

PURKEYS

DIRECT™

DIAGNOSTIC GUIDE





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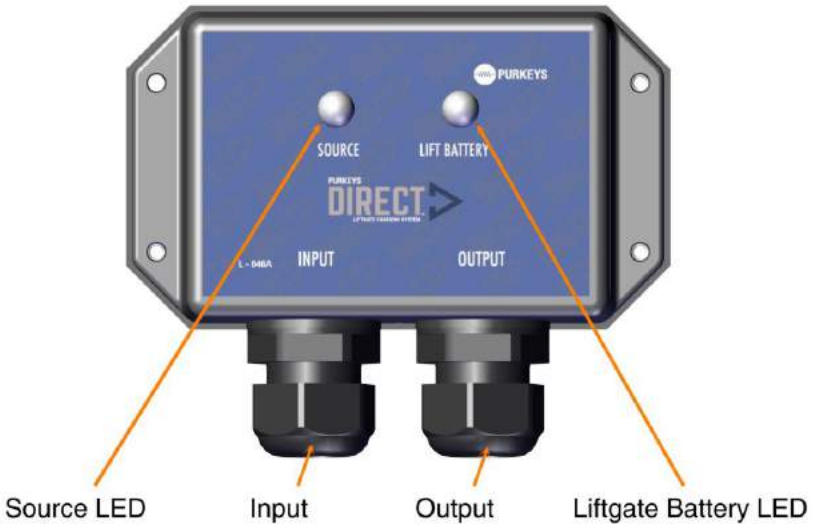
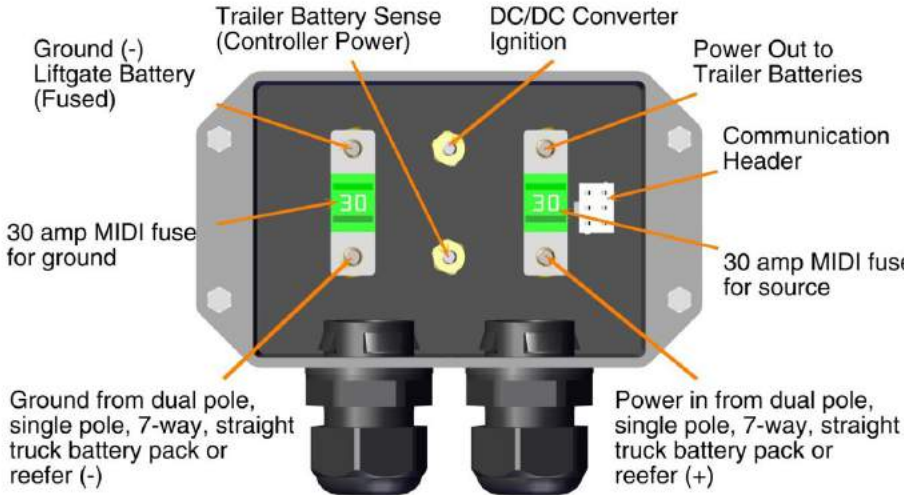
GENERAL INFORMATION

The Purkeys Direct™ system improves the charging of liftgate batteries by utilizing a DC/DC Converter to boost the voltage for optimal charging. The boost in voltage overcomes the normal voltage drop caused by the extended distance between the liftgate batteries and the vehicle charging system. Also, in cold temperatures batteries require increased charging voltages to maintain a high state of charge. The DC/DC Converter in the Direct system compensates for temperature as well as for voltage drop and provides the best voltage to the remotely located liftgate batteries. The result is well-charged liftgate batteries that will last longer and have ample power for liftgate operation.

