric motors that provide movement for the vehicle. Each motor powers an integrated gear drive for forward and reverse movement. Two electric motors drive the cutting blades for the deck system.

Power management and control is accomplished by using separate computers for the integrated electric motor and gear drive. A separate computer controls the deck and blade management system. The system communicates over a CAN bus system to provide instantaneous communication. The Digital Display communicates system status including battery charge to the operator.

The electromechanical brake has a manual release function to permit moving the vehicle for a short distance at a maximum of 2 m.p.h. without starting the electric motors.

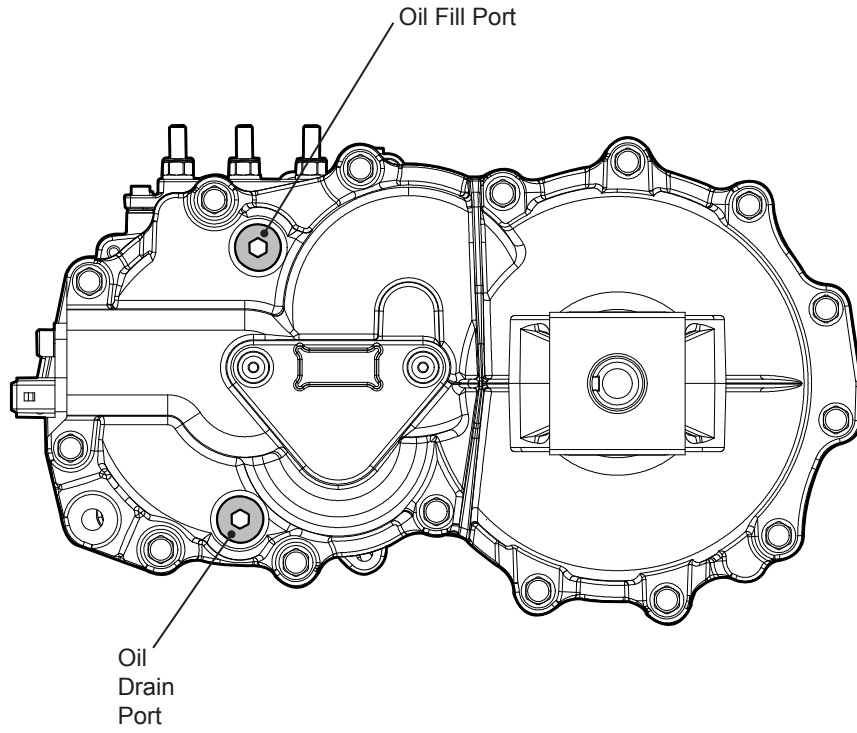
NOTE: The manual brake release option may not be utilized by all Manufacturers using this product.



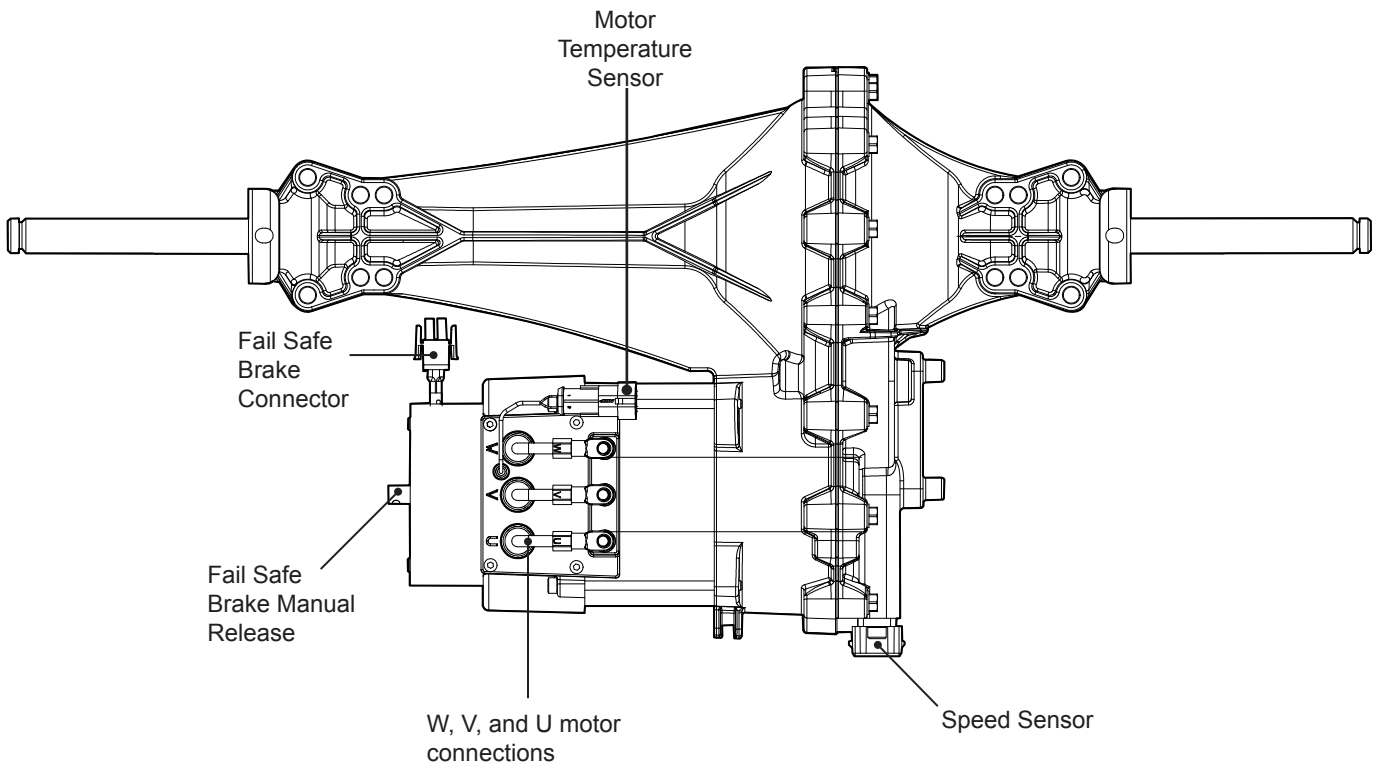
WARNING

Manually releasing the brakes will result in the loss of mechanical braking capacity. The machine must be stationary on a level surface and the key in the "OFF" position when actuating the manual release.

EXTERNAL FEATURES

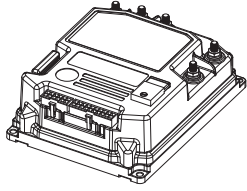


— Outboard View —

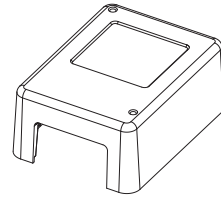


— Top View —

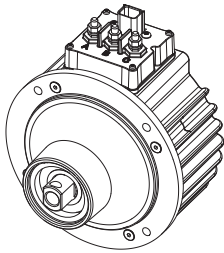
SYSTEM COMPONENTS



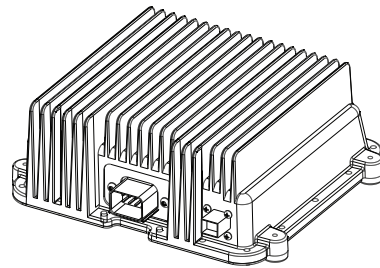
Traction Controller (1)



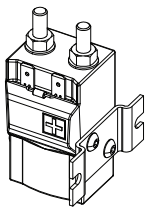
Traction Controller Cover
(If Equipped)



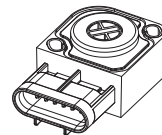
Deck Motor (2)



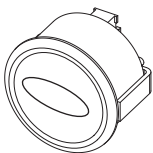
Deck Controller (1)



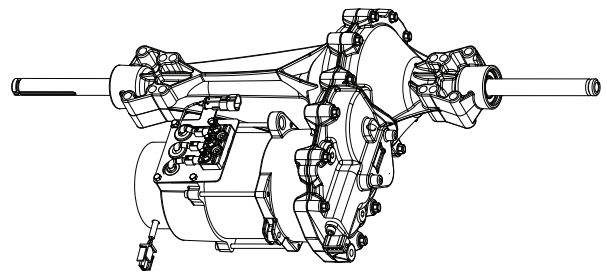
Single Pole Contactor (1)



Accelerator (1)



Digital Display
(if equipped)



Integrated Electric Transaxle (1)

TECHNICAL SPECIFICATIONS

Smartec Integrated Electric LT Drive System Specifications			
Overall Transaxle Reduction		45.11:1	
Output Torque			
Continuous Operating Torque	lb-ft [N-m]	80 [108.4]	
Peak Operating Torque	lb-ft [N-m]	322 [436.6]	
Weight on Tires (per unit)			
Maximum with 18" tires	lb [kg]	660 [300]	
Axle Shaft Diameter	in[mm]	.75 [19.05]	
Axle Shaft End Options	Keyed axle		
Parking Brake Type	Electric		
Electrical System	48v		

PRODUCT IDENTIFICATION

The model and configuration of the Smartec Drive System can be determined from the label shown below.

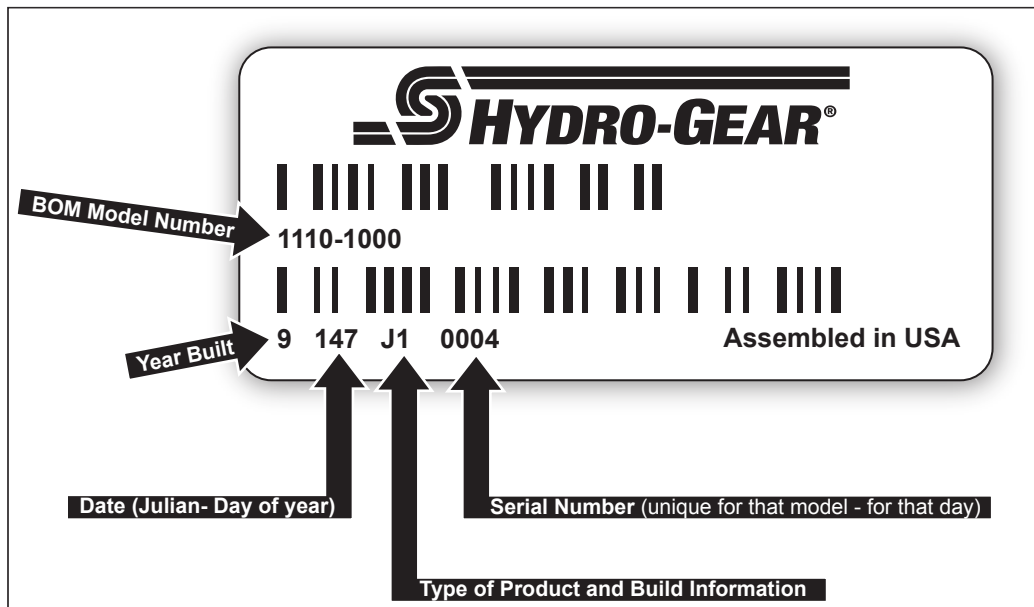


Figure 1. Configuration Label

SAFETY



This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your drive or deck system. When you see this symbol - **HEED ITS WARNING.**



WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the Smartec™ system, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the Smartec system. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

1. Other manuals pertaining to this machine,
2. Local and shop safety rules and codes,
3. Governmental safety laws and regulations,
4. OSHA and NFPA 70E Standards for Electrical Safety in the Workplace guidelines.

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Verify that you are qualified and properly trained to perform the required work. Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

The work area must be dry; free from any moisture, dampness or liquids.

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SAFETY Continued.

SERVICING SAFETY

All procedures will require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

ALL wires leading to the MAIN GROUND TERMINAL must be disconnected from the battery pack (Figure 2).

De-energize the system/components by waiting 5 minutes prior to performing any repairs or adjustments.


Never touch two posts of any battery at the same time. Never touch the body frame and the positive lead at the same time.

As a General rule, keep batteries free of debris. Reference machine owners manual for proper battery cleaning and maintenance procedures.

Some cleaning solvents are flammable. Use only approved cleaning materials: Do not use explosive or flammable liquids to clean the equipment.

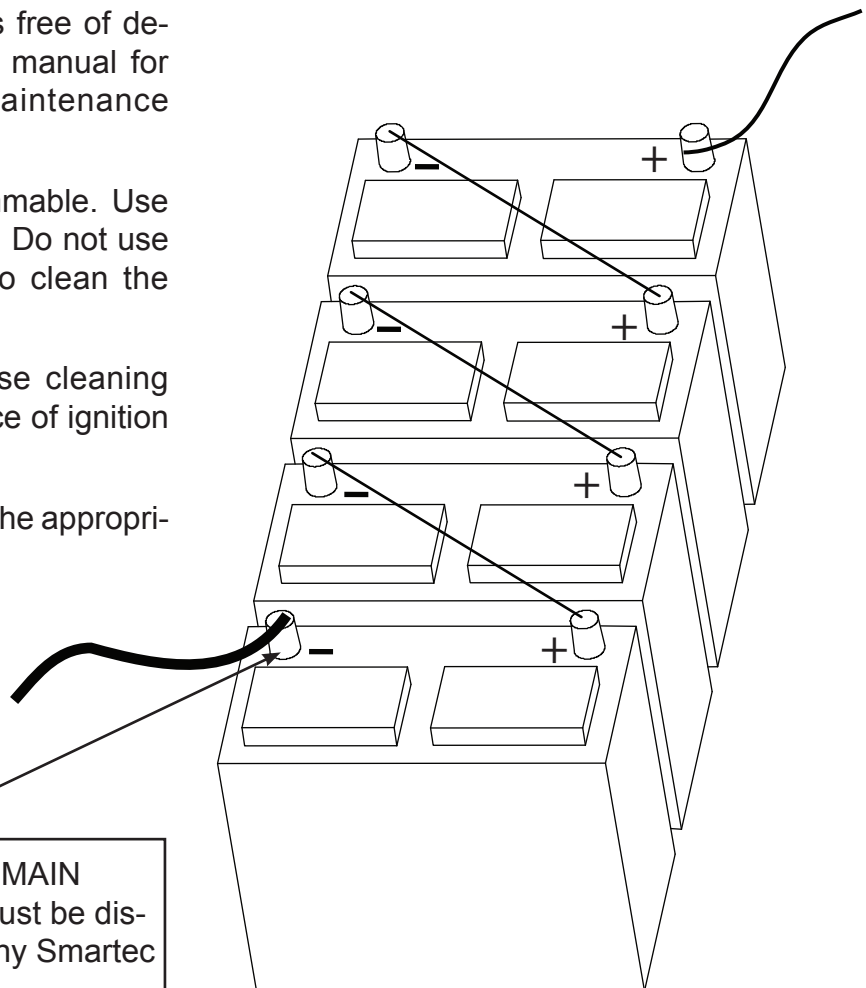
To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Discard used cleaning material in the appropriate containers.

 **WARNING**

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the Smartec™ system, fully read and understand the safety precautions described in this section.




 **ALL wires leading to the MAIN GROUND TERMINAL must be disconnected before working on any Smartec components.**

Figure 2. Battery Diagram

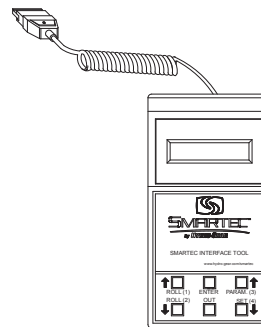
TROUBLESHOOTING

NOTE:

- Digital interface codes beginning with 02A refer to the main drive system. A code beginning with 16A refers to the Digital Display.
- The first 2 columns of the troubleshooting guide will refer to the codes found on either the digital display, or LED light on the dash of your mower.
- Smartec Interface Tool can be used for detailed diagnostic troubleshooting (Tool Functions, Page 23).



