FACTORY CAT TOMCAT

ELECTRICAL SERVICE GUIDE

VERSION 4.0

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CAUTION!

To reduce the chance of personal injury and/or property damage, the following instructions must be careful observed:

Proper service and repair are important to the safety of the service technician and the safe reliable operation of all cleaning equipment. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use replacement parts of lesser quality

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly anyone who intends to use a replacement part, service procedure or tool which is not recommended by the equipment manufacturer, must determine that neither his safety nor the safe operation of the equipment will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various cautions and notices that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the piece of equipment or render it unsafe. It is also important to note that these ‘Cautions’ and ‘Notices’ are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

Factory Cat/Tomcat service manuals are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your piece of equipment that may cause it not to operate properly

This manual should be kept in a convenient place for easy reference. When properly used, it will meet the needs of technicians and equipment owners.

Printed in U.S.A.

As our policy is one of constant improvement, all specifications are subject to change without notice.

SAFETY MESSAGE

Your safety and the safety of others is very important and operating this unit safely is an important responsibility.

To help you make informed decisions about safety, we have provided operation procedures and other safety information in this manual. This information informs you of potential hazards that could hurt you or others.

It is not practical or possible to warn you of all the hazards associated with operating this unit. You must use your own good judgement.

This is intended for commercial use. It is designed to be used on hard floors only and in an indoor environment, with the recommended pads and brushes with approved cleaning solutions.

DO NOT OPERATE THE UNIT:

- UNLESS TRAINED AND AUTHORIZED.
- UNLESS OPERATOR MANUAL IS READ AND UNDERSTOOD.
- IF UNIT IS NOT IN PROPER OPERATING CONDITION.

WHEN OPERATING UNIT:

- WEAR PROPER PROTECTIVE EQUIPMENT.
- REMOVE LOOSE OBJECTS FROM THE FLOOR THAT MAY BE PROJECTED FROM THE REVOLVING BRUSHES.
- DO NOT OPERATE THE MACHINE WHERE FLAMMABLE LIQUIDS OR GASES ARE PRESENT.
- USE EXTREME CAUTION WHEN MANEUVERING.
- MAKE SURE ALL PERSONS ARE A SAFE DISTANCE FROM THE MACHINE WHILE IN OPERATION.

BEFORE LEAVING THE UNIT:

- MAKE SURE MACHINE IS TURNED OFF.
- PARK MACHINE ON A LEVEL SURFACE.
- DISCONNECT BATTERIES.

BEFORE SERVICING:

- STOP ON A LEVEL SURFACE AND SECURE MACHINE.
- DISCONNECT BATTERIES.

SAFETY PRECAUTIONS

- Hazardous voltage. Shock, Burns or electrocution can result. ALWAYS disconnect the batteries before servicing machine.
- Batteries emit hydrogen gases, explosion or fire can result. Keep sparks and open flame away.!
- Charge unit in a well ventilated area and keep battery compartment open when charging or explosion or fire could result.
- Battery acid can cause burns. Wear protective face-shield and gloves when servicing batteries.
- Do not store outdoors or pressure wash. Prevent from getting electrical components wet.
- The use of parts and solutions other than recommended by the manufacturer may cause property damage, bodily injury or death to yourself or others.
- Dress safely. Do not wear rings, watches or other jewelry while working on this machine. They can cause an electrical short which can cause serious burns, other injury or death.
- Do not work on this machine while wearing a tie, scarf, hat or any other loose or dangling neck wear or clothing. Loose clothing can tangle or catch on rotating parts causing serious injury or death.
- Do not use this machine as a ladder or a chair.
- Operate this machine only from the operators position.
- This machine was not designed to carry passengers or transport cargo.
- Do not operate this machine on steep ramps or uneven surfaces. When climbing a ramp always drive the machine forward straight up or down the ramp. Never drive across the incline.
- Do not back down or turn on ramps!
- Always use the charger provided by the manufacturer to charge the machine. It is an automatic charger specifically designed to charge at the appropriate rate. If you must use a different charger, disconnect the batteries from the machine as this will protect the on-board electronics.
- Understand the dynamic breaking system before you operate the machine on ramps or slopes.
- Do not park the machine on ramps or slopes
- Do not operate the machine if any parts have been removed or damaged.
- Do not remove, paint over, or destroy warning decals. If warning decals become damaged they must be replaced.
- Do not operate machine in an unsafe condition. If the machine is need of repair or is in anyway unsafe to operate, the matter should be reported immediately to the shift supervisor. Do not operate the machine until it is returned to proper operating condition.
- This machine must be operated only by a trained operator. As part of their training they must read the operators manual thoroughly. If extra copies are needed contact your local dealer.
- Always park machine on a level surface and turn the power off before leaving it unattended.
- Do not operate over electrical floor outlets. This may result in serious injury or death to the operator and others.
- Do not work under machine without it properly supported on suitable safety stands.
- Do not try and lift this machine unaided it is very heavy.
- Do not use handle bars or steering mechanism as a lifting point

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CONTENTS

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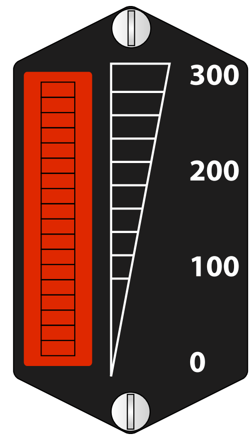
CENTRAL COMMAND I

The Central Command I system refers to all of our equipment manufactured utilizing a Curtis speed control system. This system was used an all our equipment with a speed controller from 1994 to 2002. In 2002 Central Command II was released and while some machines were migrated to Central Command II others retained the Central Command I system.

IDENTIFICATION

This Central Command I system can be identified on scrubbers by the presence of a red segmented down pressure gauge accompanied by a Curtis Instruments Battery gauge. The model 4700 and 48 sweepers still use the Central Command I control system as does the Model 200 burnisher.



MACHINE COVERAGE

Factory Cat 2000 Series, 29, 35, 38, 40, 48, 52, 290 & 350
Tomcat 2000 Series, 290, 350, 3700 & 4700

CONTROLLER IDENTIFICATION

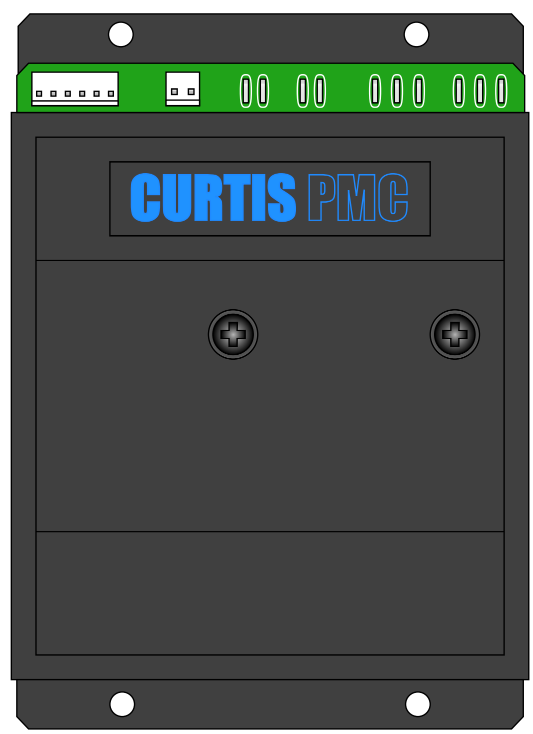
The different controllers used in the Central Command I systems easy to identify just by looking at them. The following is a guide to each controller.