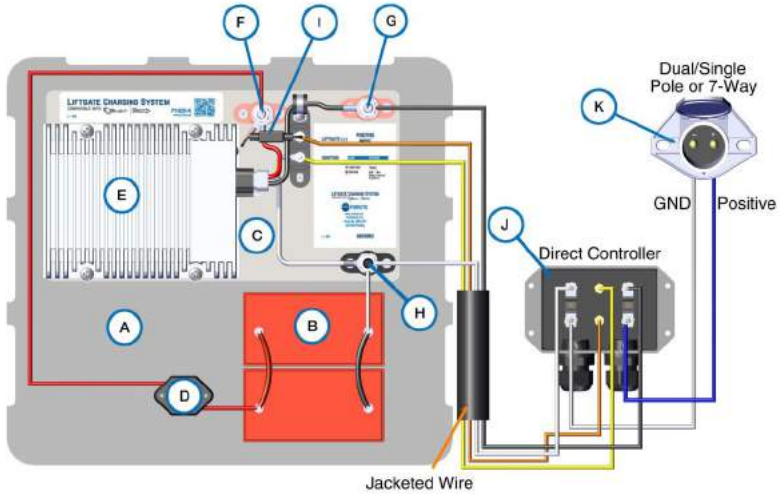
The Direct system is automatic and has easy to interpret LED indicators to assure drivers and technicians of proper system function. The Direct Controller increases the time that the DC/DC Converter can charge the liftgate batteries by monitoring the source power and “extending” the liftgate battery charge time to take full advantage of the available power, without compromising the source batteries’ ability to crank the engine. Simply put, the Direct system provides opportunity charging for the liftgate batteries that is essential in low mileage, high frequency liftgate operation applications. The LED indicators clearly show the status of the source as well as the status of the liftgate batteries. A quick glance at the Direct Controller assures the driver that the liftgate batteries are ready to go, or alerts the driver that the batteries need maintenance.

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DIRECT CONTROLLER CALL-OUTS



WIRE DIAGRAM AND LEGEND



Component:

- A. Liftgate Battery Box
- B. Liftgate Battery Pack
- C. P1020-K Liftgate Charging System Plate Assembly
- D. 30 Amp Circuit Breaker
- E. DC/DC Converter
- F. DC/DC Converter Output Stud
- G. DC/DC Converter Input Stud (+)
- H. DC/DC Converter Input Stud (-)
- I. 2 Amp Inline Fuse from Liftgate Batteries
- J. Direct Controller
- K. Input Source (Dual/Single Pole, 7-Way, Straight Truck Battery Pack, or Reefer Unit)

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WIRE COLOR	WIRE GAUGE	CONNECT FROM	CONNECT TO
Blue	10	Power In	Input Source (+)
White	10	Ground	Input Source (-)
White	8	Ground Liftgate Battery (-) Fused	DC/DC Converter Input Stud (-)
Yellow	16	DC/DC Converter Ignition	DC/DC Converter Ignition Stud
Black	8	Direct Controller Power Out to DC/DC converter	DC/DC Converter Input (+)
Orange	14	Trailer Battery Sense (Controller Power)	Positive Liftgate Battery (+)

DIAGNOSTICS

EXCESSIVE VOLTAGE DROP DIAGNOSTICS

If there is excessive voltage drop between the source battery and the Direct Controller, both Source and Lift Battery LEDs will briefly turn green, indicating that the Direct is trying to charge the batteries. Then both LEDs will toggle orange for a few seconds. This cycle then repeats (see Figure 1 for examples showing this issue).

The circuit needs to be tested while under load to determine what is causing the excessive voltage drop. See the Stinger/Aux Diagnostics section for details on diagnosing excessive voltage drop issues.

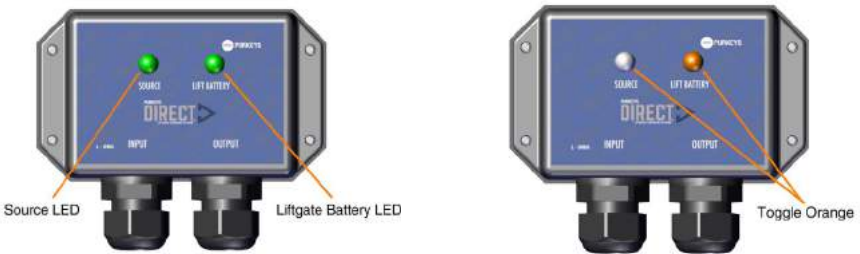


Figure 1: LEDs briefly turn green, toggle orange, then repeat



SERVICE TIP - Purkeys offers the Liftgate Double Check tool, which can simplify the diagnosis of liftgate charging system problems caused by excessive voltage drop. For more information on the tool, please call 1-800-219-1269 or visit our website at www.purkeys.net.