Digital Display



Smartec Interface Tool

Troubleshooting Guide					
Code 02	LED Flash Code	Symptom	Smartec Interface Tool	Why	How to Repair
02A11	1-1	No Drive	Watchdog	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A12	1-2	No Drive	EEPROM KO	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A13	1-3	No Drive	AUX OUTPUT KO	Output did not respond to command.	Verify wire plug connection of fail safe brake. Repair or replace connection as needed. Replace fail safe brake if alarm persists.
02A14	1-4	No Drive	LOGIC FAILURE # 3	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A15	1-5	No Drive	LOGIC FAILURE # 2	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A16	1-6	No Drive	LOGIC FAILURE # 1	Low battery charge, loose or shorted connection at key switch.	Charge battery(s) and replace as needed. Verify, repair or replace wire connection at key switch as needed. If alarm persists traction controller will need to be replaced.
				Excessive battery charge, loose or shorted connection at key switch.	Verify correctly charged battery(s). If alarm persists traction controller will need to be replaced.
02A17	1-7	No Drive	VMN LOW	Low battery charge, loose or shorted connection at drive motor or traction controller.	Charge battery(s). Verify, repair or replace connections at drive motor and traction controller as needed. If alarm persists traction controller will need to be replaced.
02A18	1-8	No Drive	VMN HIGH	Excessive battery charge, loose or shorted connection at drive motor or traction controller.	Charge battery(s). Verify, repair or replace connections at drive motor and traction controller as needed. If alarm persists traction controller will need to be replaced.
02A19	1-9	No Drive	Contactors Closed	Contactors has been manually shorted. Short between contactors and positive battery connection.	Verify, repair or replace connection between contactors and positive battery connection as needed. Replace contactors if alarm persists.
02A21	2-1	No Drive	Contactors Open	Low battery charge, short between contactors and positive battery connection.	Charge battery(s) and verify, repair or replace connection between contactors and positive battery as needed. Replace contactors if alarm persists.
02A22	2-2	Reduced Drive Speed	Ebrake KO	Brake has malfunctioned during start sequence.	Replace Fail Safe Brake.
		No Drive	Ebrake not ok	Fail safe brake has malfunctioned during start sequence.	Replace Fail Safe Brake.
02A23	2-3	No Drive	I=0 EVER	Power connection is loose on the contactors, drive motors or traction controller. Internal diagnostic malfunction..	Check that all power connections are tightened to correct torque, Cycle key, if alarm persists traction controller will need to be replaced.

TROUBLESHOOTING

Troubleshooting Guide					
Code 02	LED Flash Code	Symptom	Smartec Interface Tool	Why	How to Repair
02A24	2-4	No Drive	STBY I HIGH	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A25	2-5	No Drive	EMERGENCY	The emergency stop button is engaged.	Turn off emergency stop.
				Wiring harness has been damaged	Cycle key, if alarm persists wiring harness will need to be replaced.
02A26	2-6	No Drive	CAPACITOR CHARGE	External device or shorted connection drawing power from positive battery connection or key switch.	Remove any unapproved device drawing power from system. Verify, repair or replace connections of positive battery and keyswitch as needed. If alarm persists replace traction controller.
02A27	2-7	Reduced Drive Speed	High Temperature	Debris not allowing traction controller(s) to cool properly.	Remove debris build up from traction controller and/or base. Replace traction controller if alarm persists.
				Traction controller baseplate temperature has exceeded maximum allowable.	Remove debris build up from traction controller and/or base. Replace traction controller if alarm persists.
				Extreme mowing conditions	Refer to owners manual for proper mower use.
		No Drive	High Temperature	Debris not allowing traction controller(s) to cool properly.	Remove debris build up from traction controller and/or base. Replace traction controller if alarm persists.
				Traction controller baseplate temperature has exceeded maximum allowable.	Remove debris build up from traction controller and/or base. Replace traction controller if alarm persists.
				Extreme mowing conditions	Refer to owners manual for proper mower use.
02A28	2-8	Reduced Drive Speed	Motor Temperature	Debris not allowing drive motor to cool properly. U,V or W power connections are incorrectly connected between the traction controller and drive motor.	Remove debris build up from drive motor. Connect traction controller and drive motor wiring per the manufacturers specifications. If alarm persists replace drive motor.
				Internal failure in drive motor.	Replace drive motor if alarm persists.
				Extreme mowing conditions	Refer to owners manual for proper mower use.
		No Drive	Motor Temperature	Debris not allowing drive motor to cool properly.	Remove debris build up from drive motor. If alarm persists replace drive motor.
				Internal failure in drive motor.	Replace drive motor if alarm persists.
				Extreme mowing conditions	Refer to owners manual for proper mower use.
02A29	2-9	Reduced Drive Speed	Battery Low	Battery(s) not charged or won't hold charge.	Attempt to recharge and replace battery(s) if alarm persists.
		No Drive	Battery Low	Battery(s) not charged or won't hold charge.	Attempt to recharge and replace battery(s) if alarm persists.
02A31	3-1	Reduced Drive Speed	Encoder Locked	Speed feedback below minimum allowable.	Reconnect or replace speed sensor.
				Wheel blocked from spinning.	Remove source of blockage.
		No Drive	Encoder Locked	Speed feedback below minimum allowable.	Reconnect or replace speed sensor if alarm persists.
02A32	3-2	No Drive	Encoder Error	High speed condition, speed sensor has quit working.	Cycle key, refer to owners manual for proper mower use, if alarm persists speed sensor will need to be replaced.

TROUBLESHOOTING

Troubleshooting Guide					
Code 02	LED Flash Code	Symptom	Smartec Interface Tool	Why	How to Repair
02A33	3-3	No Drive	BRAKE	Brake switch input is high, disconnected brake switch, brake pedal not disengaging.	Verify, repair or replace brake wiring connections as needed, verify pedal is disengaged. Replace brake switch if alarm persists.
02A34	3-4	No Drive	THERMIC SENS KO	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A35	3-5	No Drive	DRIVER SHORT-ED	Voltage low at contactor.	Verify contactor connection to negative battery for short or loose connection, repair or replace as needed. Replace contactor if alarm persists.
02A36	3-6	No Drive	CONTACTOR DRIVER	Voltage high at contactor.	Verify contactor connection to positive battery for short or loose connection repair or replace as needed. Replace contactor if alarm persists.
02A37	3-7	No Drive	COIL SHORTED	Voltage high at contactor.	Replace contactor if error happens during start sequence. .
					If error occurs when the accelerator/ drive handle is pressed to move, replace fail safe brake.
02A38	3-8	No Drive	VACC NOT OK	Malfunctioning accelerator, disconnected or shorted accelerator connection.	Verify, repair or replace accelerator connections as needed. Replace accelerator if alarm persists.
02A39	3-9	No Drive	FORW + BACK	Malfunctioning accelerator, disconnected or shorted accelerator connection.	Verify, repair or replace accelerator connections as needed. Replace accelerator if alarm persists.
02A42	4-2	No Drive	LOW VOLTAGE	Loose or shorted connection between positive battery(s) and/or traction controller, malfunctioning traction controller.	Verify, repair or replace connection(s) between battery(s) and/or traction controller as needed. Replace traction controller if alarm persists.
02A43	4-3	No Drive	MANUAL BRAKE REL	Fail safe brake has been manually overridden, malfunctioning manual brake release switch, loose or shorted connection.	Verify brake is not manually released, verify, repair or replace connections as needed. Replace manual brake release switch if alarm persists.
02A44	4-4	No Drive	No seat in run	Operator came out of seat while machine is moving, seat switch is making intermittent contact.	Stay in seat. Verify, repair or replace connections as needed. Replace seat switch if alarm persists.
02A45	4-5	No Drive	PEDAL WIRE KO	Disconnected or shorted accelerator connection.	Reconnect, repair or replace accelerator connection as needed. Check for debris in connector and clean as needed. Synchronize accelerator with Smartec interface tool.
02A46	4-6	No Drive	Deck CAN bus KO	External interference with the CAN communications. Damaged or loose connection. Damaged wire shielding or malfunctioning deck controller.	Cycle key. Verify, repair or replace connections from traction controller to deck controller as needed. Refer to mower manufacturer for wire shielding requirements, repair or replace shielding as needed. Replace deck controller if alarm persists.
02A47	4-7	No Drive	PROG VACC Not OK	Accelerator inputs not set.	Synchronize accelerator with Smartec interface tool.
02A48	4-8	No Drive	WRONG SET BATTERY	Incorrect or Improperly charged battery(s).	Charge or replace battery(s) per manufacturer's recommendation.
02A51	5-1	No Drive	INPUT ERROR1 (PAL KO)	Internal diagnostic malfunction.	Cycle key, if alarm persists traction controller will need to be replaced.
02A52	5-2	No Drive	00 RELOAD HM MDI	Traction controller or digital dash display has been replaced.	Machine will default hours. Leave key in on position for two minutes then cycle key off and back on.

TROUBLESHOOTING






Troubleshooting Guide					
Code 02	LED Flash Code	Symptom	Smartec Interface Tool	Why	How to Repair
02A54	5-4	No Deck Operation	PTO time out	Power saving software has turned on due to machine in stationary position with the blades engaged.	Cycle key and restart deck.
02A55	5-5	No Drive	VACC OUT OF RANGE	Malfunctioning accelerator, disconnected or shorted accelerator connection.	Verify, repair or replace accelerator connection as needed. Replace accelerator if alarm persists. Synchronize accelerator with Smartec interface tool.
02A56	5-6	No Drive	Display CAN BUS KO	Disconnected or shorted can bus connection between traction controller and digital display.	Verify, repair or replace wire connection between traction controller and digital display as needed.
02A57	5-7	No Drive	CAN bus KO	CAN communication interrupted	Cycle key, check CAN wiring for opens or shorts, check the CAN shield wire is connected to the vehicle chassis, replace Digital Display or Traction Controller.
			Waiting For Node	Smartec Interface Tool is connected to the incorrect traction controller. CAN communication interrupted.	Switch interface tool to the other traction controller. Cycle key, check CAN wiring for opens or shorts, check the CAN shield wire is connected to the vehicle chassis, replace Digital Display or Traction Controller.
02A61	6-1	No Drive	NO SEAT START	Malfunctioning seat switch, disconnected or shorted connection.	Verify, repair or replace seat switch connection as needed. Replace seat switch if alarm persists.
				Operator not in seat.	Verify operator is in seat when starting mower.
02A62	6-2	No Drive	NO NEUT START	Drive handle or pedal not in neutral position, cruise control on, malfunctioning neutral switch, disconnected or shorted connection. If occurs while running, check the connection at the key switch	Verify pedal/handle position. Verify cruise control is off. Verify, repair or replace neutral switch connections as needed. Replace neutral switch if alarm persists.
02A63	6-3	No Drive	PTO ON AT START	PTO switch is on during start up. Malfunctioning PTO switch, disconnected or shorted connection.	Verify PTO switch is off. Verify, repair or replace PTO switch connection as needed. Replace PTO switch if alarm persists.
02A64	6-4	No Drive	ROS ON AT START	ROS switch is on during start up. Malfunctioning ROS switch, disconnected or shorted connection.	Verify ROS switch is off. Verify, repair or replace ROS switch connection as needed. Replace ROS switch if alarm persists.
02A65	6-5	No Drive	NO BRAKE START	Brake switch is not on during start up. Malfunctioning brake switch, disconnected or shorted connection.	Verify parking brake switch is on. Verify, repair or replace brake switch connection as needed. Replace brake switch if alarm persists.
16A06	None	No Digital Display	None	Digital display communication issue.	Cycle key. Verify, repair or replace CAN wire connections as needed. Refer to mower manufacturer for wire shielding requirements, repair or replace shielding as needed. Replace digital display if alarm persists.

TROUBLESHOOTING

Mechanical Symptoms (No Alarm Codes)		
Symptom	Why	How to Repair
Reduced Drive Speed	Stripped Internal Axle Spline.	Replace Gearbox components as needed.
Reduced Drive Speed	Stripped gear.	Replace Gearbox components as needed.
No Drive	Stripped internal or external axle spline.	Replace Gearbox components as needed.
No Drive	Stripped or broken gear.	Replace Gearbox components as needed.
No Drive	Damaged or missing key, damaged key slot.	Replace key and or axle as needed.
Leaks	Damaged or malfunctioning seal, sealant or o-ring.	Replace seals, sealant or o-rings as needed.

Deck System Troubleshooting

Deck System Symptoms		
Symptom	Why	How to Repair
No Deck Operation	Extreme mowing conditions.	Refer to machine owners manual for proper mower use. Move to short grass area, cycle key and restart deck. If problem persists, refer to the Deck System Resistance Test Procedure below.
	Blockage under mower deck.	Disconnect power from deck and clear of any foreign obstructions. Refer to proper procedure for disconnecting power from the system before attempting this repair (Reference page 7, Servicing Safety). If problem persists, refer to the Deck System Resistance Test Procedure below.

Deck System Resistance Test Procedure	
	Make sure your Digital Multi Meter is capable of measuring up to 1.2 million ohms (Ω) resistance before beginning these steps. Refer to your Digital Multi Meter owners manual for correct dial settings.
	Always disconnect the batteries before performing any maintenance or repair.
	Wait 5 Minutes after disconnecting the batteries prior to working on the machine.
1	Remove any debris build up from all deck components.
2	Verify all power connections on deck motors and deck controller are torqued properly. If loose connections are discovered tighten to the correct torque values found in the service and repair manual. Reconnect the batteries per the instructions in the service and repair manual and check for proper deck operation. If loose connections are not found proceed to step 3.
 3	Label all (8) deck controller connection points (per Figure 3, page 13) on the edge of the deck controller housing so they are easily viewed for correct re-connection.
 4	To ensure correct re-connection, mark all (8) wire connections with the corresponding connection point labels from step 3.
5	Remove all (8) wire connections from the deck controller.
6	Measure deck controller resistance (Ω): Reference Figure 3, page 13. (A) Place the negative (-) probe of a digital multimeter on the positive (+) battery terminal of the deck controller. (B) Place the positive (+) probe of the digital multimeter on deck controller terminals AR, then BR, then CR. Resistance for each should read between 270k (Ω) and 330k(Ω). If resistance is above or below the specified range the deck controller will need to be replaced. Repeat process for deck controller terminals AL, BL and CL.
7	If no issues are found reinstall deck controller wire connections to the proper torque values located in the service and repair manual. (See page 28)
8	Measure deck motor resistance (Ω): Reference Figure 4, page 13. (A) Place the negative (-) probe of a digital multimeter on motor terminal A. (B) Place the positive (+) probe of the digital multimeter on motor terminals B, then C. If the resistance is more than 0 to 1 (Ω) ohms the deck motor will need to be replaced. Repeat process for other deck motor as needed.
9	Measure the resistance in the six pin motor connector (per Figure 5, page 13) by placing the negative (-) probe of a digital multimeter on pin 2 and the positive (+) probe on pin 3. Resistance should read between 800k (Ω) and 1.2m (Ω) ohms. Resistance between pin 2 and pins 1, 4, 5 and 6 should be 0 ohms. If resistances are above or below these ranges the deck motor will need to be replaced. Repeat the process for the other motor as needed.
10	If steps 1-9 are completed and the issues persist please refer to the mower manufacturer's procedure for wiring harness troubleshooting for possible repair or replacement.