1203A

Used on Models:
  Factory Cat 29/35
  Tomcat 29/35

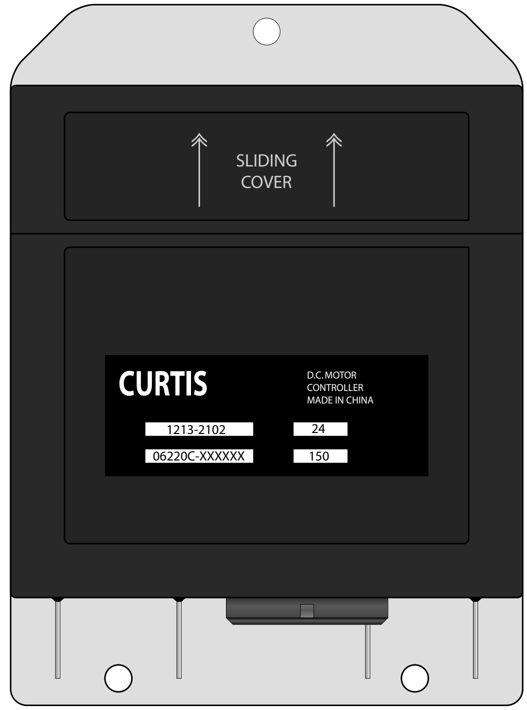
Definitive characteristics:
  No controller number listed on the face
  Black plastic back plate and case
  (10) 1/4” Quick Disconnect terminals across the top

Diagnostics
  See Chapter 2



1213

Used on models:
Factory Cat: 38, 40, 48, 52
Tomcat: 3700, 4700, 5100



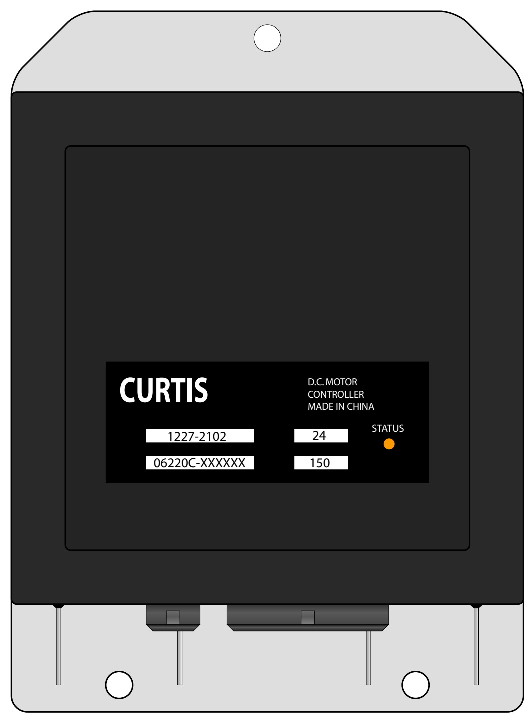
Definitive characteristics:
Is labelled Curtis 1213 on the face label,
Sliding door that covers 3 micro potentiometers.
Has only one 16 pin molex and 4 lug style connectors.
Has NO flash code LED
Has an aluminum back plate

Diagnostics
See Chapter 3

Note: The 1213 controller was replaced by the 1227 controller beginning February, 1997 production. Serial numbers with the new controller began with "EB".

1227

Used on models:
Factory Cat: 38, 40, 48, 52
Tomcat: 3700, 4700, 5100



Definitive characteristics:
Labeled Curtis 1227 on the face
Has an orange diagnostic code LED
Has a 4 pin, 16 pin and 4 lug style connectors.
Has an aluminum back plate

Diagnostics
See Chapter 4

1228

Used on models:
Factory Cat: 2000 series
Tomcat: 2000 Series, 200 Burnishers

Definitive characteristics:
Blue in color
Small package

DIAGNOSTICS

See Chapter 5

HOW CENTRAL COMMAND I SYSTEMS WORK

The Curtis system is a solid state speed controller that replaces the old style resistor-based speed control systems. The solid state system eliminates runaway machines and burnt electrical components while conserving energy and making the machine operate more smoothly.

The Curtis system has the ability to check wires before sending the full amount of power through them assuring safe and proper operation of the machine.

The Curtis system can electrically test relays to make sure they are sound before energizing them and powering the traction system.

SELF TEST EXAMPLE: MODEL 40/3700 – When you turn on the key, the key switch sends power to pin #15 of the central command, turning on the Curtis controller. The controller at this point electrically checks it self internally as well as all the wiring and devices attached to it. It can not power a drive motor until these checks are performed.

When you step on the foot pedal, the Curtis turns on Relay #1 (the MAIN relay), providing the Curtis with the power it needs to run the traction motor. At the same time this is occurring the Curtis turns on the “#2” relay which turns on the vac motor, the scrub motor, the Deltrol solution valve, the brake release, the headlight, etcetera. This second relay must operate properly for the traction motor to energize.

When you release the foot pedal or the throttle button the Curtis controller diverts the power generated from the drive motor, which on deceleration acts like a generator, back into the batteries to recharge them a small amount.

GENERAL DIAGNOSIS OF THE CURTIS SYSTEM

The Curtis system diagnosis is performed in many cases by the substitution of known good parts into the system. This system of diagnosis, although seemingly crude, is very effective from a time management stand point.

Some Curtis systems uses a “flash code” system to assist in diagnosing it. There is either an LED on the controller itself or an LED located on or around the control panel of the machine.

There is a list of parts needed to diagnose the system using the parts replacement method. (See Appendix A)

The following is a basic check list to follow in the event of problems

1. Check Battery Voltage.
2. Check battery cables for physical damage and test with a hydrometer.
3. Load Test the batteries.
4. Do a voltage drop test on the battery cables.
5. Check the cable to the traction motor and see if it is tight
6. Is the Curtis control “On” ?
7. Are the relays OK?
8. Is the potentiometer OK?

For further diagnosis see the chapter for the controller your machine is equipped with.

POTENTIOMETERS

The potentiometer on the Curtis system use a high and a low reference voltage supplied to the outside terminals of the potentiometer. These voltages are combined by the potentiometer to give a smooth sweeping voltage of from 0 to 5 volts DC. This sweeping voltage signal is then sent to the controller which in turn propels the machine at a speed relative to the potentiometers position.

TESTING THE POTENTIOMETER.

With the machine power on using a quality digital voltmeter, measure from one outside terminal of the potentiometer to the other outside terminal of the pot. You should see from 4.7 to 5.2 volts across these terminals with the key in the “on” position. If you have between 4.7 & 5.2 volts here then touch your negative meter probe to the negative battery terminal or negative buss bar and measure at the center terminal of the throttle pot with your positive lead and slowly rotate the pot. You should get a smooth sweeping voltage from 0 to 0.2 volts at one end of travel to 4.8 to 5.2 volts at the other. The voltage should rise or fall smoothly through the travel. If the voltage is jerky along the way, the pot is damaged and must be replaced. If you did not have the 4.7 - 5.2 volts across the two outside terminals see the appropriate diagnostic section for your controller.

THROTTLE SIGNAL

The throttle signal originates at the high and low throttle signal outputs of the Curtis Control. The high and low output are sent to the coil circuit of a 5K ohm hermetically sealed potentiometer. The potentiometer sums the signals and outputs a varied voltage signal from 0.2 volts (+/- 0.2 volts) to 4.8 volts (+/- 0.2 Volts) on the center terminal of the potentiometer.

Walk Behinds

The signal that comes out of the potentiometer is then sent to the common terminal on one pole of a double pole double throw toggle switch. The terminal from on of the throws is then wired to the throttle input of the controller.

On the same terminals of the switch that have the potentiometer output wire and the wire that runs back to the controller there is an additional wire piggybacked in each terminal. These wires go to the handle bar buttons. When either one of the handle bar buttons is depressed or the reverse switch is depressed the varied voltage signal from the potentiometer passes through the switch and then through the wire to the controller.

Riders

The signal that comes out of the potentiometer is then sent to the throttle input signal on the controller.

The controller then calculates the voltage being sent by the potentiometer and adjusts the machine's travel speed accordingly.

On some walk-behinds, due to the way we interrupt the throttle signal to start and stop the machine, the Curtis Controllers will flash a Diagnostic Flash Code of "1-2" when the throttle is not depressed. This indicates there is an open circuit in the throttle circuit.

CURTIS SELF TESTS

When the throttle input moves above 0.2 Volts the Curtis Control turns on and immediately checks the following.

#1 Relay coil circuit test – This test measures the resistance of the coil circuit on the #1 relay. The relay coil circuit test must have a value of between 68 and 78 ohms or the controller will not start.

#1 Relay contact test – This test checks to make sure there is no continuity from one side of the relay's contact to the other. This ensures that the relay is in an open state before applying power to it.

#2 Relay coil circuit test - This test measures the resistance of the coil circuit on the #2 relay. The relay coil circuit test must have a value between 68 and 78 ohms or the controller will not start.