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STATIC DIAGNOSTICS

Not connected to a charging source or not charging (at rest) (see Figure 2 for location of Liftgate Battery LED; see Figure 3 for LED status reference, located on right side of Direct Controller).



Figure 2



Figure 3

LED STATUS	CONDITION	ACTION NEEDED	REFERENCE
Slow Flashing Green	Liftgate batteries in good state of charge (more than 12.4 volts).	None.	
Slow Flashing Orange	Liftgate batteries in low state of charge (voltage between 9.0 and 12.4 volts).	Charge and test batteries.	
Rapid Flashing Orange	Open ground fuse.	Repair circuit and/or replace fuse.	Ref #1
No LED	Open circuit from liftgate battery positive and Direct Controller or disconnected ground in liftgate battery box.	Repair circuit, reset circuit breaker, or replace fuse.	Ref #2

REFERENCE #1

Rapid Flashing Orange LED: Repair ground circuit and/or replace ground fuse (see Figure 4 for ground fuse location).



Figure 4

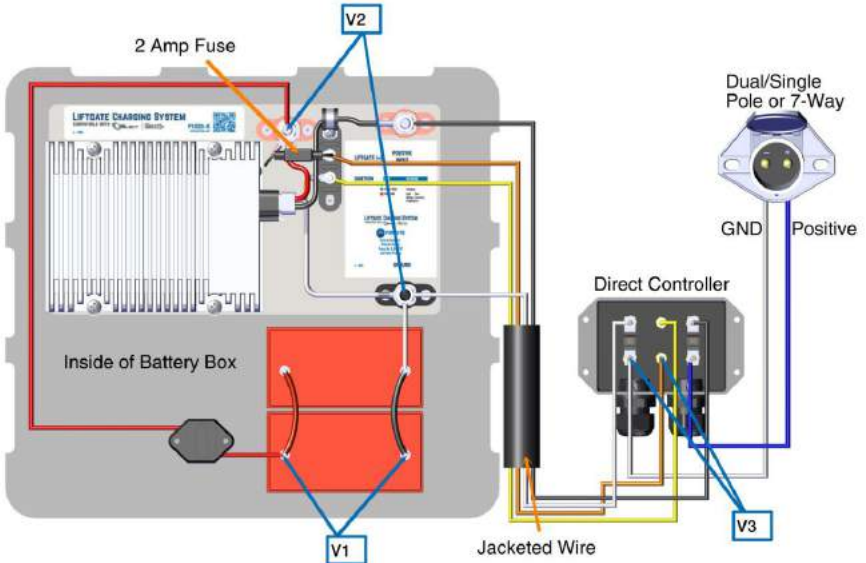


Figure 5

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REFERENCE #2

No LED: Open circuit between liftgate battery positive or liftgate battery ground and the Direct Controller. Follow the steps below to diagnose the No LED Status (see Figure 5).

1. Using a voltmeter, measure the voltage between the positive post and the negative post on the liftgate battery (see V1 in Figure 5). If the reading is less than 12.0 V, charge or replace the batteries. If the battery is higher than 12.0 V, move to step 2.
2. Using a voltmeter, measure the voltage between the positive and negative studs on the plate inside the battery box (see V2 in Figure 5). If there is no voltage reading, the issue is either the circuit breaker or the wire from one of these studs to the circuit breaker. Reset the circuit breaker or repair/replace the wire. If there is battery voltage, move to step 3.
3. Using a voltmeter, measure the voltage between the ground stud from the 7-way and the liftgate battery positive stud inside the Direct Controller (see V3 in Figure 5). Liftgate battery voltage should read 12.0 or higher. If not, check the 2-amp fuse and replace if necessary. If there is still no voltage reading, repair or replace the wires between the battery box and the Direct Controller. Once these steps are completed, if there are still no LEDs, call customer service, as the Direct Controller may not be functioning properly.