TROUBLESHOOTING

Deck System Troubleshooting Guide

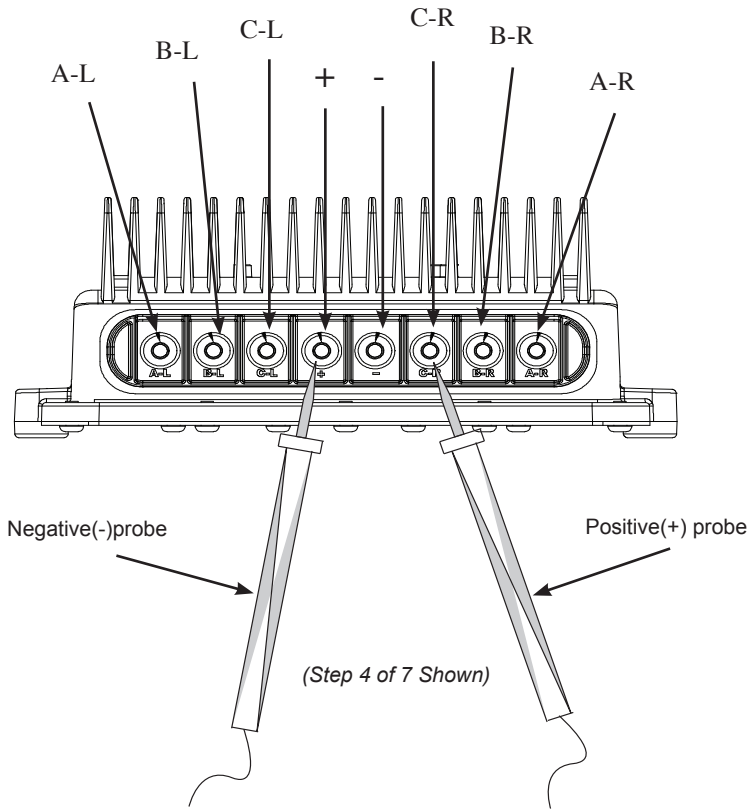


Figure 3. Deck Controller

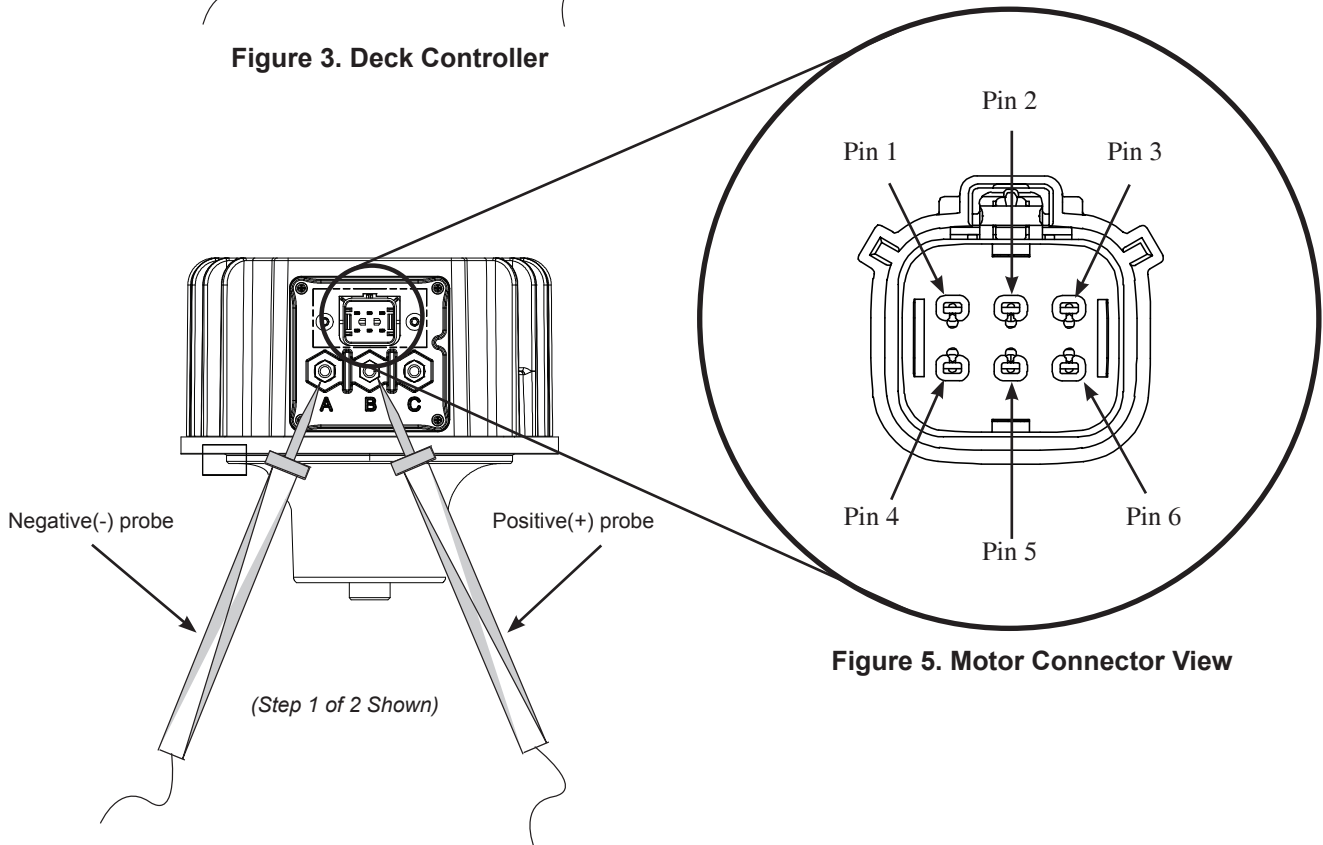


Figure 5. Motor Connector View

Figure 4. Deck Motor

SERVICE AND MAINTENANCE

EXTERNAL MAINTENANCE

Regular external maintenance of the Smartec Drive & Deck system should include the following:

1. Check the vehicle operator's manual for the recommended load ratings. Insure the current application does not exceed load rating.
2. Check oil level in accordance with Figure 6 Page 15.
3. Inspect the vehicle wiring harnesses for loose connections or broken wires. If wire insulation shows signs of cracking or wear, the wire harness should be replaced.
4. Inspect the cooling fins on the deck motors and deck controller for grass clippings, leaves, dirt, etc. Remove to ensure proper cooling and operation of these components.
5. Inspect the fail safe brake manual release linkage to insure proper operation of the brake.

SERVICE AND MAINTENANCE PROCEDURES

All the service and maintenance procedures presented on the following pages can be performed while the Smartec™ components are mounted on the vehicle, provided the vehicle frame allows access. Any repair procedures as mentioned in the tear down and assembly section of this manual must be performed after the component has been removed from the vehicle.

FLUIDS

The fluids used in Smartec™ products have been carefully selected, and only equivalent, or better products should be substituted.

Typically, an engine oil with a minimum rating of 9.0 cSt (55 SUS) at 230°F (110° C) and an API classification of SL is recommended. A 20W-50 engine oil has been selected for use by the factory and is recommended for normal operating temperatures. Biodegradable oils are not approved for this unit as they degrade to quickly while in service.

FLUID VOLUME AND LEVEL

Fluid volume information is provided in the Table below.

Certain situations may require additional fluid to be added or even replaced. Refer to Figure 6, Page 15 and page 3 for the proper fill port location.

Fill the Smartec™ transaxle to the bottom of the oil fill port.

Fluid Description
20W50 engine oil
Volume-per transaxle
29.6 fl. oz. (875ml)

FLUID CHANGE PROCEDURE

This transaxle is designed in such a manner that the factory oil fill should last the life of the unit and is not required to be changed. However, should circumstances require the oil to be changed, follow the procedure below.

The following procedure can be performed with the transaxle installed in the vehicle, provided the vehicle frame allows access to the fill and drain ports. Otherwise the transaxle must be removed from the vehicle to change the oil. The vehicle must be on level ground.

1. Place an oil drain pan beneath the oil drain plug. Remove the oil fill plug to allow venting. Remove the oil drain plug from the transaxle to drain the oil.
2. After the oil has drained from the transaxle, replace the oil drain plug.
3. Fill the transaxle with new 20W50 motor oil through the fill port.
4. Install the oil fill plug. When tightening the oil fill plug, refer to the table on page 28 for the required torque values.
5. Install the oil fill plug.

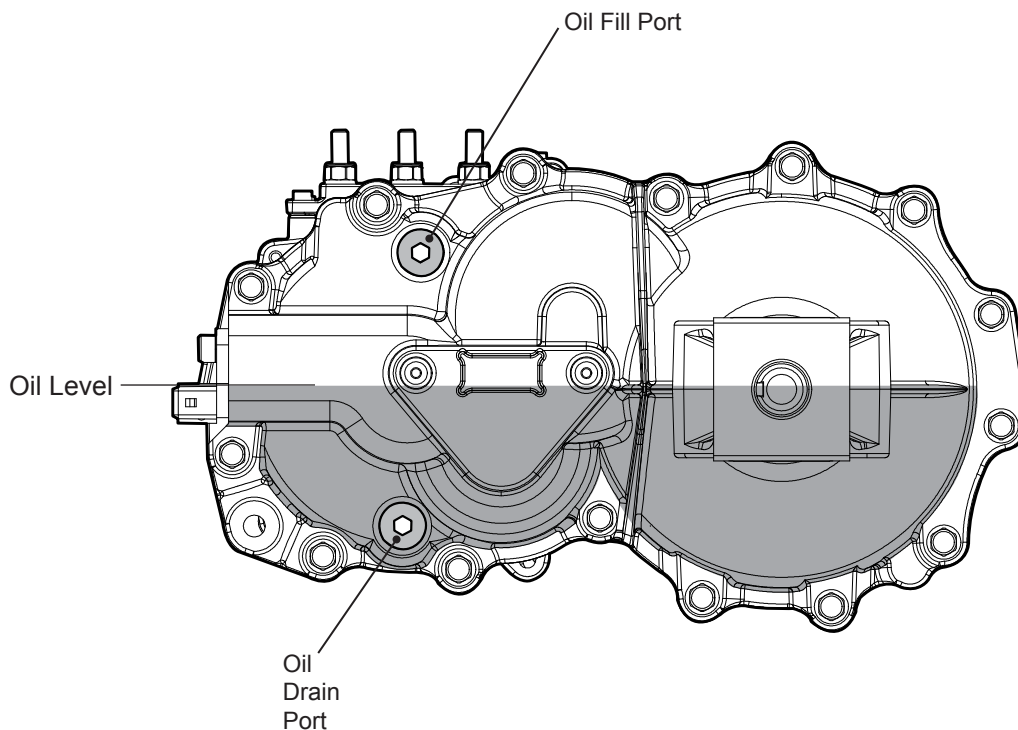


Figure 6. Oil Volume

BATTERY CHARGING

The Smartec charger is a solid state battery charger that charges 48-volt sealed or wet lead-acid deep cycle batteries to full charge and then maintains that charge on the batteries during non-use periods.

The charger maintains the batteries at full charge without degrading or overcharging the batteries, thus extending the life of the batteries.

Operating Instructions

Before charging the batteries familiarize yourself with all provided safety instructions.



WARNING

Do not turn the key "ON" while the batteries are charging. The key must be in the "OFF" position before connecting the charger to the vehicle.

1. Make sure the charger is connected to AC power and the GREEN LED is ON.
2. Place the vehicle key in the "OFF" position.
3. Plug the charger connector into the vehicle's battery receptacle.

Safety Instructions



CAUTION

To reduce risk of injury, charge only 48-volt lead-acid type rechargeable batteries. Other types of batteries may burst causing personal injury or damage.

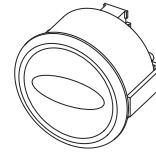
1. Before using battery charger, read all instructions and caution markings on the
 - (a) Battery charger
 - (b) Battery
 - (c) Vehicle using the battery
2. Do not expose charger to rain or snow.
3. Use of an attachment not recommended or sold by the battery manufacturer may result in risk of fire, electric shock, or injuries to persons.
4. To reduce risk of damage to electric plug and cord, pull by plug rather than cord when disconnecting charger.
5. Extension cord should not be used unless absolutely necessary. Use of improper extension cord could result in risk of fire and electric shock. If extension cord must be used, make sure:
 - a. The pins on plug of extension cord are the same number, size, shape, as those on the charger.
 - b. The extension cord is properly wired and in good electrical condition.
6. Make sure cord is located so that it will not be stepped on, tripped over, or otherwise subject to damage or stress.
7. Do not operate charger with damaged cord or plug - replace immediately.
8. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in anyway.
9. Do not disassemble or unscrew the charger for any repair or maintenance. This will void the warranty.
10. To reduce risk of electric shock, unplug charger from outlet before attempting maintenance or cleaning.
11. When charging batteries, keep in a well ventilated area.

DIGITAL DISPLAY REPLACEMENT



Digital Display Replacement

1. Position the vehicle on level ground and place the key in the “OFF” position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Remove 4 pin connector in back of Digital Display.
5. Remove 2 securing nuts from bracket and lift Digital display out of bracket and machine.
6. Install the new Digital Display into vehicle. Plug in 4 pin connector and secure device.
7. Reconnect the main negative battery cable(s) to the battery terminal.



Digital Display

Transferring hours to new display

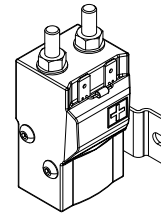
Cycle the key to the on position and the display will read 02A52 (hour meter mismatch) for one minute. During this one minute the traction controller is disabled. If no action is taken within the one minute via the Smartec Interface Tool, the digital display hour meter is overwritten with the hours stored in the traction controller. Therefore, the hour data is transferred automatically to the new display and no further action is required. Cycle the key off and back on to clear the error code.

SINGLE POLE CONTACTOR REPLACEMENT



Single Pole Contactor Replacement

1. Position the vehicle on level ground and place the key in the “OFF” position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Mark the orientation of the wires for properly reconnecting.
5. Remove all wire connections from the contactor.
6. Remove securing device of contactor. Remove contactor from vehicle.
7. Install and secure new contactor in the vehicle. Connect all wires to the contactor. When securing the contactor, refer to page 28 for the proper torque values.
8. Reconnect the main negative battery cable(s) to the battery terminal.