#2 Relay contact test – This test checks to make sure there is no continuity from one side of the relay’s contact to the other. This ensures that the relay is in an open stat before applying power to it.

Once these two relays have passed the internal test of the Curtis control the controller will then turn on and apply power to the drive motor.

For Contactor and Relay Testing please see Chapter 11

BRUSH DECK OPERATION TROUBLE SHOOTING

Later versions of all of our scrubbers incorporated a brush deck limit switch that would prevent the brush deck motors from turning while the brush deck is in the raised position. These switches are in the following locations:

MACHINE SERIES & SWITCH LOCATION & NOTES

2000 Series early production:
On the right hand side of the frame at the front of the machine
Disc: The rear lip of the

2000 late production:
Mounted to the brush deck actuator

Rider Disc Scrubbers:
At front of scrub deck compartment at head of the actuator on the right hand side.

Rider Cylindrical Scrubbers
At the middle of the scrub compartment on the suspension cross beam on the right hand side

29/35 Disk
Just left of center mounted to the rear wall of the scrub chamber.

35 Cylindrical
Far left side mounted on a flange.

The switch interrupts the power from the Curtis control to the scrub deck relay when it is depressed by the brush deck.

The brush relay is powered by the #2 relay. This configuration is what makes the brushes turn on and off when the machine starts and stops. The Model 52 has two relays, one for the two outer brushes and one for the inner brush.

BRUSH CIRCUIT BREAKERS

All of our machines with Central Command 1 have in line brush motor protection. The protection is in line auto resetting circuit breaker(s) These breakers will open in the event of an over load and reset themselves when they cool. These breakers can burn out in the event of a huge overload and weaken over time if they are tripped repeatedly.

The following is a list of the machines and what circuit breakers are used on each one.

MODEL	BREAKER	QUANTITY
2000 Cylindrical 22	50 amp	1
2000 Cylindrical 28	30 amp	2
2000 Disc STANDARD	30 amp	2
2000 Disc HEAVY DUTY	40 amp	2
29 Disc – STANDARD	30 amp	2
29/35 Disc – HEAVY DUTY	40 amp	2
35 Cylindrical	30 amp	2
38/40/3700 Disc	40 amp	2
40/3700 Cylindrical	30 amp	2
52 Disc	40 amp	3

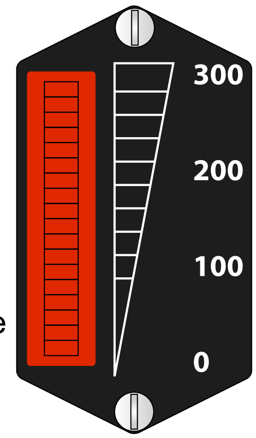
SIMPLIFIED TROUBLE SHOOTING

1. Check battery voltage. Batteries voltage must be at least 24 volts or over to begin testing.
2. Load test batteries. – Batteries not tested under load can have undetected bad cells in them.
3. Check all battery cable connections. – The Curtis system is very sensitive and can shut down from a loose or corroded battery connection.
4. Check the connections to the traction motor. On early machines we used an Anderson Connector between the controller and the drive motor. These connectors can fail over time.
5. Are the Relays OK? In order for the Curtis system to operate relays #1 and #2 (On all units but 2000 this unit had a #2 relay only) must be operating properly for the machine to move. Sometimes the relays overheat which affects their coil resistance causing the Curtis controller to shut down. We recommend substituting good relays for the ones in the machine to see if replacement fixes the problem. You can wire the relay in and not mount it to the machine to save trouble shooting time. We use only two types of relays on the Curtis systems. A canister type 80 amp relay and an automotive type 15 amp cube relay.
6. Is the potentiometer OK? The potentiometer creates a varied voltage from approximately 0.2 volts to 4.9 volts and sends it to the Curtis control to tell the controller to move the machine.

For advanced trouble shooting please see the chapter for the controller you machine is equipped with.

DOWN PRESSURE GAUGE

The scrubbers that were equipped with Central Command 1 used an active down pressure readout. This readout would convert the amp draw of the brushes into brush deck pressure and show it on the control panel mounted brush pressure gauge. For this to work it utilized the down pressure gauge, a control module and a shunt. The shunt is wired in series with the brush deck motor(s). When the brush deck is turned on the control module calculates the down pressure from the millivolt signal it receives from the shunt. The module then displays the down pressure relative to the amp draw on the control panel display.



DOWN PRESSURE GAUGE

ELECTRICAL SHUNT

DOWN PRESSURE GAUGE DIAGNOSIS

The down pressure gauge system is quite simple. The Shunt being a primarily mechanical device rarely fails. If a gauge flickers or is inoperative the gauge/control module must be replaced. The gauge and control module are a set and must be replaced as one.

VACUUM SYSTEM DIAGNOSIS

GENERAL DIAGNOSIS

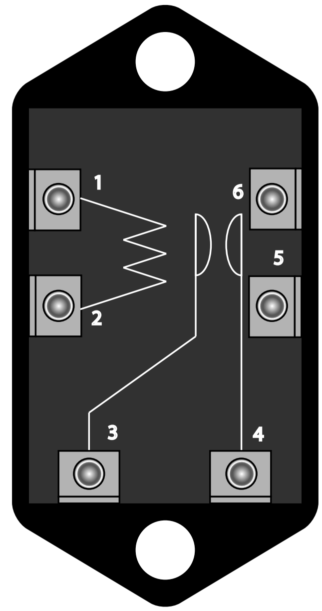
The vacuum systems on the Central Command II scrubbers came either with or without a vacuum delay timer depending on the model. The following is a list of which models were manufactured with a timer

Models with a timer: 38, 40, 51, 290, 350, 3700, 5100 & (29,35 built after August 2000)

SOLID STATE VACUUM TIMER

TIMER CONNECTIONS

The timer is a solid state device that has 6 terminals. The connections for these pins are as follows:



Pin #1 Switched B+ Power

Pin #2 B-

Pin #3 Switched output of the timer 24V

Pin #4 Switched B+ Power

Pin #5 Timer Input - From squeegee limit switch (24V)

Pin #6 Not Used

TIMER OPERATION

The timer receives an input signal of 24V on pin #5 When this occurs the timer sends power out on Pin #3 for as long as their is power on Pin #5 and then for 21 seconds after the power on Pin #5 is removed. This output feeds though a diode to protect the timer assembly from back feeding voltage.

NON TIMER SYSTEMS

The systems without a timer are very simple. The switch for the squeegee receives power from the positive buss bar. The switch passes power though it to the vacuum solenoid (relay/contactor). The solenoid then closes its load terminals. When the load terminals close positive power is sent thru a circuit breaker to the vacuum motor.

If the vacuum will not run check the following:
Wiring to the vacuum motor. Especially the Anderson connector if equipped.
Check the squeegee switch to make sure it has power in and gives power out when it is turned on.
Try substituting a known good 80 amp solenoid.
Try substituting a know good circuit breaker.

TIMER BASED VACUUM SYSTEMS

The following model machines had timer based vacuum systems:
29, 35, 38, 40, 52, 3700 & 5100

There 2 different systems, 1 system for walk behind machines and another for rider machines.

WALK BEHIND MACHINES

The walk behind timer circuit is very straight forward. Pin #5 on the timer receives +24 Volts from the limit switch that is actuated by the squeegee lift bar. When the squeegee is lowered the linkage contacts the switch sending +24 Volts from the + Buss bar to Pin #5 of the timer. When the timer receives +24 volts on Pin #5 it would turn on the timer and output +24 Volts on Pin#3 which is connected to the vacuum solenoid thus turning on the solenoid. When voltage is removed from pin #5, the timer maintains power on Pin #3 for 21 seconds. When the power is turned off by the timer after the 21 second delay the Vacuum solenoid then turns off thus turning off the vacuum motor.