STINGER/AUX DIAGNOSTICS

Plug in the stinger and start the tractor (see Figure 6 for location of Source LED; see Figure 7 for LED status reference, located on right side of Direct Controller).



Figure 6



Figure 7

LED STATUS	CONDITION	ACTION NEEDED	REFERENCE
Solid Green	Charging mode from stinger or aux.	None.	
Slow Flashing Orange	Input voltage from the source is less than 12.4 volts.	Determine where the problem exists and repair or replace defective portion.	Ref #4
Slow Flashing Green	Voltage is over 12.4 volts.	Start the tractor.	
Rapid Flashing Orange	Open positive fuse on the stinger circuit.	Repair the circuit and replace the fuse.	Ref #3
No LED	No voltage from the stinger cord.	Determine where the problem exists and repair or replace the circuit.	Ref #4
Green, then Toggling Orange and Repeating	Excessive voltage drop.	Replace or repair the source power and ground wire harness.	Ref #5

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Note: For systems that utilize the aux circuit and a 7-way cord, tractor manufacturers have typically used 30 amp fuses on the aux circuit, but some older vehicles may have a 20-25 amp fuse or circuit breaker. Over time, these devices deteriorate and lose their ability to carry the rated amount of current. This can cause the fuse or circuit breaker to open, turning off power to the circuit. If this is occurring, replace the fuse or circuit breaker with a new unit and test the system.

REFERENCE #3

Rapid Flashing Orange LED: Blown fuse on the stinger circuit. Replace the fuse (see Figure 8 for source fuse location).