Single Pole Contactor

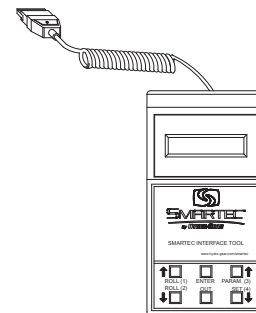
TRACTION CONTROLLER REPLACEMENT



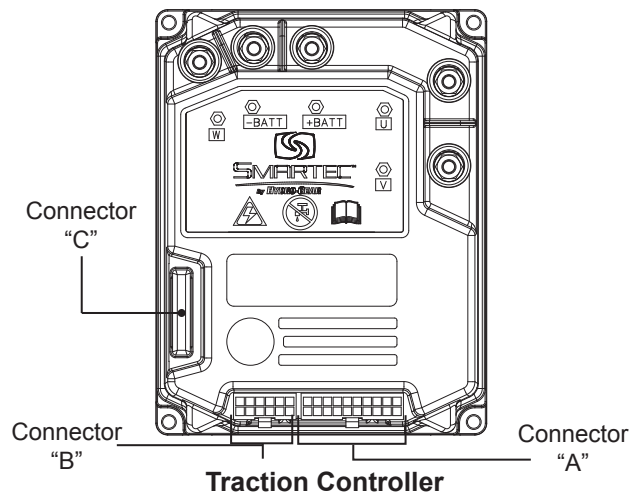
WARNING

Traction Controller Replacement

1. Position the vehicle on level ground and place the key in the “OFF” position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Check Batt(-) and Batt(+) on the traction controller to be sure there is no power to the traction controller. If power is still present, contact Technical Support.
5. Mark all wires with their connection letter marked on the controller.
6. Remove Batt(-) and Batt(+) connections and cover wire connectors in electrical tape.
7. Remove connector plugs (A) and (B) from the existing traction controller.
8. Remove (U), (W), and (V) power connections.
9. Remove the four mounting screws, and the thermal grease (if applicable) from the mounting base.
10. Apply a new light layer of thermoconductive grease to the bottom of the new traction controller (if applicable).
11. Install the new traction controller in the vehicle. Reconnect all wires and connectors to the traction controller.
12. Connect the Smartec Interface Tool to connector “C” on the new traction controller and reconnect the main negative battery cables to the battery.
13. Place the key in the “ON” position to supply power to the new controller and Interface Tool. If error code 02A52 appears, proceed to step 14. If error code 02A52 does not appear, skip to step 15.
14. *Within one minute*, set the “LOAD HM FROM DIGITAL DISPLAY” parameter on the Interface Tool to “ON”. (Reference page 23 - Main Menu Adjustments) If this is not accomplished in the specified timeframe, the stored hours will be erased and set to match the new controller which most likely will be “0”.
15. Follow the steps outlined in the “Accelerator Sensor Calibration” section to calibrate the new traction controller to the accelerator sensors on (Pages 21 or 22).
16. Once the traction controller has been calibrated, place the key in the “OFF” position and disconnect the Interface Tool from the traction controller. Place the rubber cap on connector “C” of the traction controller.



Smartec Interface Tool



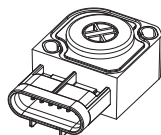
ACCELERATOR REPLACEMENT

NOTE: *If applicable, when an Accelerator is replaced, the dead band calibration procedure should be performed (Page 21) and it must be calibrated to the system per pages 22.*



Accelerator Replacement

1. Position the vehicle on level ground and place the key in the “OFF” position. Place steering handles in neutral and outward position. Remove the key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for electrical discharge of the machine.
4. Remove wire connector from Accelerator.
5. Remove mounting nuts (2) in order to remove accelerator from machine.
6. Install the new accelerator so the mounting studs are centered in the slotted mounting holes. Hand tighten the nuts and attach wire connector. Reconnect the main negative battery cable to the battery.
7. Perform the Dead Band Calibration Procedure (page 21) on machines that apply.
8. Perform the Calibration Procedure on page 22.



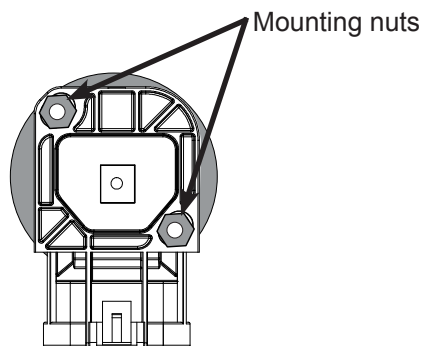
Accelerator

ACCELERATOR REPLACEMENT

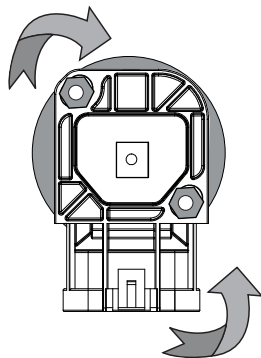
Dead Band Calibration Procedure

Note: The machine drive wheels must be securely off the ground while performing this procedure. This procedure requires 2 people, as one person will need to sit on the machine to adjust the pedal.

1. Turn key on to allow power to the drive system (Do not engage mowing blades).
2. Keep the pedal in the neutral position and
Note: *The drive wheels may start to move at this time.*
3. Loosen the mounting nuts holding the accelerator.



4. Adjust the mounting position by gently twisting left or right on the accelerator until the drive wheels stop moving.



5. Tighten the mounting nuts with the correct torque from the owners manual.
6. Calibrate the accelerator using the procedures on page 22.

ACCELERATOR CALIBRATION

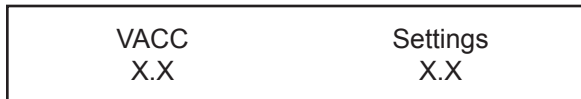
Whenever the accelerator sensor and/or traction controller is replaced, the accelerator sensor must be calibrated to the system.

NOTE: The vehicle will not move during programming.

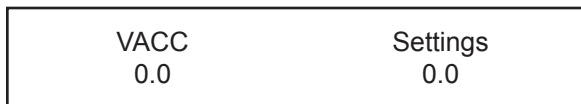
1. Plug the Smartec Interface Tool into connector “C” on the traction controller.
2. Place the key in the “ON” position.
3. Press “ENTER” on the Interface Tool.
Screen Display



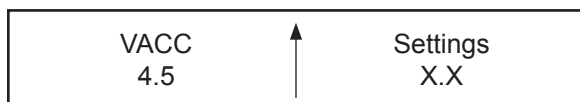
4. Press “ENTER”.
Screen Display



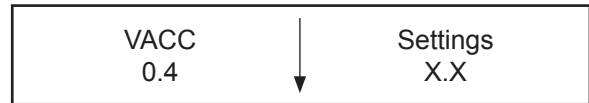
5. Press “ENTER” to clear the old settings.
Screen Display



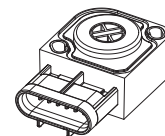
6. Push the vehicle’s pedal forward. Do not go past 4.5. Hold for 1 second to set the forward bias. NOTE: The vehicle will not move during programming.
Screen Display



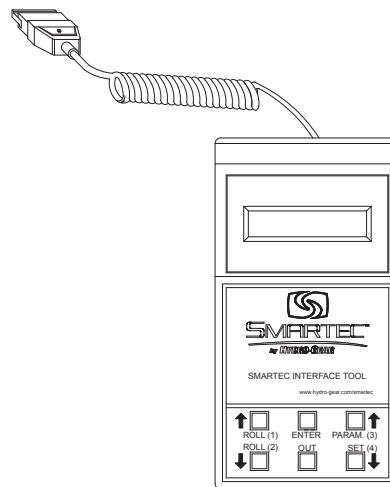
7. Release the pedal and place it in the neutral position for 1 second.
8. Push the pedal to the reverse position. Do not go past 0.4. Hold for 1 second to set the reverse bias. *Do not release pedal.*
Screen Display.



9. With the control lever in the reverse position, press the “OUT” button on the Interface Tool.
10. Press “ENTER” to save the new settings.
11. While keeping the pedal in the reverse position, turn the key to the “OFF” position.
12. Disconnect the Interface Tool from the traction controller. Place the rubber cap on connector “C”.



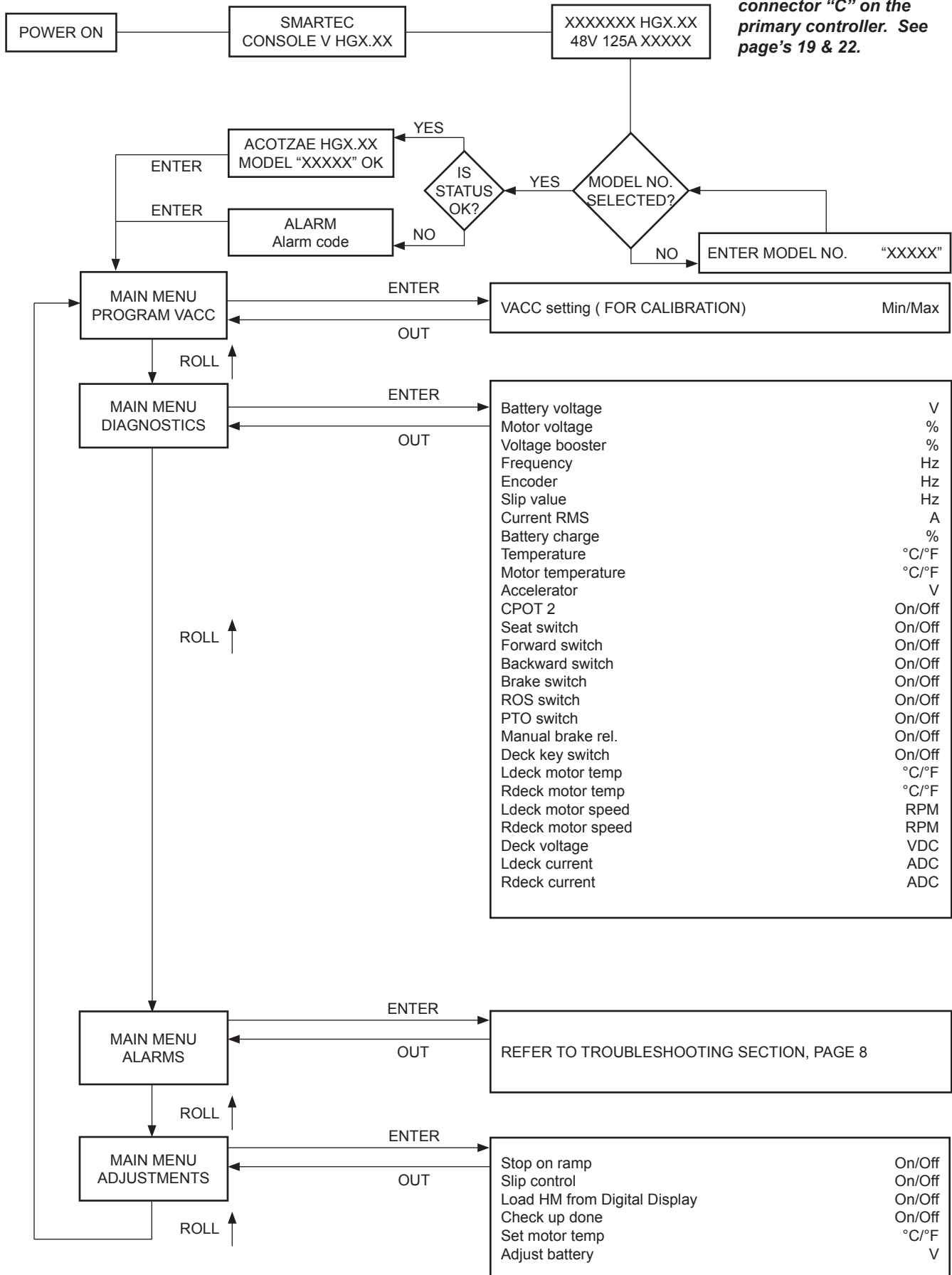
Accelerator



Smartec Interface Tool

SMARTEC INTERFACE TOOL FUNCTIONS

Smartec Interface tool must be plugged into connector "C" on the primary controller. See page's 19 & 22.



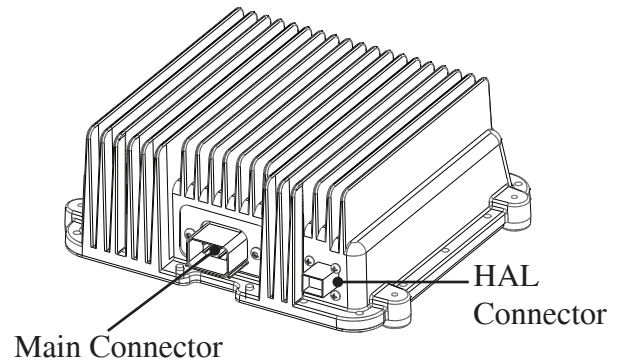
DECK CONTROLLER REPLACEMENT



WARNING

1. Position the vehicle on level ground and place the key in the "OFF" position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Disconnect all wires and connectors from the deck controller and label each accordingly. Remove all fasteners from the deck controller and remove the deck controller from the vehicle.
5. Place the new deck controller on the vehicle and secure with the required fasteners. Connect all the wires and connectors that were removed in the previous step (Figures 7 and 8).
6. Reconnect the wire(s) that were disconnected from the main negative battery terminal.

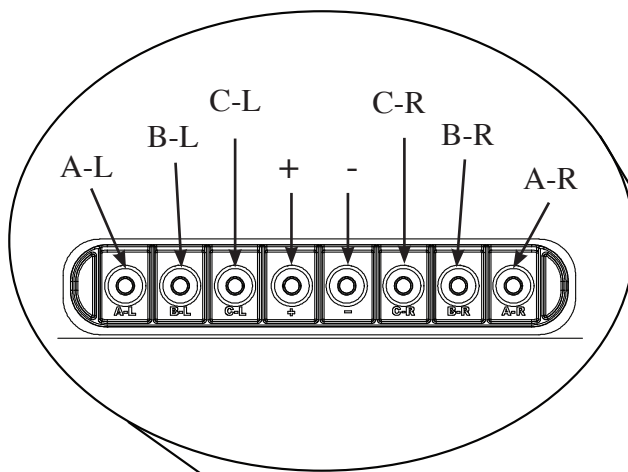
Deck Controller (front view)



Wire Connection Table

CONNECTION	CONNECTED TO
A-L	"A" on Left Deck Motor
B-L	"B" on Left Deck Motor
C-L	"C" on Left Deck Motor
+	Battery Positive (+ 48 VDC)
-	Battery Ground
C-R	"C" on Right Deck Motor
B-R	"B" on Right Deck Moto
A-R	"A" on Right Deck Moto

Figure 7. Wiring Configuration



Deck Controller (deck motor & battery connection view)

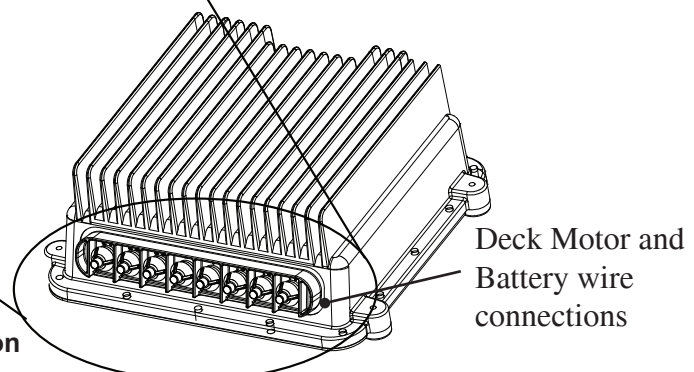



Figure 8. Wiring Configuration

DECK MOTOR REPLACEMENT



1. Position the vehicle on level ground and place the key in the “OFF” position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Disconnect all wires and connectors from the deck motor and label each accordingly.
5. Remove the blade and all fasteners from the deck motor.  Use caution as blades may be sharp. **Note:** Refer to machine owners manual for removing blades and blade adaptors.
6. Remove the deck motor from the deck.
7. Install the new deck motor onto the deck with the required fasteners.
8. Install the blade and torque fastener according to OEM specifications.
9. Reconnect all wires from the Deck Controller according to Figure 8 (page 24).
10. Reconnect the wire(s) that were disconnected from the main negative battery terminal.