DIAGNOSIS

Turn the machine on.
Drop the squeegee assembly with the handle
Measure for battery voltage (+/- 1 volt) at the vacuum motor
 If the voltage is OK replace the vac motor
 If the voltage is out of spec proceed to the next step.
Check for battery voltage from the positive (+) buss bar to the negative (-) buss bar.
Check for battery voltage at the blue wire on the vacuum switch.
Check for battery voltage at the white wire when the squeegee is lowered
 If OK proceed to next step
 If there is no voltage make sure the switch is being moved by the squeegee linkage.
 If the movement is OK replace the switch. If not adjust the switch.
Check for battery voltage at Pin #5 of the vacuum timer assembly
 If there is no voltage then repair the wiring from the vac switch to the timer.
Check for battery voltage out of the timer on Pin #3
 If there is battery voltage go to the next step
 Using a volt meter set to the DC scale to accommodate 24 volts measure from pin #2 on the timer to pin #1 there should be battery voltage there. If that is good them measure from pin #2 to pin #4. There should be battery voltage there if either of these terminals is missing voltage repair the wiring between the timer and the buss bars. If there is battery voltage both places replace the timer.
Check for battery voltage on the yellow wire connected to the coil circuit on the vacuum motor solenoid.
 If there is voltage go to the next step
 If there is no voltage repair the wiring between pin #3 and the vacuum motor solenoid.
With the volt meter measure from one coil terminal to the other on the vacuum motor solenoid.
 If there is battery voltage (+/- 1.5 volts) go to the next step

If there is not battery voltage (+/- 1.5 volts) repair the ground wire to the coil of the vacuum motor solenoid.

With a volt meter measure from the negative buss bar to the left load terminal on the contactor.

If there is battery voltage go to the next step

If there is not battery voltage there is a battery or battery cable problem.

Measure from the negative (-) buss bar to the right side load contact on the solenoid.

If there is battery voltage (+/- 1 volt) go to the next step

If the voltage is less than 1 volt below battery voltage replace the solenoid.

Measure for voltage at both posts of the vacuum motor circuit breaker.

If there is battery voltage (+/- 1 volt) on both posts go to the next step.

If there is NOT battery voltage (+/- 1 volt) on both posts replace the circuit breaker

Check the wiring from the breaker to the vacuum motor and the vacuum motor to ground.

RIDER MACHINES

TYPE 6 Central Command I Rider squeegee actuator

The CCI rider squeegee actuator limit switch set up is the most complicated limit switch set up we have. It has 3 different states and this is how each of them works.

State 1: Forward/Reverse switch “FORWARD” Squeegee switch “OFF”

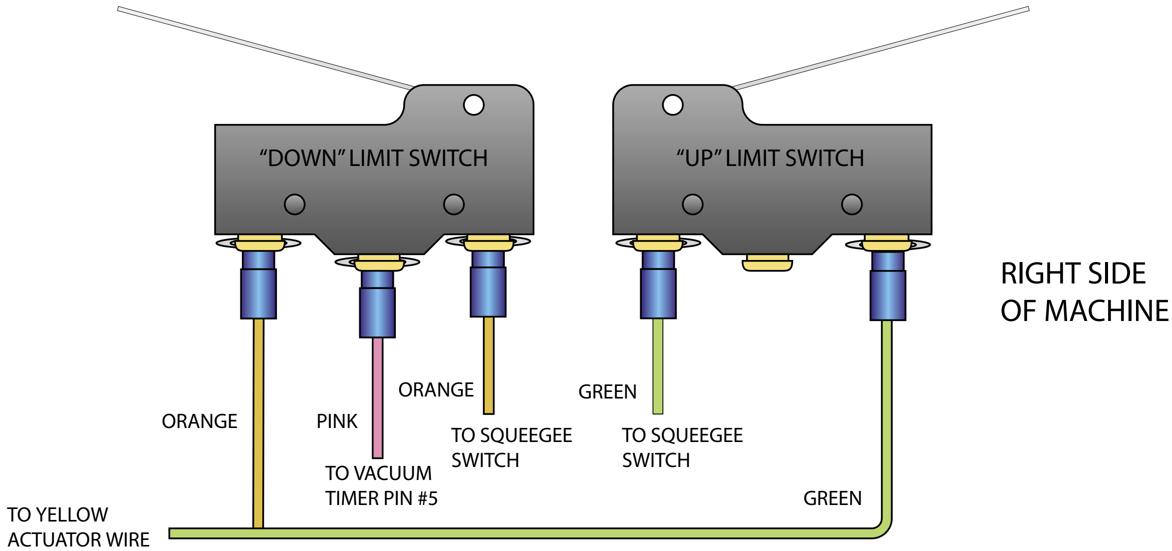
Positive power is sent from the squeegee rocker switch out the green wire on the squeegee rocker switch to the front terminal of the “up” limit switch, thru the switch, out the green wire to the yellow wire of the actuator. Negative power is sent out the white wire to two places. The first is along the white wire to the actuator motor and along the other white wire to the reverse diode bridge. The actuator retracts until it contacts the “UP” limit switch which then opens stopping the actuator motor.

State 2: Forward/Reverse switch “FORWARD” Squeegee switch “ON”

Negative power is sent from the squeegee switch out the orange wire to the back terminal of the down limit switch. Positive power is sent out the white wire to two places, the first being the white wire that connects to the red wire on the squeegee actuator. This will make the actuator extend until it contacts the rear ”down” limit switch. The second place it sends power to is the positive terminal on the reverse diode bridge which stops voltage from flowing through when the squeegee switch is turned on. When the squeegee actuator drops the squeegee and reaches its end of travel it depresses the “down” limit switch. The switch then delivers the power from the actuator thru the “Hella” vac relay on the pink wire and then out of the relay on the white wire and to pin #5 on the vacuum timer assembly.

State 3: Forward/Reverse switch “REVERSE” Squeegee switch “ON”

Positive power is sent from the squeegee switch out the green wire thru the “UP” limit switch out to the yellow actuator wire. Negative power is sent through the squeegee switch out the white wire to the red wire on the actuator. When the actuator extends all the way the “UP” limit switch opens and turns off the actuator motor.



Early versions of the Model 40 scrubber were equipped with a float switch that was in the recovery tank. This float switch would interrupt the power from the center terminal on the "down" limit switch to pin # 5 of the electronic vacuum delay timer.

SPECIAL NOTES BY MACHINE

34/3300

38/40/3700

52/5100

29/35

20/2000

30/3000

290/350

2023

MINIMAG

MAGNUM

250/GTX

XR

200

255/275

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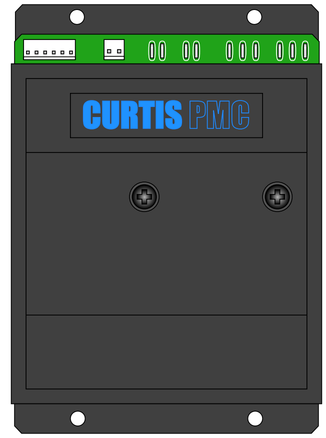
CURTIS 1203



The Curtis 1203A controller was used on our model 29 & 35 walk behind scrubbers. This controller was a non programmable controller we used on all of these machines built with Central Command I. This controller has true regenerative and dynamic braking providing complete downhill and deceleration speed control. The traction control parts are all housed internally including the forward, reverse and power contactors. All connections to the controller are made with quick connects and plug type power connectors to allow easy servicing of the controller.

FEATURES

- Infinitely variable drive speed and regenerative braking control.
- High efficiency MOSFET power design.
- High frequency silent operation.
- Ultra smooth low speed performance.
- Dual ramp automatic reversing provides a smooth deceleration / acceleration.
- Motor current limiting in both drive and brake modes.
- Throttle fault detection / auto shut down.
- Thermal protection auto limits controller current
- Battery under voltage protection.
- Power failure default breaking.

SPECIFICATIONS

Operation voltage: 24 Volts DC
Controller capacity: 75 Amps
Outputs
    Drive
    Auxiliary

The 1203A controller was not programmable.

The 1203A controller required suppression diodes be wired in parallel to the coil of solenoids to control voltage spikes when the solenoid was turned off.

CONNECTIONS

BATTERY

The connections from the controller to the battery are made via 0.25” quick connects (Spade terminals). The positive battery cable connects from the main circuit breaker to any one of the 3 terminals labeled “B+”. The negative battery cable connects to any one of the 3 terminals labeled “B-”.

POWER SWITCH

The power switch is a very simple circuit. +24 volts is taken from the main circuit breaker and it is switched on and off to the controller thru a SPST lighted switch. The signal is sent into the controller thru a 16 gauge red wire into pin #6 of the P1 connector.