Figure 8

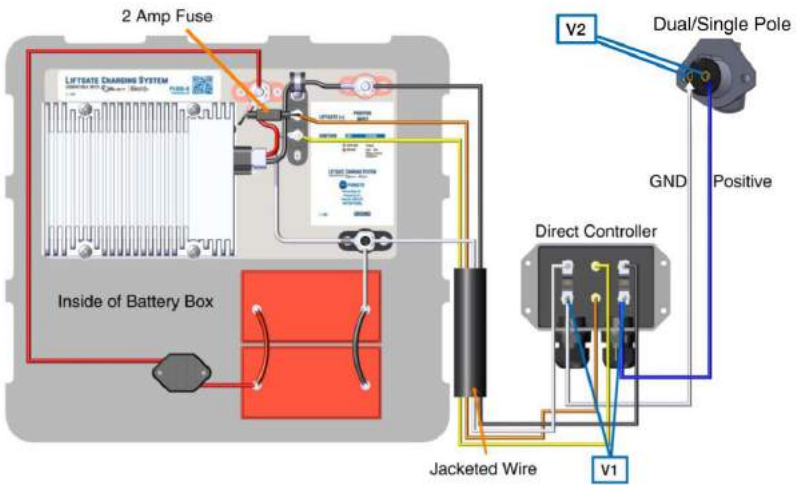


Figure 9

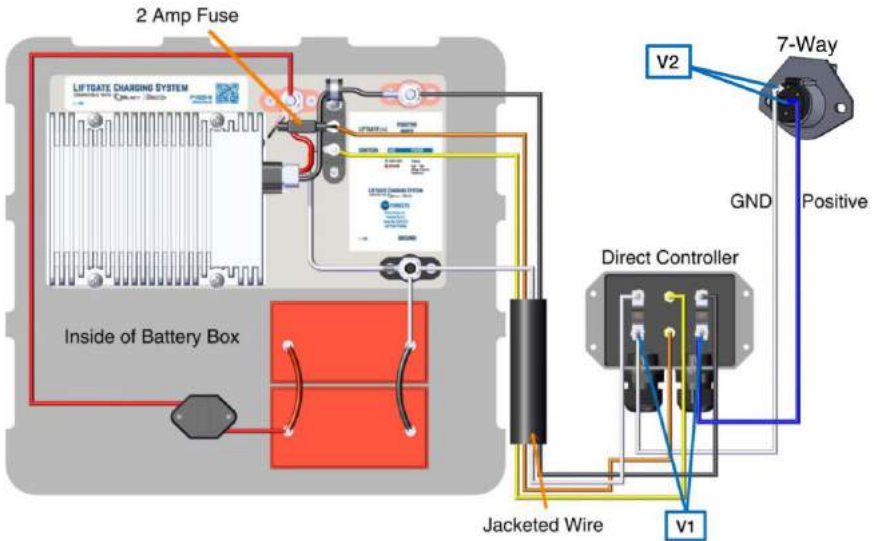


Figure 10

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REFERENCE #4

Input voltage has not reached 13.8 volt turn-on threshold. Follow the steps below to diagnose.

1. With the stinger cord still plugged in, and the tractor running, use a voltmeter to measure the voltage between the dual pole positive stud and the dual pole negative stud inside the Direct Controller (see V1 in Figure 9 or 10). It should read 13.8 volts or greater. If yes, and the light still is not solid green, call customer service, as the Direct Controller may be defective. If no, proceed to step 2.
2. With the stinger cord still plugged in, and the tractor running, use a voltmeter to measure the voltage between the positive and negative poles in the stinger receptacle (see V2 in Figure 9 or 10). It should read 13.8 volts or greater. If yes, repair or replace the wiring between the stinger and the Direct Controller. If no, measure the voltage at the truck battery. If the reading is greater than 13.8 volts, the issue is the wire from the stinger to the truck. If the reading is less than 13.8 volts, the issue is the charging system of the truck; allow the battery to charge or repair the charging system on the truck.

REFERENCE #5

Excessive Voltage Drop:

1. Check wires and connections from stinger or 7-way nosebox to Direct Controller, making sure wires are undamaged and connections are clean and tight.
2. Disconnect the stinger or 7-way cord, apply a load of about 20 amps, and measure the voltage. Voltage must remain above 10.5 volts. If not, test the stinger or 7-way cord and the wiring in the truck (wires from truck battery to stinger or 7-way connection on truck).

7-Way Nosebox Tips:

- Inspect circuits inside the 7-way box for excessive electrical resistance caused by overheating, corrosion, loose/poor connections, or undersized wiring.
- Check to see if the 7-way nosebox is equipped with circuit breakers (see Figure 11), as the problem may be a failing circuit breaker. Either replace circuit breaker with a new part or connect the blue wire from the Direct Controller to the unprotected side of the circuit breaker. Circuit protection is provided by the 30 amp fuse inside the Direct Controller.
- Ensure the 7-way or stinger cord has a tight fit and has good electrical contact at the tractor and trailer receptacles.



Figure 11: 7-Way Nosebox



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CHARGING DIAGNOSTICS

Charging from the source (the source LED is Solid Green). The Lift Battery LED status is as listed in table below (see Figure 12 for location of Liftgate Battery LED; see Figure 13 for LED status reference located, on right side of Direct Controller.)



Figure 12



Figure 13

LED STATUS	CONDITION	ACTION NEEDED	REFERENCE
Solid Green	Charging.	None.	
Slow Flashing Green	Good battery voltage, but may not be charging.	Check the DC/DC Converter and circuit protection.	Page 16
Slow Flashing Orange	Low battery, but may not be charging.	Check the DC/DC Converter and circuit protection.	Page 16
No LED	Open circuit from liftgate battery positive and Direct Controller or disconnected ground in liftgate battery box.	Repair circuit, reset circuit breaker, or replace fuse.	Ref #2

TESTING THE DC/DC CONVERTER

See Figure 14 to see the LED on the DC/DC converter. A rapid flashing red LED on the converter is normal if the trailer is disconnected from a running truck. It will continue to flash for a short period of time. A rapid flashing red LED is only a fault if the trailer is connected to a running truck.