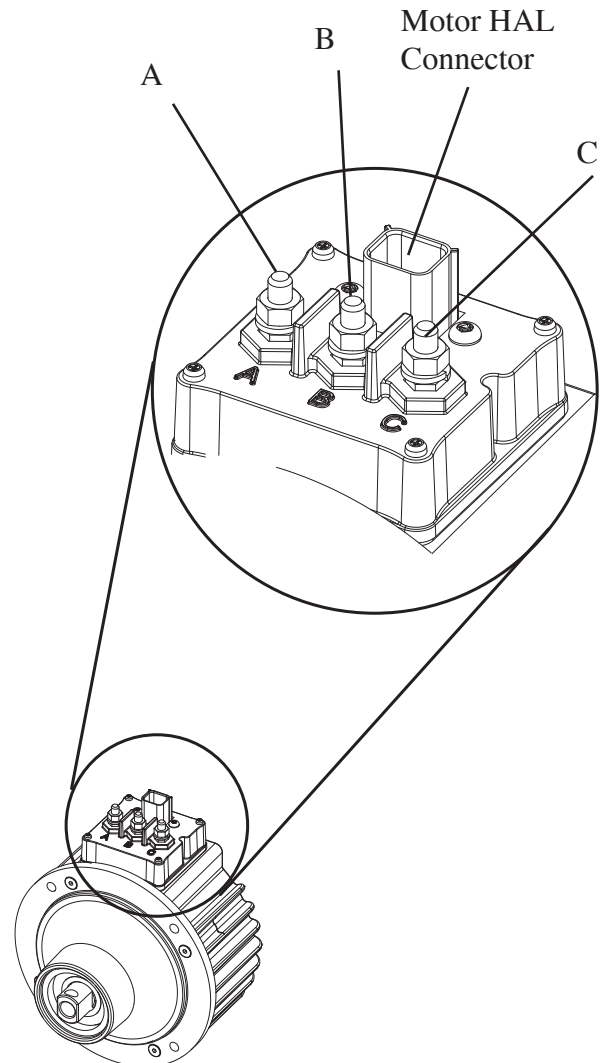


Figure 9. Deck Motor(Connections)

DECK MOTOR: NOSE CONE REPLACEMENT

Refer to Figure 10.

Complete the steps below when the deck motor has been completely removed from the machine and disconnected from any wires attached.

1. Remove 4 screws that connect nose cone to deck motor.
2. Remove nose cone from deck motor.

Inspection

1. Check nose cone for any damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the 4 screws, refer to the table on page 28 for the required torque values.

NOTE: As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

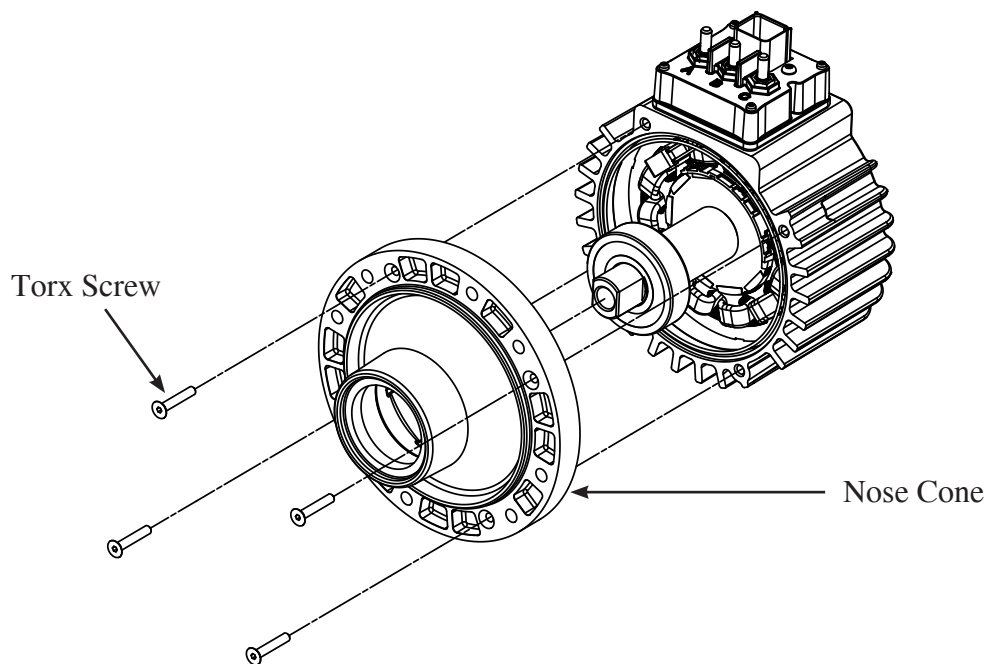


Figure 10. Nose Cone Removal

TRANSAXLE TEAR DOWN AND REASSEMBLY

Each subassembly illustrated in this section is illustrated by an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See page 44-45 for part names and descriptions. A complete exploded view and item list of the transaxle is provided on pages 41 and 42.

Many of the parts and subassemblies of this transaxle can be removed and serviced independently of other components. Where some components and assemblies must be removed before a given assembly can be serviced, that information is given at the beginning of the disassembly instructions.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation lightly lubricate all seals, O-rings, gaskets with a clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with a cellophane (plastic wrap, etc.) material. Be sure all remnants of this covering are removed after servicing.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found on page 42. Use only original

Hydro-Gear® replacement parts found in the authorized dealer section of the Hydro-Gear web site. www.hydro-gear.com

TRANSAXLE REMOVAL

It is necessary to remove the Smartec Electric Transaxle from the vehicle before performing the repair procedures presented in this section.

LIMITED DISASSEMBLY

The following procedures are presented in the order in which they must be performed to completely disassemble the unit. Do not disassemble the unit any farther than is necessary to accomplish the required repairs. Each disassembly procedure is followed by a corresponding assembly procedure.

Reassembly is accomplished by performing the "Assembly" portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 39.

TOOLS

REQUIRED TOOLS	
Smartec Charger	1-1/8 inch Socket
Smartec Interface Tool	Large Internal Retaining Ring Pliers
Digital Multi Meter	Small External Retaining Ring Pliers
Paint Pen	Large Flat Tip Screwdriver
3mm Allen Wrench	Rubber Mallet
5mm Allen Wrench	Needle Nose Pliers
1/4 inch Allen Wrench	Electrical Tape
3/8 inch Socket	Wire Markers (masking tape can be used)

TORQUES

REQUIRED TORQUE VALUES			
Item	Description	Torque	Operation
8	HFHCS, 1/4-20 x 1.25	105-155 in-lbs [11.8-17.5 Nm]	Housing Screw
16	Plug, 9/16-18 (Metal) - Magnetic	180-240 in-lbs [20.3-27.1 Nm]	Plug
56	SHCS, M4 x .7 x 40	40-56 in-lbs [4.5-6.3 Nm]	Electric Brake Kit Screw
58	SHCS, M5 x .8 x 100	40-56 in-lbs [4.5-6.3 Nm]	Drive Motor Kit Screw
68	SHCS, M6 x 1.0 x 20	40-56 in-lbs [4.5-6.3 Nm]	Speed Sensor Screw
142	Nut, Hexlock 3/4-16	240-260 ft-lbs [271.2-298.3 Nm]	Axle/Hub Nut
*	Screw, Torx M5 X .8	65-95 in-lbs [7.3-10.7 Nm]	Nose Cone Screw
*	Nut, M6	53 in-lbs [5.9 Nm]	Drive Motor Terminal Nut
*	Nut, M6	48-53 in-lbs [5.4-5.9 Nm]	Traction Controller Terminal Nut
*	Nut, M6	32-34 in-lbs [3.6-3.9 Nm]	Contactorm Terminal Nut
*	Nut, M6	35-55 in-lbs [3.9-6.2 Nm]	Deck Controller Terminal Nut
*	Nut, M6	35-55 in-lbs [3.9-6.2 Nm]	Deck Motor Terminal Nut

* Not designated by an item number

TRANSAXLE REMOVAL

NOTE: It is necessary to remove the Smartec Integrated Electric Transaxle from the vehicle before performing the repair procedures presented in this section.

Before starting any disassembly, make certain that your work area is neat and clean. Clean the external parts of the transaxle.

The following procedures are presented in the order recommended for a complete tear down of the transaxle.

Do not disassemble the unit any farther than necessary to accomplish the required repairs.

Reassembly is accomplished by performing the "Assembly" portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 39.

1. Position the vehicle on level ground and place the key in the "OFF" position. Remove key from machine.
2. Disconnect main negative battery cable(s) at the battery and cover connector(s) in electrical tape (See pages 6-7).
3. Wait 5 minutes for discharge of the machine.
4. Disconnect the Motor Temperature Sensor.
5. Disconnect the Electric Brake.
6. Disconnect the Electric Brake Linkage Pin.
7. Disconnect the Speed Sensor. (143).
8. Disconnect the W, V, and U motor connections.
9. Remove the transaxle from the vehicle.

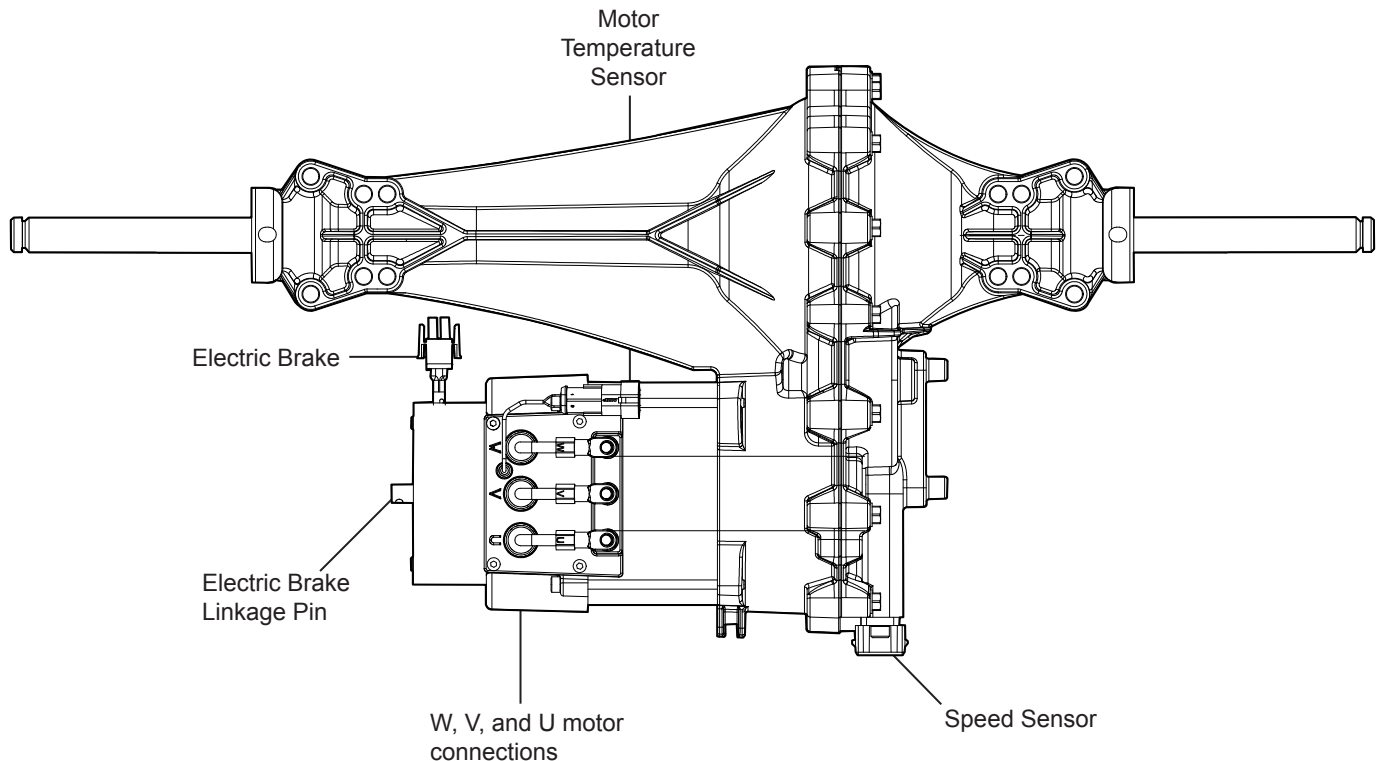


Figure 11. Smartec Integrated Electric Transaxle

BRAKE ASSEMBLY

Refer to Figure 12

1. Mark the orientation of the brake (201) with a paint pen.
2. Remove the three cap screws (56) from the brake.
3. Remove the brake (201) from the drive motor.

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Be sure to line up the paint reference mark when installing the brake.
3. Install the cap screws(56)

When tightening the cap screws(56) refer to page 28 for the required torque values.

NOTE: As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

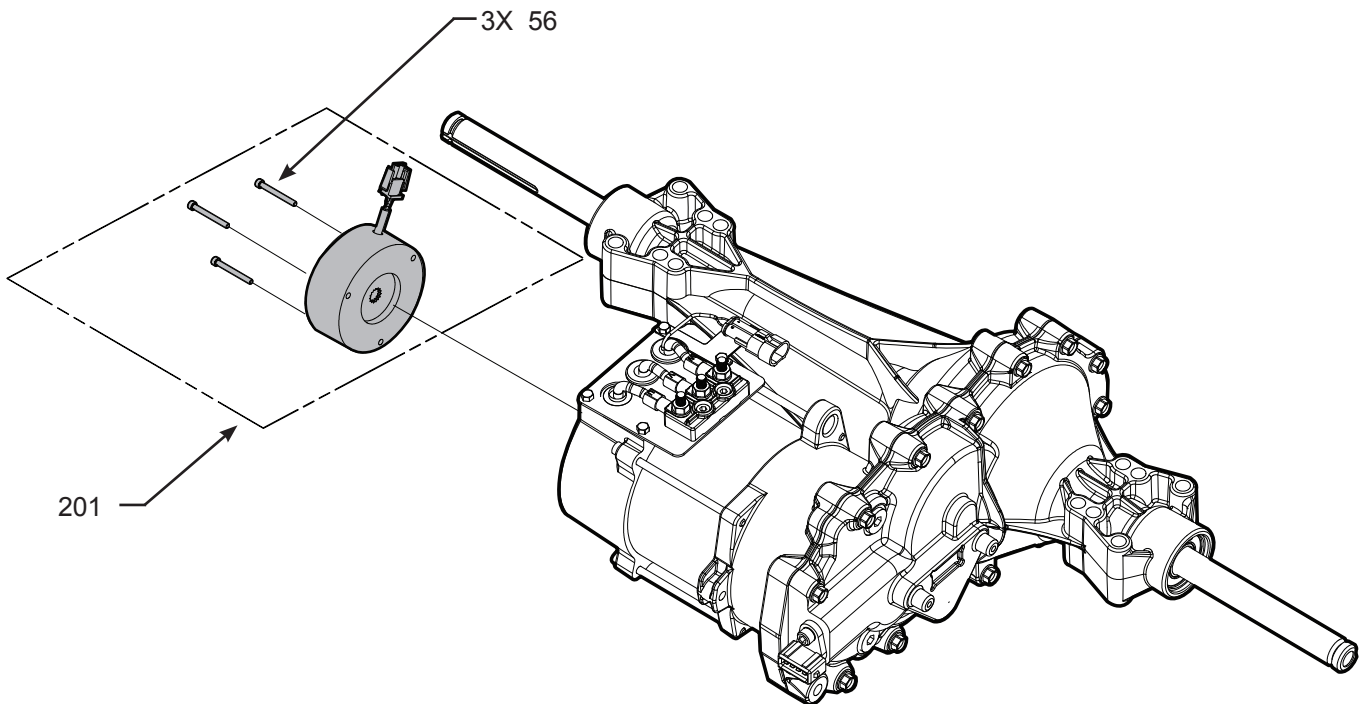


Figure 12. Brake Assembly

SPEED SENSOR

Refer to Figure 13.