THROTTLE

The throttle uses a 5K hermetically sealed potentiometer to sum the high and low reference from the controller. The output from the potentiometer is a varied voltage from +0.2 volts +/- 0.1 volt to 4.8 volts +/- 0.1 volt. This signal is then sent to the reverse switch and the handle bar buttons or bail assembly. Either one of these switches closes the circuit passing the varied voltage signal through to the controller on pin #2 of the P1 connector.

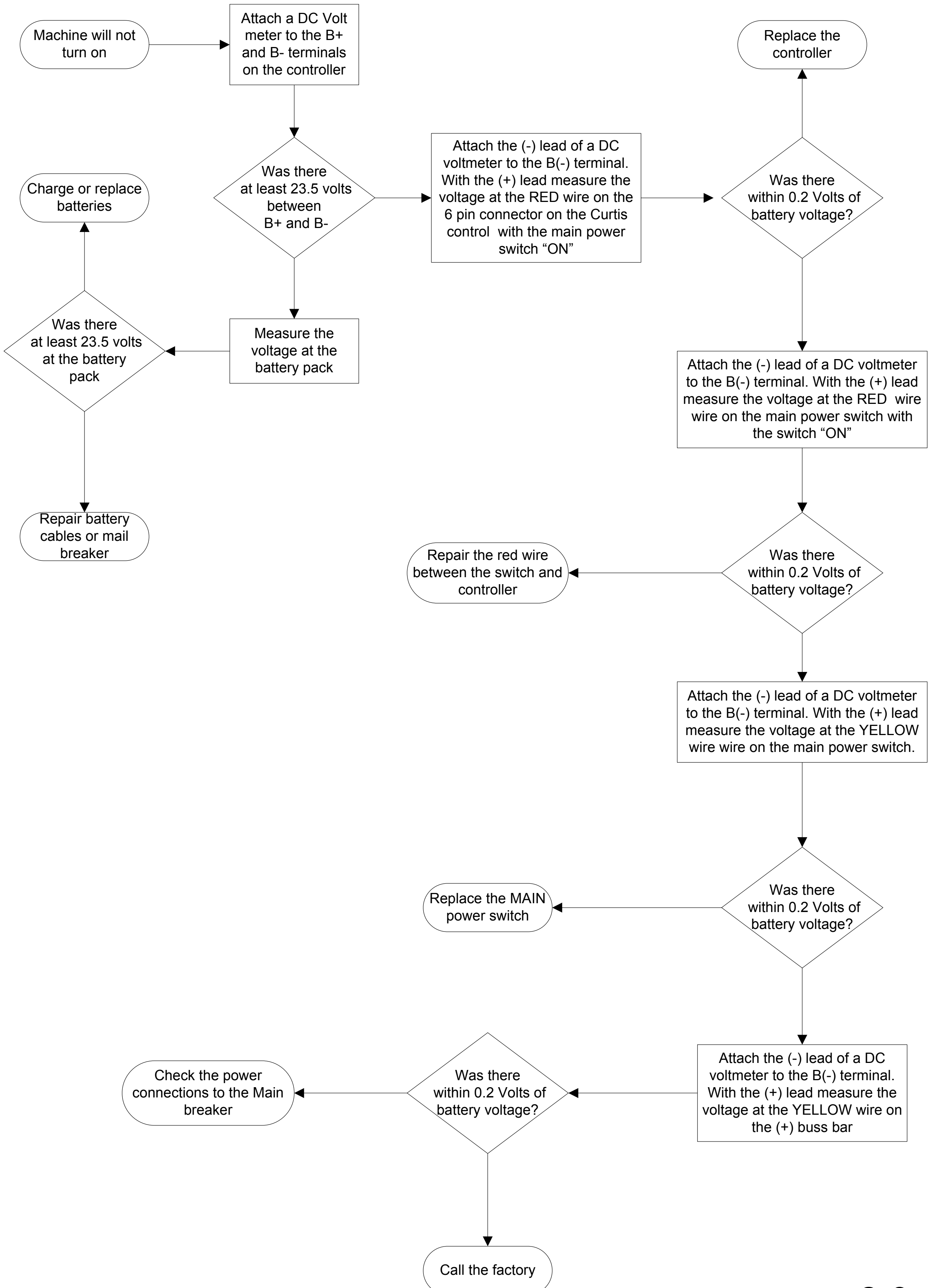
REVERSE SWITCH

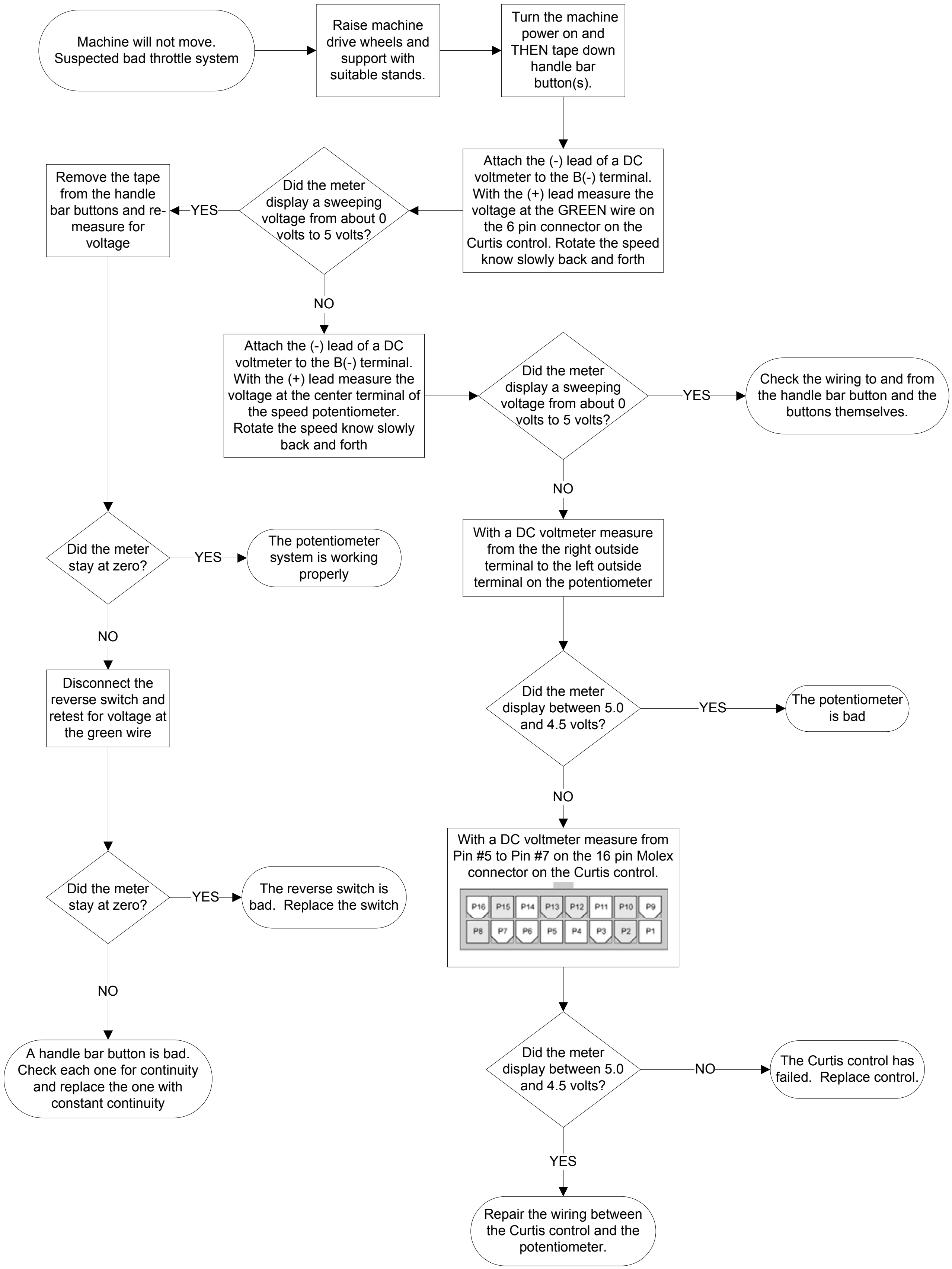
The reverse switch circuit is very simple. There is a pair of wires that go to one pole of the DPDT switch. When this switch is activated this pole of the switch completes the circuit telling the controller that the machine should be going in reverse. The other pole of the DPDT switch send the throttle signal to the controller causing it to move.