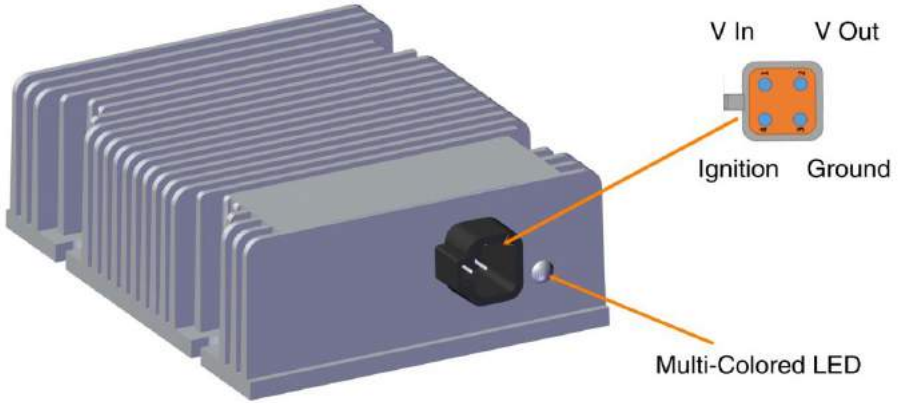


Figure 14

LED STATUS	CONDITION	ACTION NEEDED	REFERENCE
Solid Green	DC/DC Converter is on.	Ensure circuit protection on 30 amp circuit breaker is in working order.	Ref #9
Rapid Flashing Red	DC/DC Converter has a fault.	Determine the fault.	Ref #9 and 10
No Light	No voltage.	Determine the fault.	Ref #9 and 10

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REFERENCE #9

Steps to test power to the DC/DC Converter:

1. Look at the Source LED on the Direct Controller and ensure that it is Solid Green. If no, refer to the Stinger or Aux Diagnostics sections. If yes, measure the voltage at the DC/DC Converter Input (+) stud and Ground (-) Liftgate Battery (Fused) stud (see V1 on Figure 15). Voltage should be over 10.0 volts. If yes, go to step 2. If no, check 30 amp MIDI fuses for the stinger or aux.
2. With a voltmeter, measure the voltage at the ignition output (see V2 on Figure 15). Should be over 10.0 volts. If yes, skip to step 3. If no, replace Direct Controller.
3. With a voltmeter, measure the input and ignition voltages at the P1020-K Liftgate Charging System Plate Assembly (see V3 and V4 on Figure 15). Both should be over 10.0 volts. If no, repair or replace the wires between the Direct Controller and the P1020-K Liftgate Charging System Plate Assembly. If both voltages are over 10.0 volts, move to reference 10.

REFERENCE #10

Steps to testing the DC/DC Converter:

1. After completing the steps in Reference #9, check the circuit breaker. Reset the circuit breaker if tripped.
2. Check to verify that the DC/DC converter is charging the batteries. This can be done by measuring the voltage at the battery or by measuring the current going to the battery. If the voltage is above 14.0 volts, OR if the voltage is rising over time, OR if current is flowing into the battery, the DC/DC converter is charging the batteries. See a, b, or c below for details on how to make these measurements.
 - a. Measure the voltage at the liftgate batteries (see V5 on Figure 15). If higher than 14.0 volts, the charging system is functioning properly.

- b. If the voltage at the liftgate batteries is below 14.0 volts, use a voltmeter to monitor the voltage at the liftgate batteries for 2–5 minutes (see V5 on Figure 15). If the voltage rises, the DC/DC converter is functioning properly; allow time for the batteries to charge.
- c. Using a clip-on ammeter, measure current flow (see clip-on ammeter on Figure 15). If above 10.0 amps, the system is working. Allow time for the liftgate batteries to charge.