1. Remove the drain and fill plugs (16) from the transaxle and drain the oil out of the housing.
2. Remove the capscrew (68).
3. Remove the speed sensor (67) from the housing.

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Place the speed sensor (67) in the housing.
2. Install the capscrew (68).
3. Install the drain plug (16).
4. At the fill port, fill the transaxle with clean 20W50 motor oil.
5. Install the oil fill plug (16).

When tightening the plugs (16) and capscrew (68), refer to the table on page 28 for the required torque values.

NOTE: As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

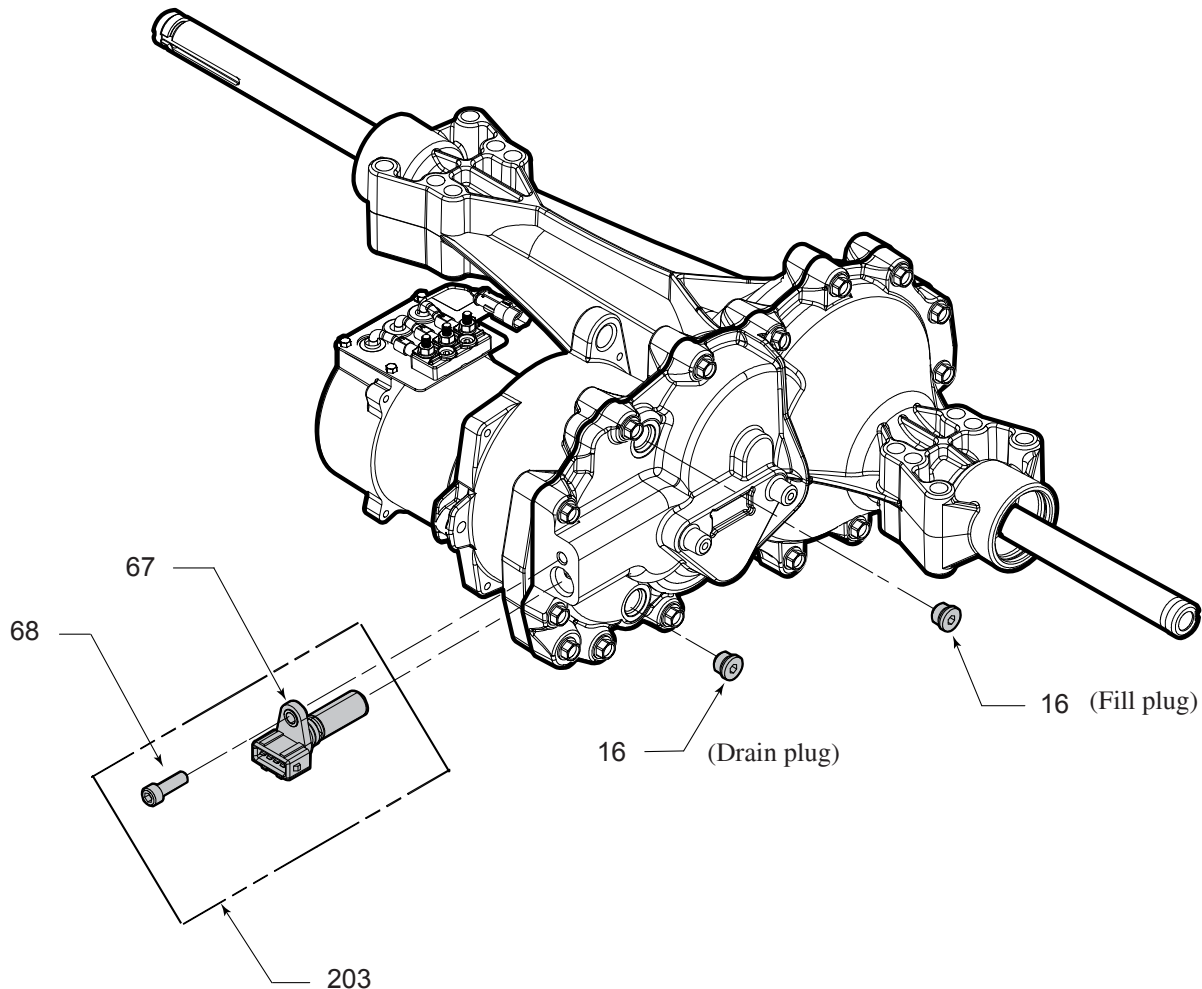


Figure 13. Speed Sensor

AXLE BEARINGS, SEALS & RETAINING RINGS

Refer to Figure 14.

1. Remove the axle seals retaining ring (109).
2. Remove the axle seals (110).
3. Remove the axle bearings (105).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Install the axle bearings (105).
2. Protect the axle seal from cuts by placing cellophane over the axle shaft before installing the seal (110).
3. Install the seals (110).
4. Install the retaining rings (109).
5. Remove the cellophane from the axle shafts.

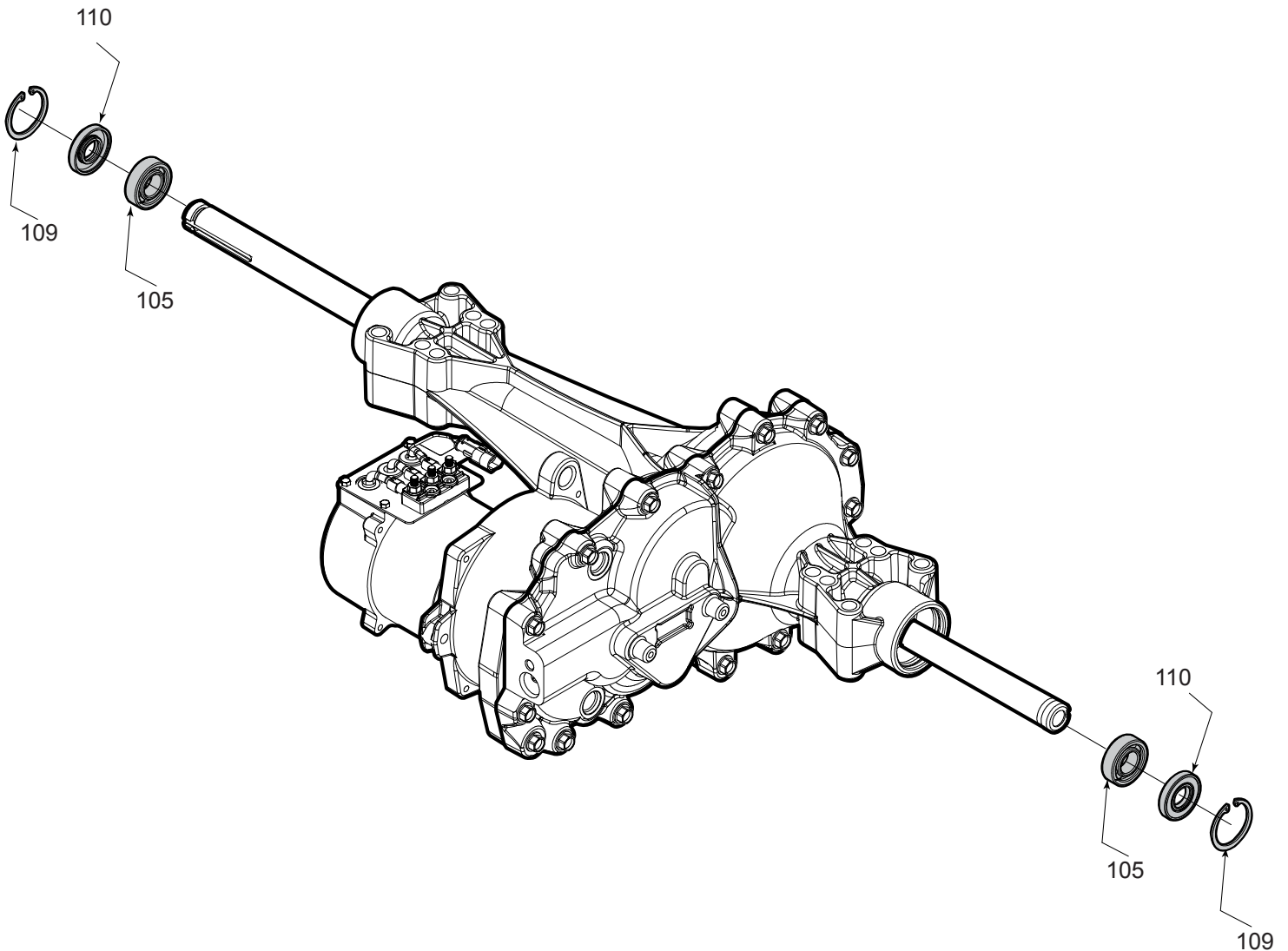


Figure 14. Axle Seals, Bearings & Retaining Rings

SIDE HOUSING

Refer to Figure 15.

For ease of disassembly, rotate the transaxle so that the drive motor is facing down and the axle is facing up. Keep the unit in this position for the remaining disassembly steps.

1. Remove the fifteen capscrews (8) that hold the main and side housing together.
2. Use a pry tool at the housing pry points to separate the housing.
3. Remove the side housing (2).
4. Scrape and clean all the old sealant off the housings.

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Apply a bead of sealant to the main housing. Refer to page 40 Figure 21.
2. Slide the side housing over the axle and mate it to the main housing.
3. Install the fifteen capscrews (8) into the side housing. When tightening the capscrews (8), refer to the table on page 28 for the required torque values and refer to Figure 22 on page 40 for the torque sequence.

NOTE: As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

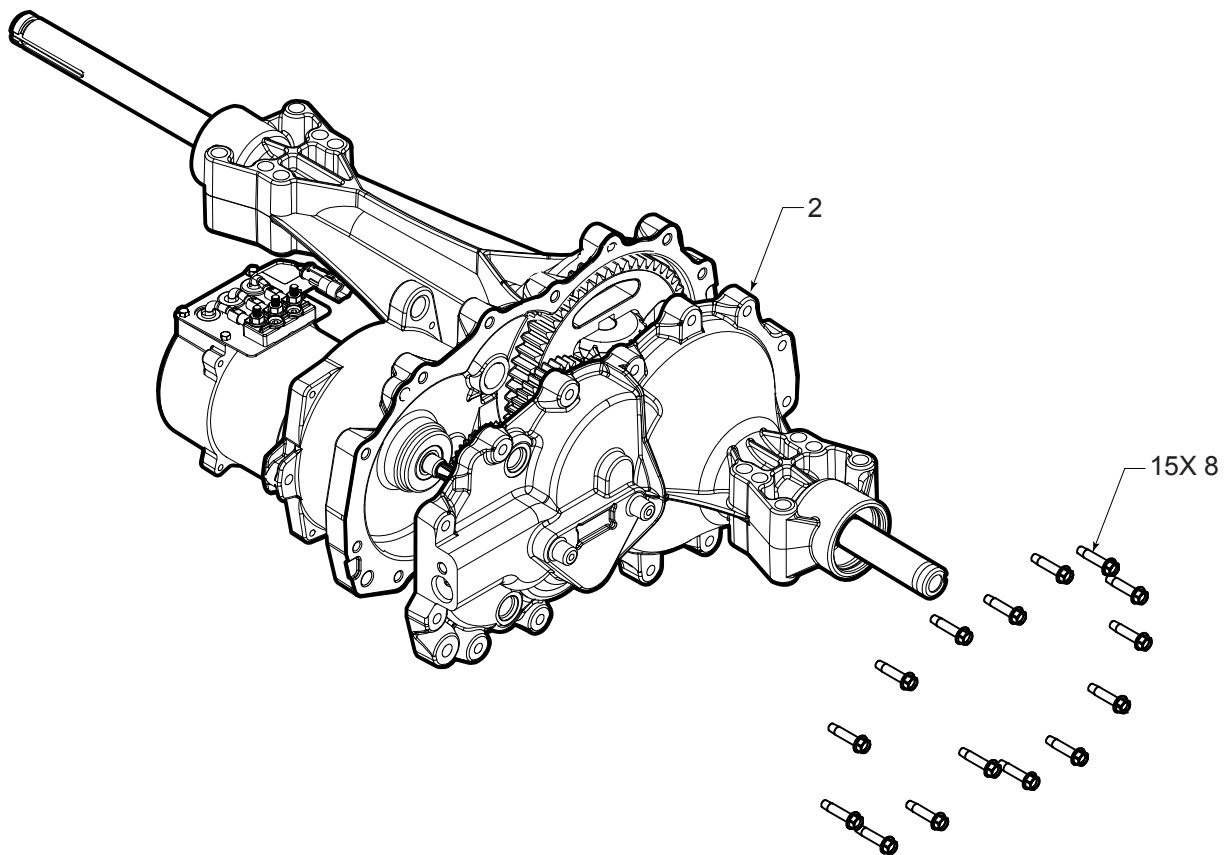


Figure 15. Side Housing

RH AXLE SHAFT

Refer to Figure 16.

1. Remove the retaining ring (100) and bevel gear (101).
2. Remove the axle shaft (103).
3. Remove the washer (14) and inner bearing (105).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Install bevel gear (101) and retaining ring (100) on to axle shaft (103).
2. Install the washer (14) on axle shaft (103).
3. Install inner bearing (105) into side housing (2).
4. Install axle shaft (103) into housing.

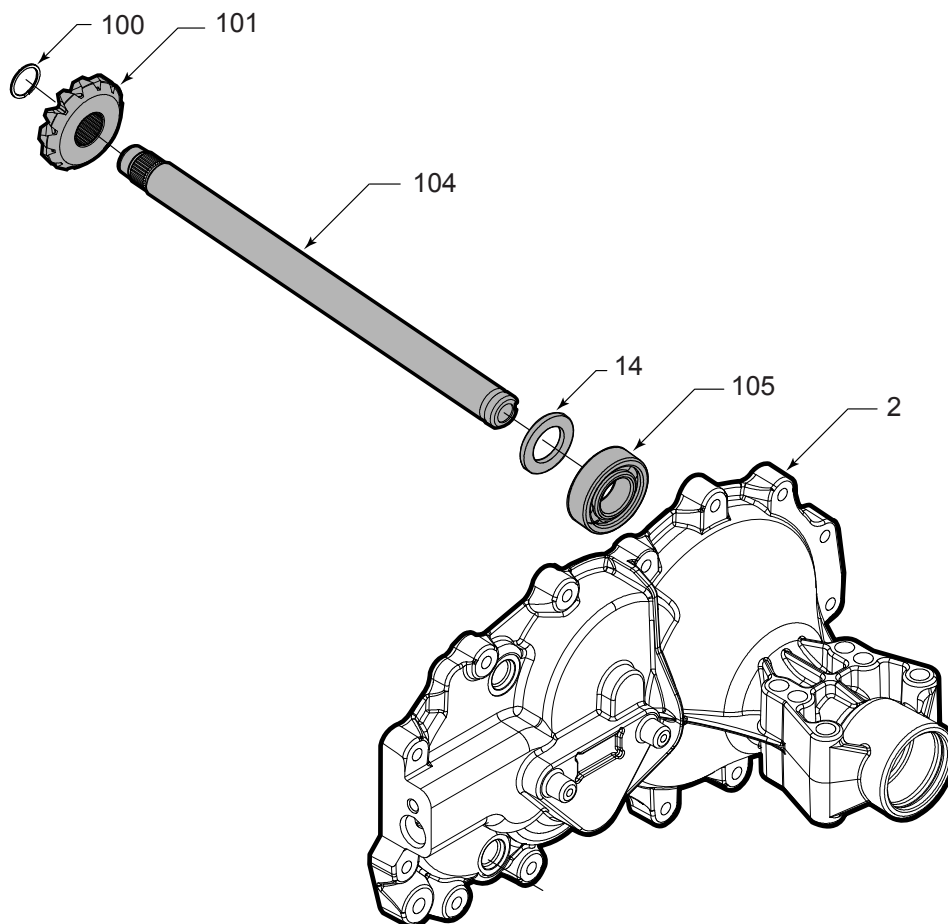


Figure 16. Right hand Axle Shaft

SENSOR GEAR AND PINION GEAR

Refer to Figure 17.