BRAKE OUTPUT

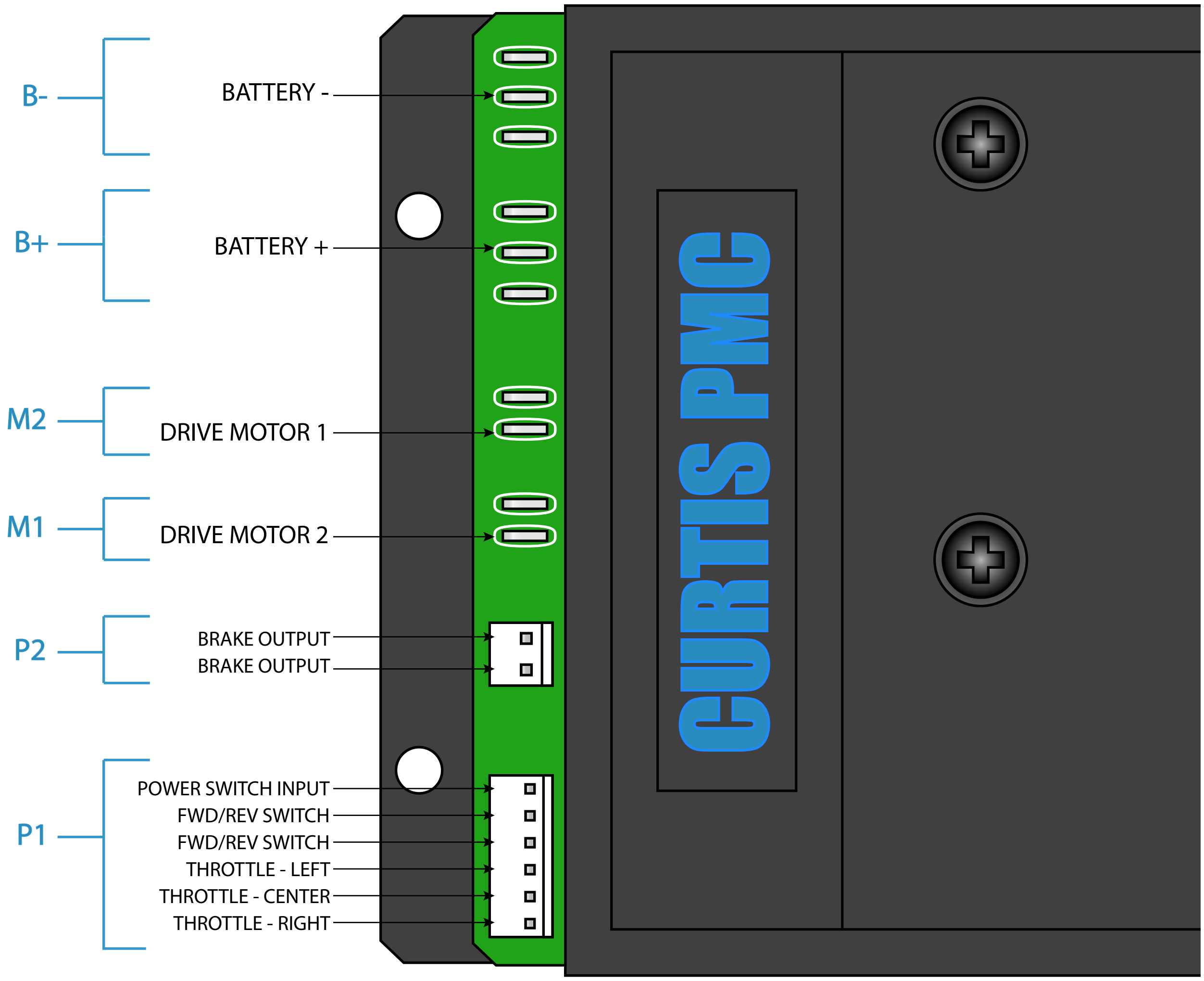
The brake output of the controller is used to turn a solenoid on and off the controls when the brushes run. This output is turned on by the controller immediately when the machine is put in motion and stays on for 1 second after the throttle input is turned off.

DIAGNOSIS


Machine will not turn on
Attach a DC Volt meter to the B+ and B- terminals on the controller
Was there at least 23.5 volts between B+ and B-
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the RED wire on the 6 pin connector on the Curtis control with the main power switch “ON”
Was there within 0.2 Volts of battery voltage?
Replace the controller
Charge or replace batteries
Was there at least 23.5 volts at the battery pack
Measure the voltage at the battery pack
Repair battery cables or mail breaker
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the RED wire wire on the main power switch with the switch “ON”
Was there within 0.2 Volts of battery voltage?
Repair the red wire between the switch and controller
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire wire on the main power switch.
Was there within 0.2 Volts of battery voltage?
Replace the MAIN power switch
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire on the (+) buss bar
Was there within 0.2 Volts of battery voltage?
Check the power connections to the Main breaker
Call the factory


Machine will not move. Suspected bad throttle system
Raise machine drive wheels and support with suitable stands.
Turn the machine power on and THEN tape down handle bar button(s).
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the GREEN wire on the 6 pin connector on the Curtis control. Rotate the speed know slowly back and forth
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Remove the tape from the handle bar buttons and re-measure for voltage
NO
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the center terminal of the speed potentiometer. Rotate the speed know slowly back and forth
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Check the wiring to and from the handle bar button and the buttons themselves.
NO
With a DC voltmeter measure from the the right outside terminal to the left outside terminal on the potentiometer
Did the meter stay at zero?
YES
The potentiometer system is working properly
NO
Disconnect the reverse switch and retest for voltage at the green wire
Did the meter display between 5.0 and 4.5 volts?
YES
The potentiometer is bad
NO
With a DC voltmeter measure from Pin #5 to Pin #7 on the 16 pin Molex connector on the Curtis control.
P16 P15 P14 P13 P12 P11 P10 P9
P8 P7 P6 P5 P4 P3 P2 P1
Did the meter stay at zero?
YES
The reverse switch is bad. Replace the switch
NO
A handle bar button is bad. Check each one for continuity and replace the one with constant continuity
Did the meter display between 5.0 and 4.5 volts?
NO
The Curtis control has failed. Replace control.
YES
Repair the wiring between the Curtis control and the potentiometer.

WIRING


B-
BATTERY -
B+
BATTERY +
M2
DRIVE MOTOR 1
M1
DRIVE MOTOR 2
P2
BRAKE OUTPUT
BRAKE OUTPUT
P1
POWER SWITCH INPUT
FWD/REV SWITCH
FWD/REV SWITCH
THROTTLE - LEFT
THROTTLE - CENTER
THROTTLE - RIGHT
CURTIS PMC

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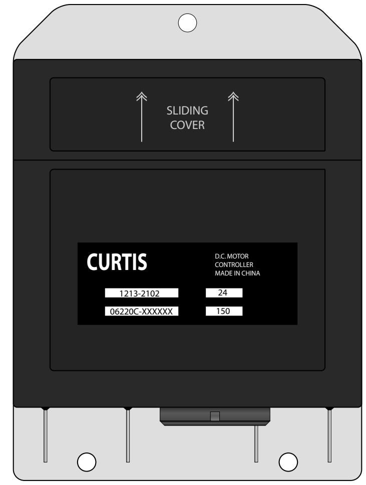
CURTIS 1213



The Curtis 1213 controller was used on our model 48 sweepers until 1997. The controller is an adjustable controller that has true regenerative braking that also provides complete downhill deceleration and speed control. This controller required no forward and reverse contactor due to its full bridge design.