NOTE: If the voltage at the liftgate batteries is above 14.0 volts, and the batteries are fully charged, the current will taper down to under 10.0 amps.

If the DC/DC converter is not charging, check the wiring and connections to the DC/DC converter. If problem continues, replace the DC/DC converter.

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DIAGNOSTIC DIAGRAM

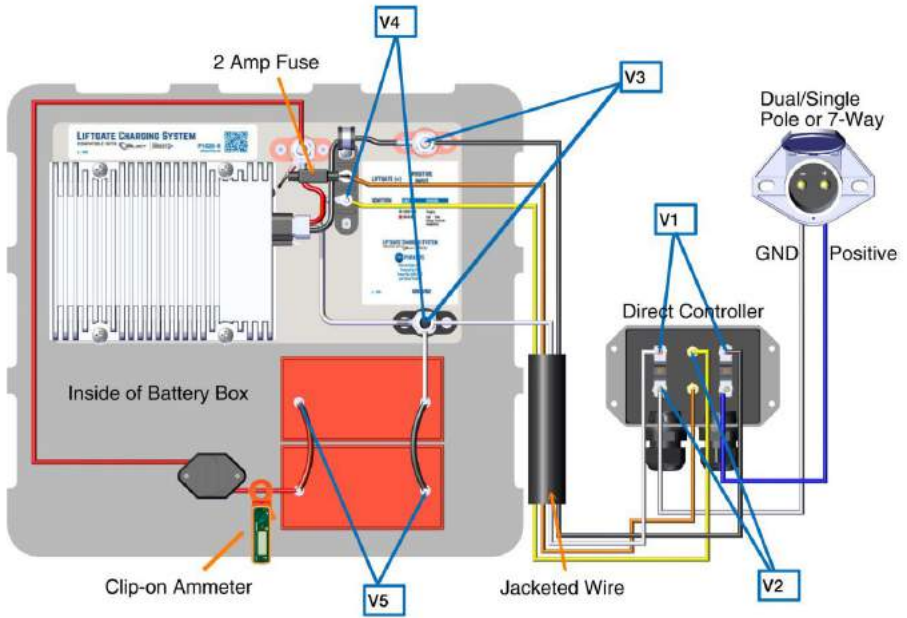














Figure 15

SUMMARY

LED Status		Logic
	<p>Solid Green on Lift Battery and Source</p>	<p>Charging State – Source voltage was greater than 13.8 volts. DC/DC converter is on. Tractor must be running and alternator good to achieve 13.8 volts. A batteries surface charge cannot reach this value.</p> <p>Note: The turn on voltage is 13.2 volts after 5 mins or 13.8 volts immediately. Reason is that if in Dual Pole in Parallel state, the Select input is now connected to liftgate batteries via the dual pole cables. If the liftgate batteries had been charging using the DC/DC converter, then that voltage could be above 13.2 volts.</p>
	<p>Solid Green on Source Slow Flashing Orange on Lift Battery</p>	<p>Charging State - Tractor connected and running. DC/DC converter is operating but the liftgate batteries are defective or below 12.8 volts.</p>
	<p>Solid Green on Lift Battery and Source</p>	<p>Extend State – Source voltage drops below 13.8 volts. DC/DC converter is on for 1 hour. Every two minutes the controller turns off the DC/DC converter so there is no current flow (no voltage drop) and measures the battery voltage on the tractor batteries. If over 12.4 volts, the controller turns on for another two minutes. This will repeat until 60 minutes has expired or the battery voltage drops below 12.4 volts.</p>