1. Remove the retaining ring (49).
2. Remove the speed sensor target gear (80).
3. Remove the pinion gear (69).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Install the pinion gear (69).
2. Install the speed sensor target gear (80).
3. Install the retaining ring (49).

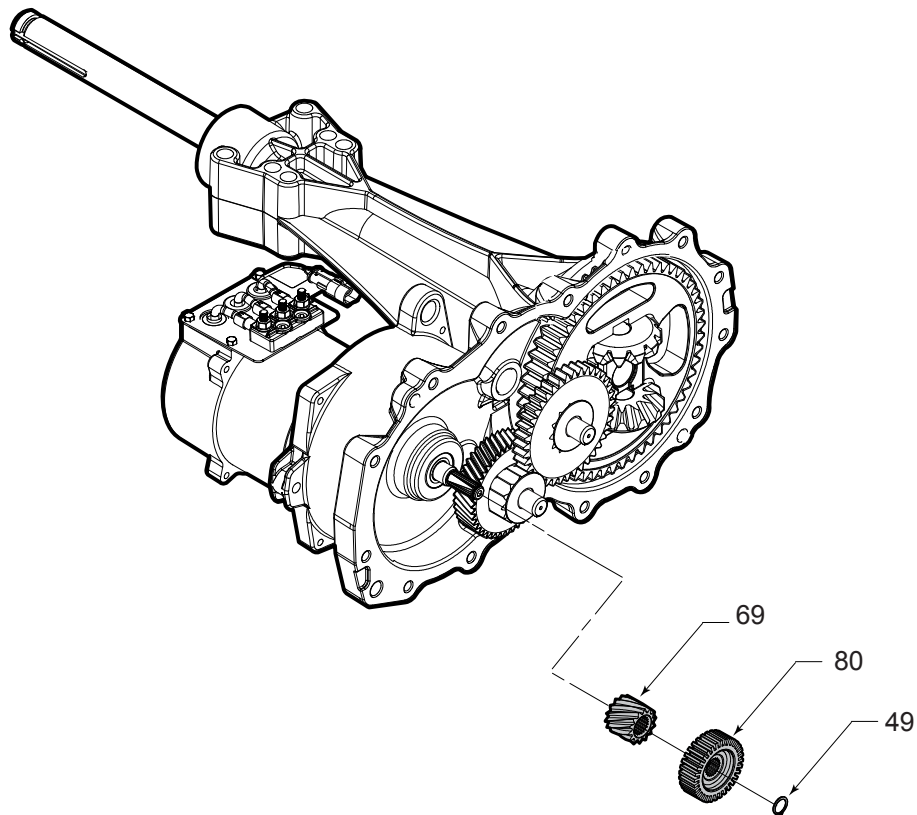


Figure 17. Sensor Gear and Pinion Gear

DRIVE MOTOR

Refer to Figure 18.

1. Remove the four drive motor capscrews (56).
2. Pull the lip seal (50) and wave washer (51) from the motor shaft.
3. Remove the retaining ring (49).
4. Remove the speed sensor target gear (80).
5. Remove the pinion gear (69).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Install the wave washer (51) and lip seal (50) on the motor shaft.
2. Mate the drive motor to the main housing. Secure with the four capscrews (56). When tightening the capscrews (56), refer to the table on page 28 for the required torque values.

NOTE: As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

3. Install the pinion gear (69).
4. Install the speed sensor target gear (80).
5. Install the retaining ring (49).

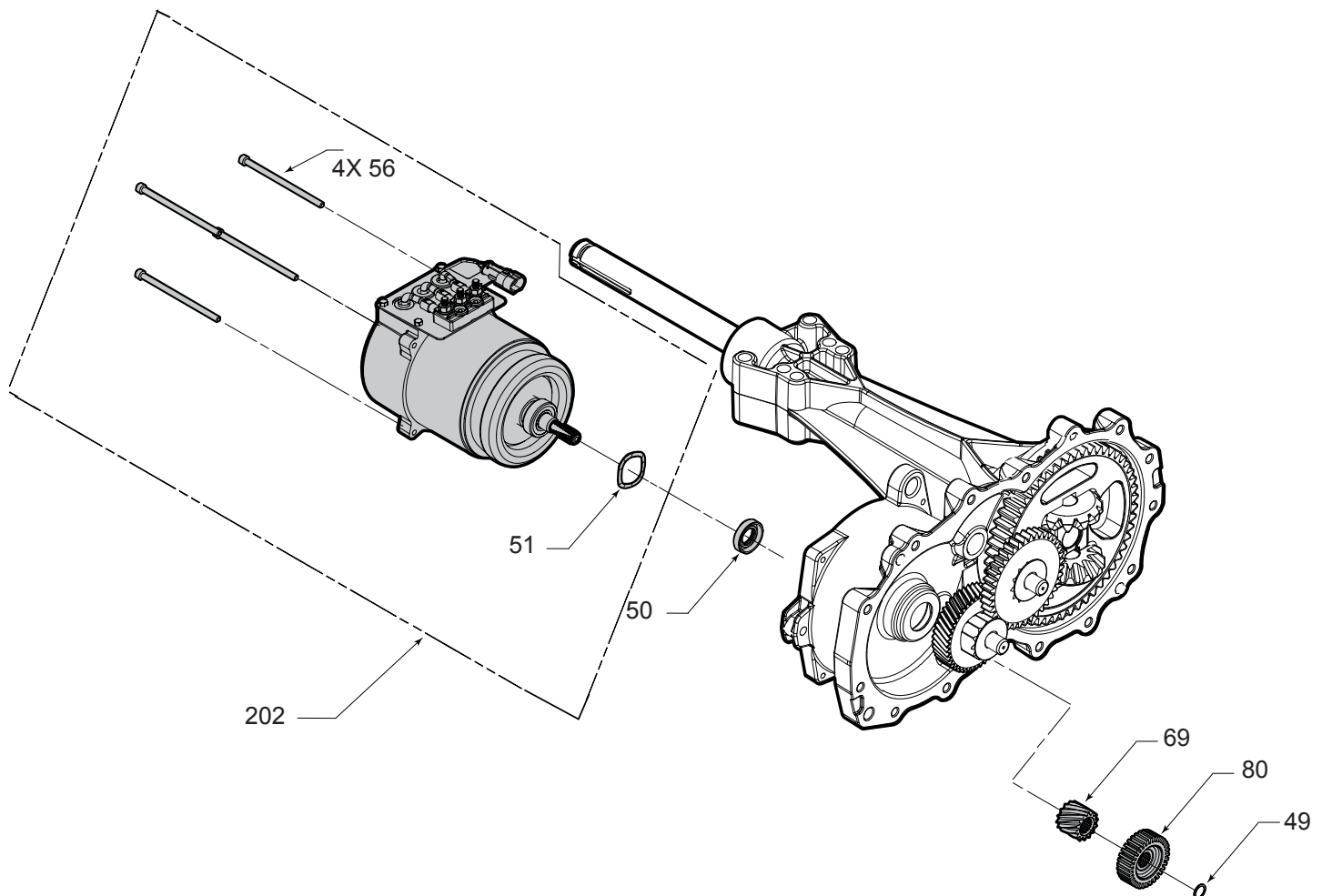


Figure 18. Drive Motor

INTERNAL GEARS

Refer to Figure 19.

1. Remove the two washers (93) and jackshaft pins (92).
2. Remove the 39T/12T gear (90) and the 12T pinion gear (91).
3. Remove the 12T/23T pinion gear (81) and the 12T/44T helical gear (84).
4. Remove the two remaining washers (93).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Install two of the flat washers (93).
2. Install the 12T/44T helical gear (84) and the 12T/23T pinion gear (81). Pay attention to the orientation of the pinion gear.
3. Install the jackshaft pin (92) and washer (93).
4. Install the 12T pinion gear (91) and the 39T/12T gear (90).
5. Install the final jackshaft pin (92) and washer (93).

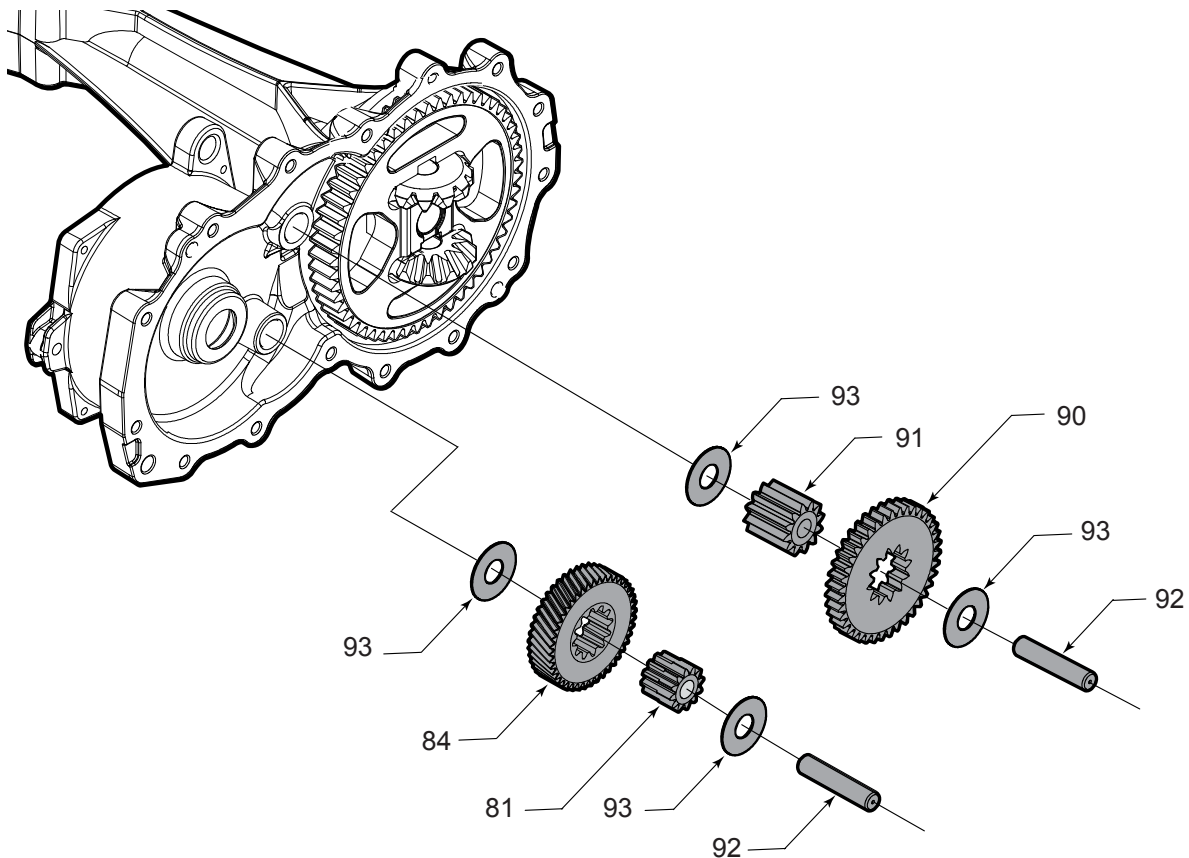


Figure 19. Internal Gears

BULL GEAR & LH AXLE SHAFT

Refer to Figure 20.

1. Remove the bull gear set - two bevel gears (102), two differential pins (108) and bull gear (15).
2. Remove the retaining ring (100).
3. Separate the axle shaft (104) from the bevel gear (101).
4. Remove washer (14) and inner bearing (105)
5. Pull axle shaft (104) out of housing (1) in direction of arrow.

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Slide the spacer (14) and internal bearing (105) onto the axle shaft (104).
2. Attach the axle shaft (104) into bevel gear (101).
3. Install a new retaining ring (100) onto the axle shaft to secure bevel gear (101).
4. Assemble two bevel gears (102), two differential pins (108) and bull gear (15).
5. Place bull gear assembly onto shaft and bevel gear (101).
6. Place the assembly in the main housing (1).

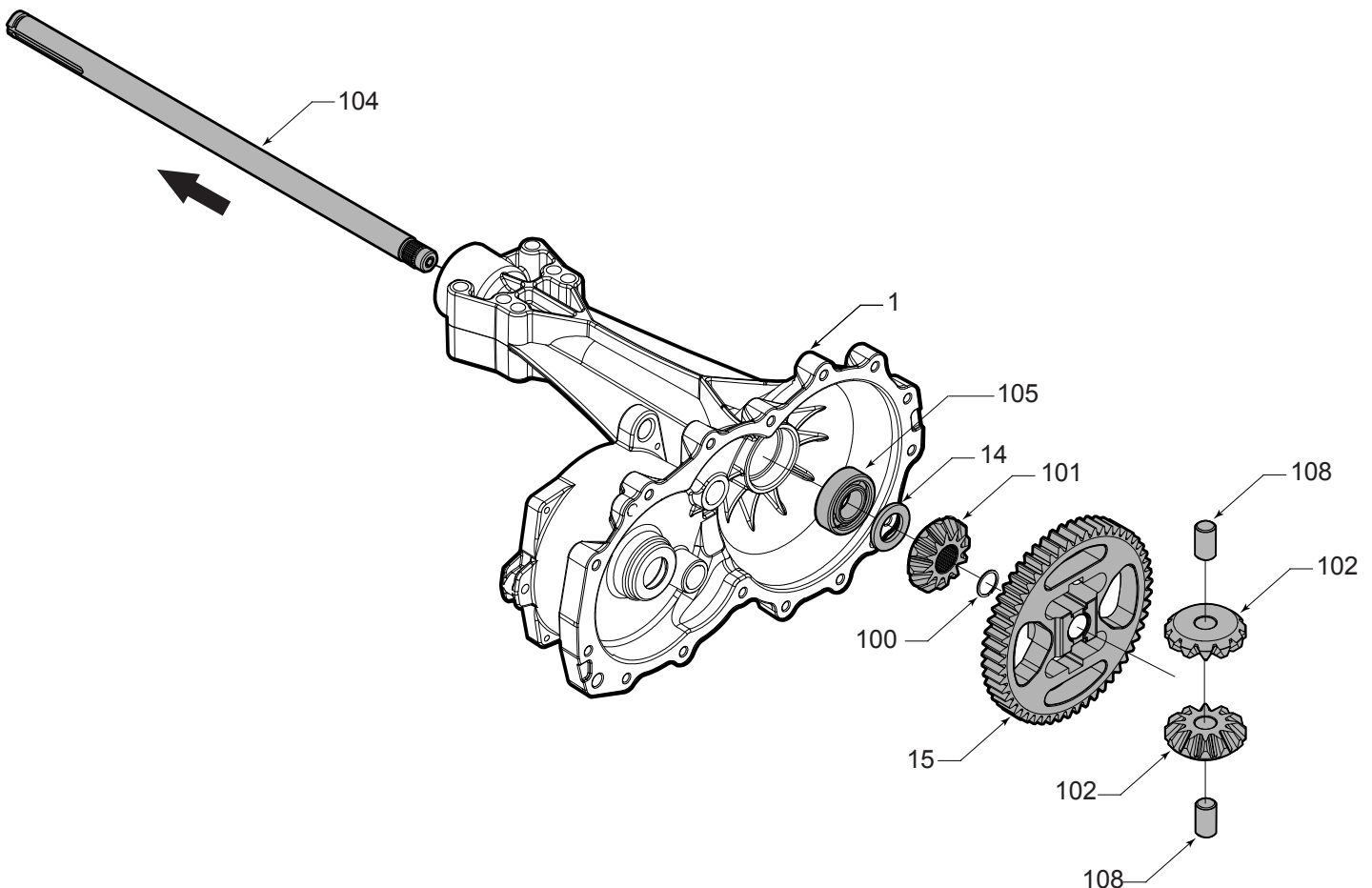


Figure 20. Bull Gear & Axle Shaft

ASSEMBLY AFTER COMPLETE TEARDOWN

If the transaxle has been torn down completely, the following summary identifies the assembly procedures necessary to completely assemble the transaxle. Each assembly procedure is located by a page reference.