FEATURES

- Full bridge power MOSFET design.
- Silent operation
- Current limiting in both drive and brake modes
- Potentiometer adjustable acceleration, deceleration and reverse speeds
- Power failure default braking
- Anti rollback/roll forward circuitry
- Terminal overload protection

SPECIFICATIONS

Operation Voltage: 24 Volts
Controller capacity: 200 amps
Outputs
    Traction Drive
    Main Power Relay
    Brake

The 1213 controller was adjustable but not programmable

The 1213 controller required suppression diodes be wired in parallel to the coil side of the solenoid.

CONNECTIONS

BATTERY

The connections from the controller to the battery are made using ring terminals that are fastened to the lug style terminals on the controller. It is important to tighten theses terminals with two wrenches using one to hold the nut and one to turn the bolt so undo stress is not put on the terminals. The

POWER SWITCH

The power switch is a very simple circuit. +24 volts is taken from the main circuit breaker and it is switched on and off to the controller thru a SPST lighted switch. The signal is sent into the controller thru a 16 gauge red wire into pin #6 of the P1 connector.

THROTTLE

The throttle uses a 5K hermetically sealed potentiometer to sum the high and low reference from the controller. The output from the potentiometer is a varied voltage from +0.2 volts +/- 0.1 volt to 4.8 volts +/- 0.1 volt. This signal is then sent to the controller on pin #16 of the 16 pin Molex connector.

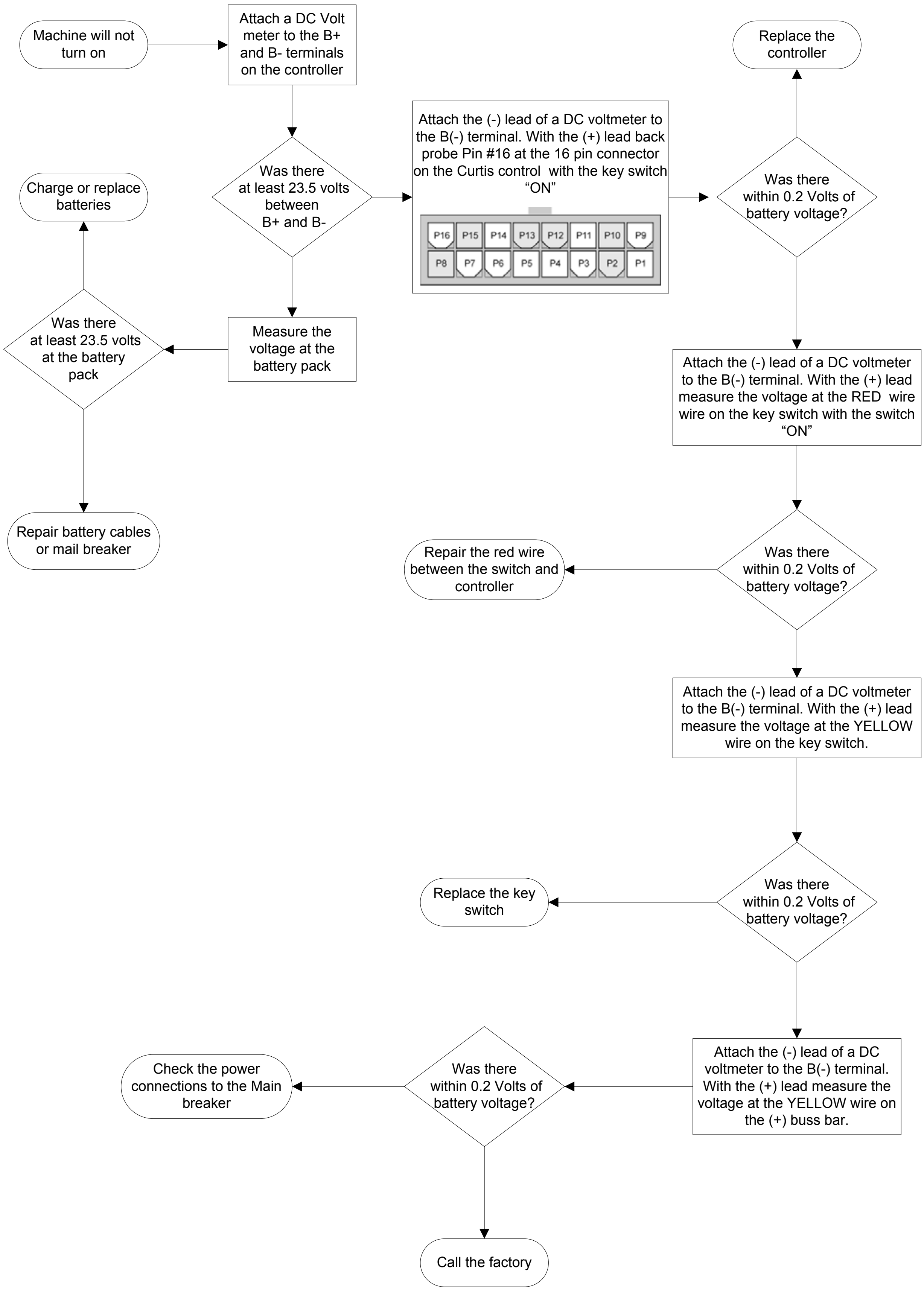
REVERSE SWITCH

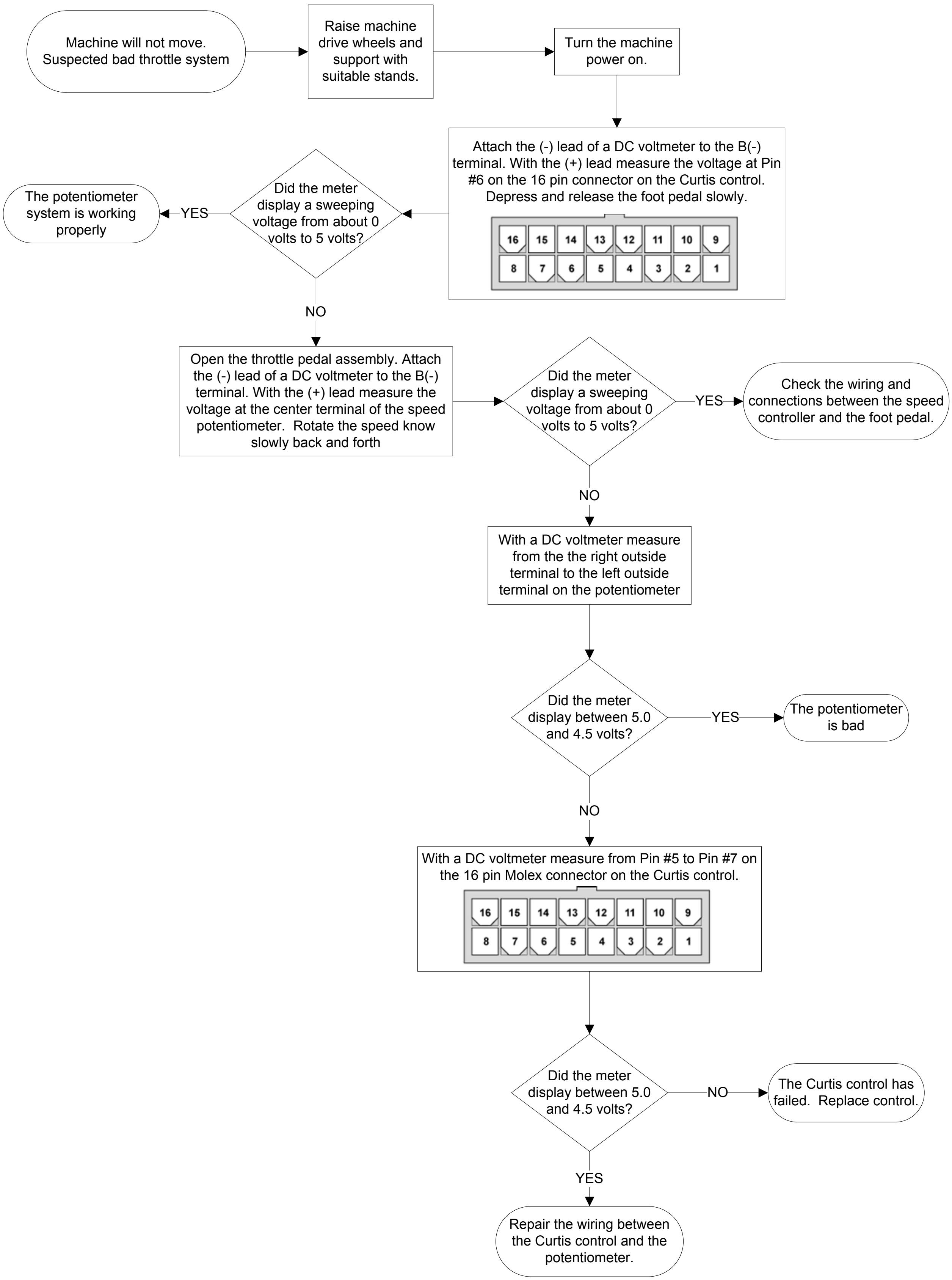
The reverse switch sends +24 Volts DC from the positive buss bar to Pin #11 on the 16 pin Molex connector on the Curtis controller. This tells the controller that when it receives a throttle signal from the throttle potentiometer to move in a reverse direction.