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LED Status	Logic	
	<p>Dual Pole in Parallel Mode</p> <p>Solid Green on Lift Battery and Source</p>	<p>Extend State –Tractor turns off or voltage drops below 12.6 volts (dual pole coupled, but engine off). Then it will extend for approx. 2 minutes and turn off. If voltage at dual pole does not drop below 12.6 volts, then the Direct will extend until 60 minutes has expired.</p>
	<p>No Source LED</p> <p>Lift Battery LED Slow Flashing Green</p>	<p>Static State - No tractor connected to the trailer and the liftgate batteries are more than 12.4 volts.</p>
	<p>No Source LED</p> <p>Lift Battery LED Slow Flashing Orange</p>	<p>Static State - No tractor connected to the trailer and the liftgate batteries are less than 12.4 volts.</p>
	<p>Slow Flashing Green on Lift Battery and Source</p>	<p>Off State – Source voltage below 13.8 volts and extend period is over. Voltage at the lift batteries and the source is above 12.4 volts. Voltage at source must achieve 13.8 volts to go into Charging State.</p>
	<p>Slow Flashing Orange on Lift Battery and Source</p>	<p>Off State (Low Voltage) – Lift battery and source voltage below 12.4 volts. DC/DC converter is off. Voltage at source must achieve 13.8 volts to go into Charging State.</p>
	<p>Rapid Flashing Orange on Lift Battery and/or Source</p>	<p>Off State (Fault) – Blown ground fuse if flashing on lift battery and blown source fuse if flashing on source.</p>

LED Status		Logic
	<p>No LED</p>	<p>Off State (Fault) – Open circuit in lift battery or source circuit. This could also be caused by the liftgate battery voltage being below 6 volts.</p>
		<p>Excessive Voltage Drop – Tractor is running and the voltage is above 13.8 volts. The controller turns on the DC/DC converter and current starts to flow. If the voltage drops below 10.5 volts, the controller will tell the DC/DC converter to turn off. What the operator will see is the Source and Lift Battery go Solid Green. Then both LEDs will toggle orange for a few seconds. The cycle then repeats.</p> <p>Note: Low voltage shut off in the 1st 5 mins is 9.5 volts.</p>

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LIMITED COMMERCIAL WARRANTY POLICY

Purkeys Fleet Electric, Inc. (hereafter "Purkeys"), warrants each product to be free of defects in material or workmanship under normal use and service. This warranty is for the benefit of Original Equipment Manufacturers, Dealers, Warehouse Distributors, Fleets, or other End Users (hereafter "Customers") and covers products manufactured by Purkeys and sold new to Customers either directly by Purkeys or by its authorized dealers, distributors, or agents. The length of the Warranty Period is 36 months.

The warranty period commences on the in-service or install date and is not transferable. Failure to provide the in-service or install date on the warranty claim form will cause the warranty period to begin on the date the part was manufactured or date of sale recorded on the original sales invoice, whichever is earlier.

A completed warranty claim form should accompany all parts submitted to Purkeys for consideration for repair or replacement under warranty. The submitted claim form should contain all of the information required. Lack of a properly or fully completed claim form will result in delay or denial of warranty claim. Claims must be submitted no later than 30 days after part is removed.

This warranty does not apply if, in sole judgement of Purkeys, the product has been damaged or subjected to accident, faulty repair, improper adjustment, improper installation or wiring, neglect, misuse, or alteration or if the product failure is caused by defects in peripheral vehicle components or components attached to the Product or failure of a part not manufactured by Purkeys.

This warranty shall not apply if any Purkeys product is used for a purpose for which it is not designed or is in any way altered without the specific prior written consent of Purkeys. ANY Product alleged by a Customer to be defective must be inspected by Purkeys as a part of the warranty claims process in order to confirm that the part has failed as a result of a defect in material or workmanship.

Transportation for products and parts submitted to Purkeys for warranty consideration must be prepaid by Customer. Repaired or replaced products and or components will be returned to Customer pre-paid by Customer or "freight collect" to the address provided by Customer in the warranty claim form. No charge will be made for labor or material in effecting such repairs.

The Warranty provided by Purkeys hereunder is specifically limited to repair or replacement of the Product as Purkeys deems most appropriate in its sole discretion. Purkeys neither assumes nor authorizes any other person to assume on its behalf any other warranty or liabilities in connection with Purkeys products. The Warranty does not apply to fuses or other "consumable" or maintenance items which are or may be a part of any Purkeys product.

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