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view on page 41.

1. Assemble the axle shaft (104), bull gear (15) and bevel gear (102) assembly. Page 38
2. Install the internal gears. Page 37
3. Install the drive motor (202), lip seal (50) and wave washer (51). Page 36
4. Install the sensor gear (80) and pinion gear (69). Page 35
5. Apply sealant to the main housing (1). Page 40 Figure 21
6. Install the side housing (2), right hand axle (103) and bevel gear (102) assembly, and inner bearing (105). Page 34
7. Install the outer bearing (105) axle seals (110) and retaining ring (109). Page 32
8. Install the speed sensor (67) and drain plug (16). Page 31
9. Fill the drive transaxle with new 20W50 motor oil.
10. Install the oil fill plug (16). Page 31
11. Install the brake assembly (201). Page 30

SEALANT PATTERN AND SCREW TIGHTENING SEQUENCE

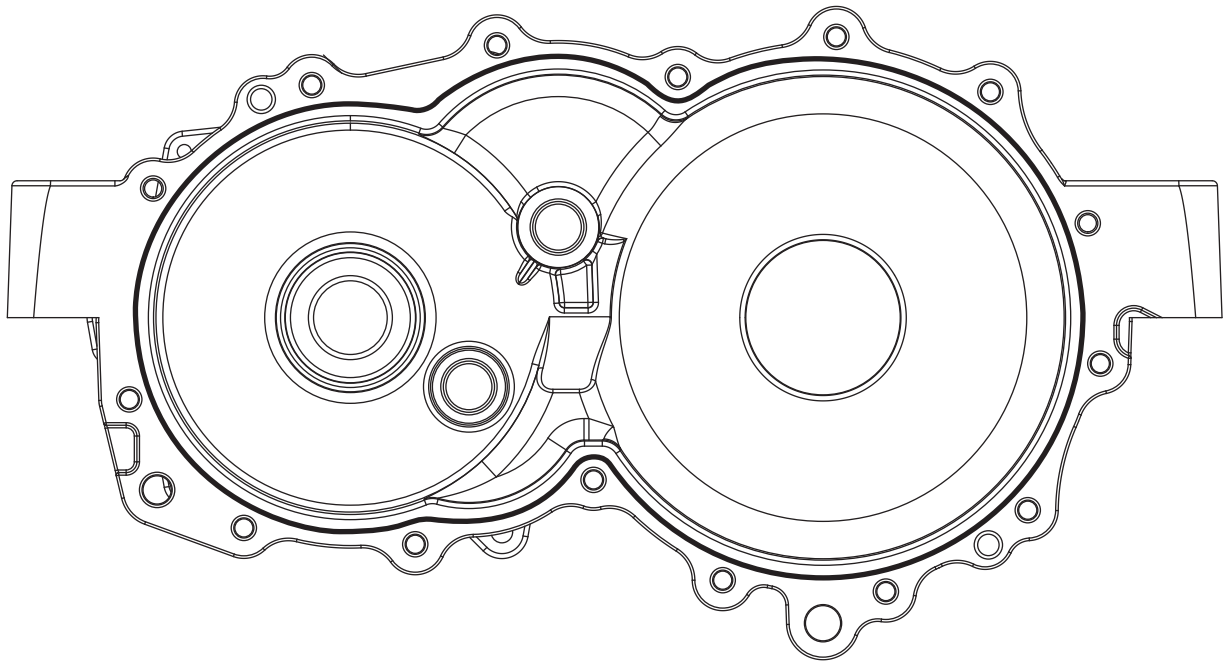


Figure 21. Housing Sealant Pattern

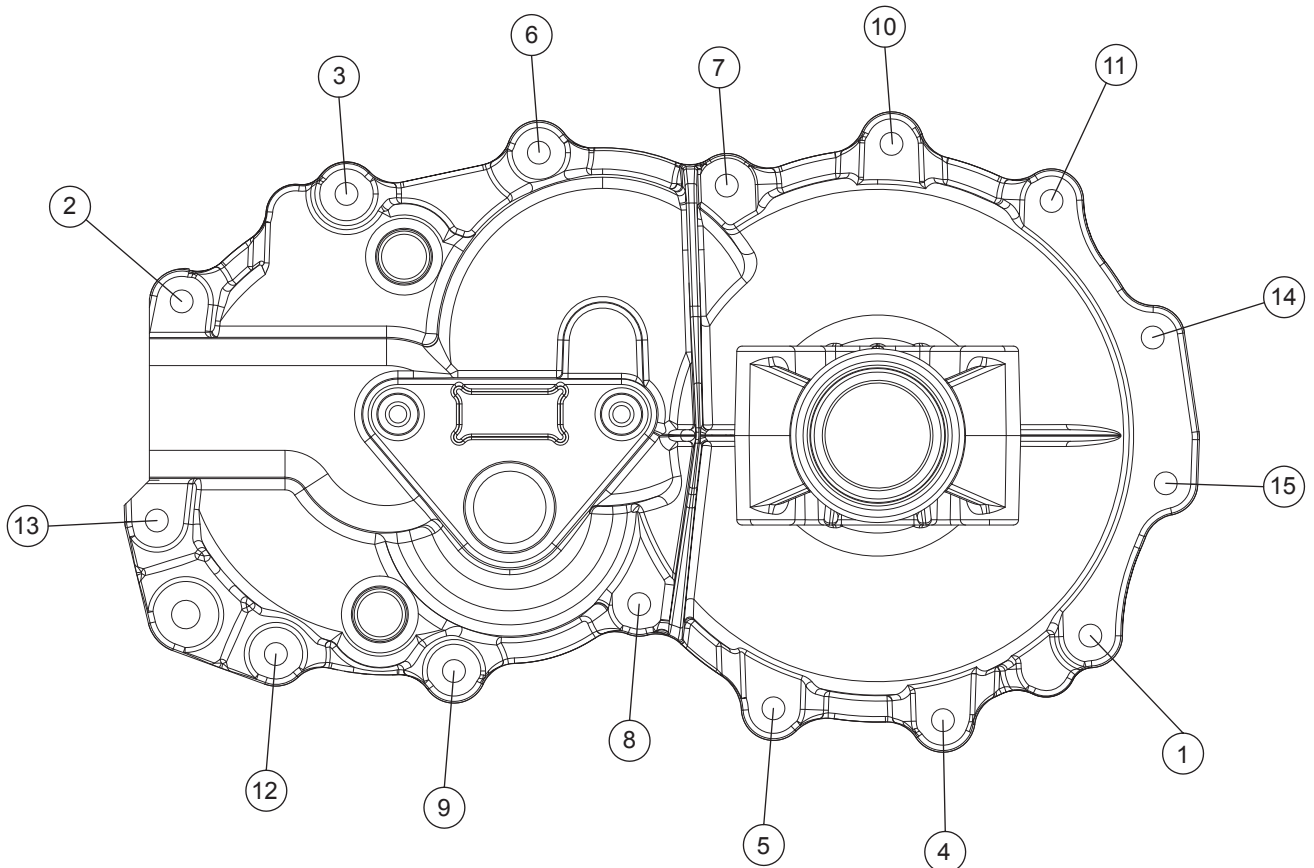
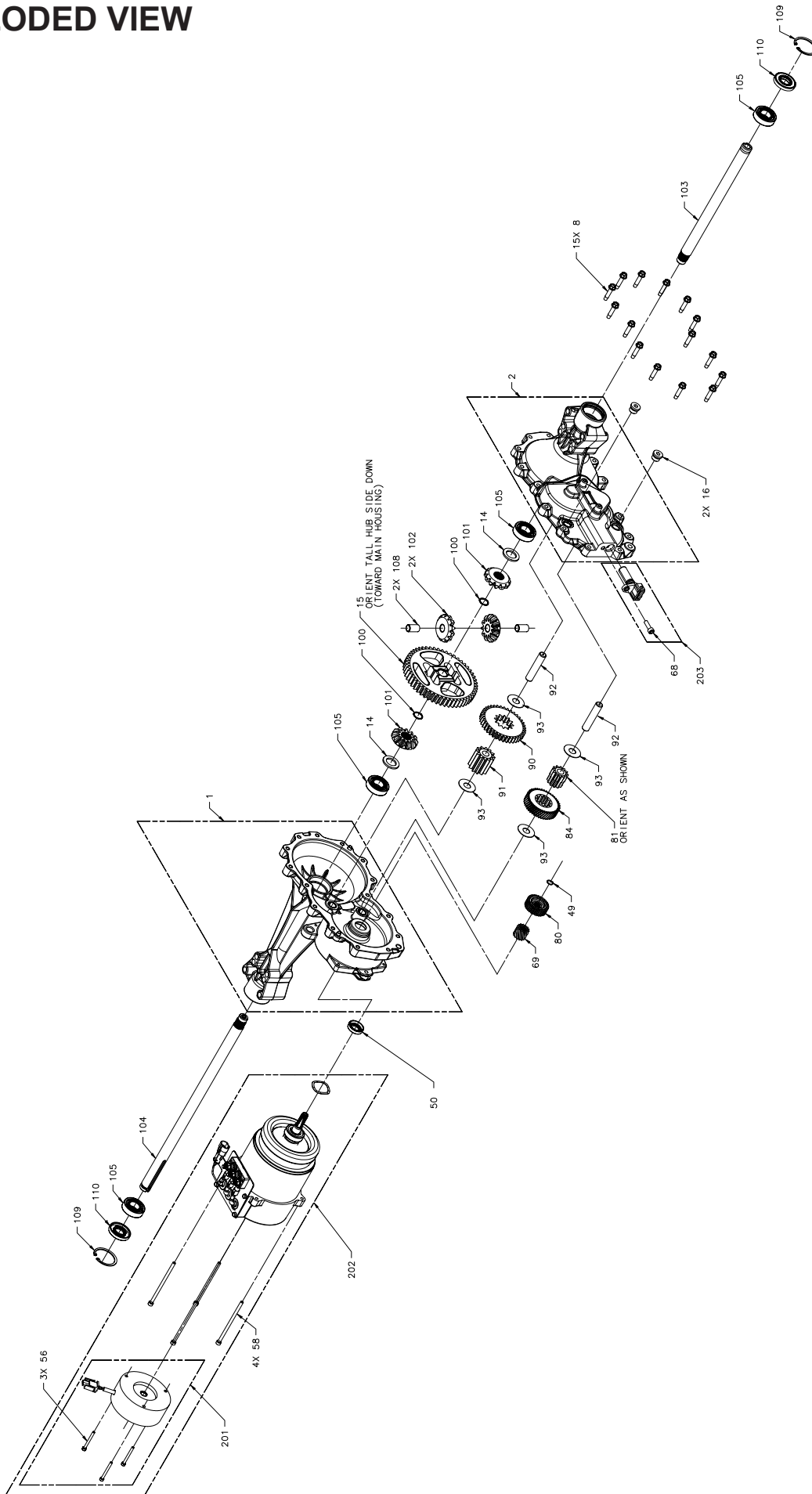


Figure 22. Housing Screw Torque Sequence

EXPLODED VIEW



PARTS LIST

Item Number	Description
1	Housing, main
2	Housing, side
3	Label, adhesive bar code
8	HFHCS, 1/4-20 x 1.125
10	Gasket material (Loctite 5900)
11	Oil, 20W50
14	Washer, Flat
15	Gear, 53T
16	Plug, 9/16-18 (metal) - magnetic
49	Retaining ring
50	Seal, lip
51	Washer, wave
52	Bearing, ball sealed
53	Motor
55	Brake, electromechanical
56	SHCS, M4 x .7 x 40
58	SHCS, M5 x .8 x 100
67	Sensor, speed
68	SHCS, M6 x 1.0 x 20
69	Gear, 14T/21T helical pinion
80	Gear, 32T/21T speed sensor target
81	Gear, 12T/23T pinion
84	Gear, 12T/44T helical
90	Gear, 39T/12T
91	Gear, 12T pinion
92	Pin, jackshaft
93	Washer, .5 x 1.00 x .03
94	Damper, bull gear
100	Ring, retaining
101	Spacer
102	Washer, flat
103	Shaft, axle 0.75
104	Shaft, axle 0.75
105	Bushing
109	Ring, retaining
110	Seal, lip
170	Axle clips
171	Wave washer .50 X .75 X .08
201	Brake assembly
202	Motor assembly
206	Seal kit

GLOSSARY OF TERMS

Accelerator: An electric sensor that replaces the trunnion arm and mechanical linkage function that is found in a traditional hydrostatic drive system.

CAN: Control Area Network, A communication protocol for active components in a system.

Continuity: Is an uninterrupted path from point A to point B.

Contact: An electromagnetic switch device (a relay) used for switching an electrical circuit.

Deck Controller: The computer controller for the deck motors, reports to the Traction Controller.

Deck Motor: The electric motor that powers the cutting blades.

Digital Display: LCD dash display that communicates system status from the traction controller to the operator.

DMM: Digital Multi-Meter; combination ohm, voltage and current meter.

Drive Motor: The electric motor that powers the gear case.

Integrated Electric Transaxle: The electric motor and gear case assembly that transmits power to the wheels.

Electric Current: Is the rate of charge flow past a given point in an electric circuit measured in Amps.

Electric Short: A low resistance connection between two points in an electrical circuit. The current flows through the area of low resistance, bypassing the intended current flow in the circuit.

NC: Normally closed switch.

NO: Normally open switch.

Ohm Meter: A meter that only measures resistance, measured in ohms.

Resistance: Is the level of opposition to current flow in a electrical system, measured in Ohms.

Smartec Interface Tool: Diagnostic tool for use with the Traction Controller to aide in trouble shooting and repairs.

Traction Controller: The computer controller for the drive and deck system.

Voltage: Is a measurement of the electrical energy in a circuit at a given point; measured in volts.

Voltage Inverter: An electrical device that converts the system DC voltage to AC voltage.

Wiring Harness: Grouping of conductors (wires) that carry information and electricity.



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