BRAKE OUTPUT

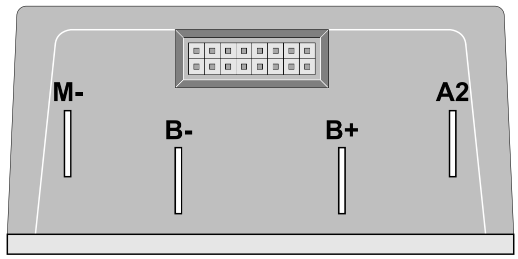
The parking brake output from the controller is used to activate the “#2 Relay” in the Central Command I. The coil on the “#2 relay is driven by pins 1 and 3 on the 16 pin Molex connector. This contactor is wired with a suppression diode across it to prevent the controller from damage when the coil is turned off. The silver stripe on this diode goes on the positive side of the coil connection.

DIAGNOSIS

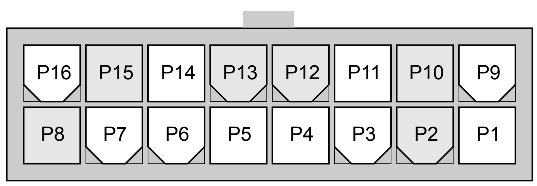

Machine will not turn on
Attach a DC Volt meter to the B+ and B- terminals on the controller
Was there at least 23.5 volts between B+ and B-
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead back probe Pin #16 at the 16 pin connector on the Curtis control with the key switch “ON”
P16 P15 P14 P13 P12 P11 P10 P9
P8 P7 P6 P5 P4 P3 P2 P1
Was there within 0.2 Volts of battery voltage?
Replace the controller
Charge or replace batteries
Was there at least 23.5 volts at the battery pack
Measure the voltage at the battery pack
Repair battery cables or mail breaker
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the RED wire wire on the key switch with the switch “ON”
Was there within 0.2 Volts of battery voltage?
Repair the red wire between the switch and controller
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire on the key switch.
Was there within 0.2 Volts of battery voltage?
Replace the key switch
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire on the (+) buss bar.
Was there within 0.2 Volts of battery voltage?
Check the power connections to the Main breaker
Call the factory


Machine will not move.
Suspected bad throttle system
Raise machine drive wheels and support with suitable stands.
Turn the machine power on.
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at Pin #6 on the 16 pin connector on the Curtis control. Depress and release the foot pedal slowly.
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
The potentiometer system is working properly
NO
Open the throttle pedal assembly. Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the center terminal of the speed potentiometer. Rotate the speed know slowly back and forth
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Check the wiring and connections between the speed controller and the foot pedal.
NO
With a DC voltmeter measure from the the right outside terminal to the left outside terminal on the potentiometer
Did the meter display between 5.0 and 4.5 volts?
YES
The potentiometer is bad
NO
With a DC voltmeter measure from Pin #5 to Pin #7 on the 16 pin Molex connector on the Curtis control.
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
Did the meter display between 5.0 and 4.5 volts?
NO
The Curtis control has failed. Replace control.
YES
Repair the wiring between the Curtis control and the potentiometer.

WIRING



M- output to motor armature (-)
B- Negative battery connection
B+ Positive connection to battery
A2 Output to motor armature



P1: brush solenoid
P2: not used
P3: brush solenoid
P4: main contactor +
P5: throttle: pot high
P6: throttle: pot wiper 0 - 5 V
P7: throttle: pot low
P8: not used

P9: not used
P10: not used
P11: direction input: single-ended throttles
P12: not used
P13: not used
P14: inhibit
P15: not used
P16: keyswitch input (KSI)

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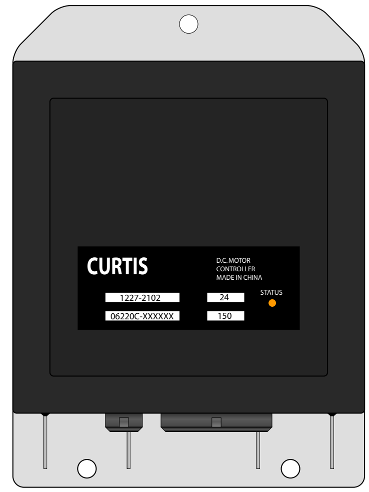
CURTIS 1227 CONTROLLER



The Curtis 1227 controller replaced the Curtis 1213 controller in the models 38, 40, 48, 3700 & 4700. The 1227 is more modern control with more adjustable parameters. The controllers are fully programmable with the use of a Curtis 1307 or 1311 hand programmer or a Curtis PC Programmer with special interface cord.

FEATURES

- Infinitely variable forward and reverse drive speed and regenerative braking control
- Full bridge power MOSFET design
- No reversing relay required
- Fully programmable with hand held programmer
- Status LED on the controller
- Fully compliant with all applicable international standards and TUV requirements
- Current limiting in both driving and braking modes
- High pedal disable function on power up to eliminate run aways
- Key off/Power failure deceleration brings machine to a controlled stop
- Fault detection system monitors main contactor, output stage and throttle demand
- ISO 7176 Compliant throttle fault detection

SPECIFICATIONS

Operating voltage:	36 Volts
Controller Capacity:	200 amps
Outputs:	Traction Drive
	Auxiliary

SYSTEM PARTS

Main Contactor - We call this the #1 relay. We use a canister type single pole single throw contactor.

Parking Brake Relay - We call this the #2 relay. We use a canister type single pole single throw contactor.

DIAGNOSTICS

FLASH CODES

To assist in the diagnosis of problems the controller has an LED that flashes diagnostic codes. During normal operation, with no faults present, the status LED is steadily on. If the controller detects a fault, the status LED provides two types of information. First, it displays a slow flash (2 Hz or 2X a second) or a fast flash (4Hz or 4X a second) to indicate the severity of the fault. Slow flash faults are self-clearing; as soon as the fault is corrected, the machine will operate normally. Fast-flash faults ("*" in the table below) are considered to be more serious in nature and require that the keyswitch be cycled to resume operation after the fault is corrected.

Then after the severity indication has been active for 5 seconds, the Status LED flashes a 2-digit fault identification code continuously until the fault is corrected. For example, code "4.1" -- low battery voltage and code "3.2" -- electromagnetic brake driver appear as.:

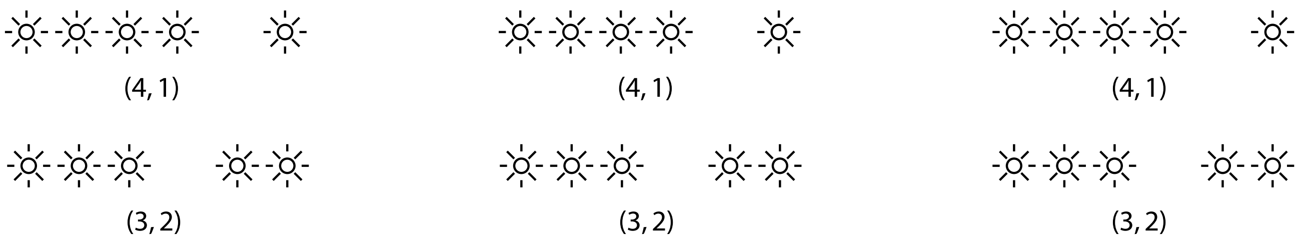


Table 9 STATUS LED FAULT CODES

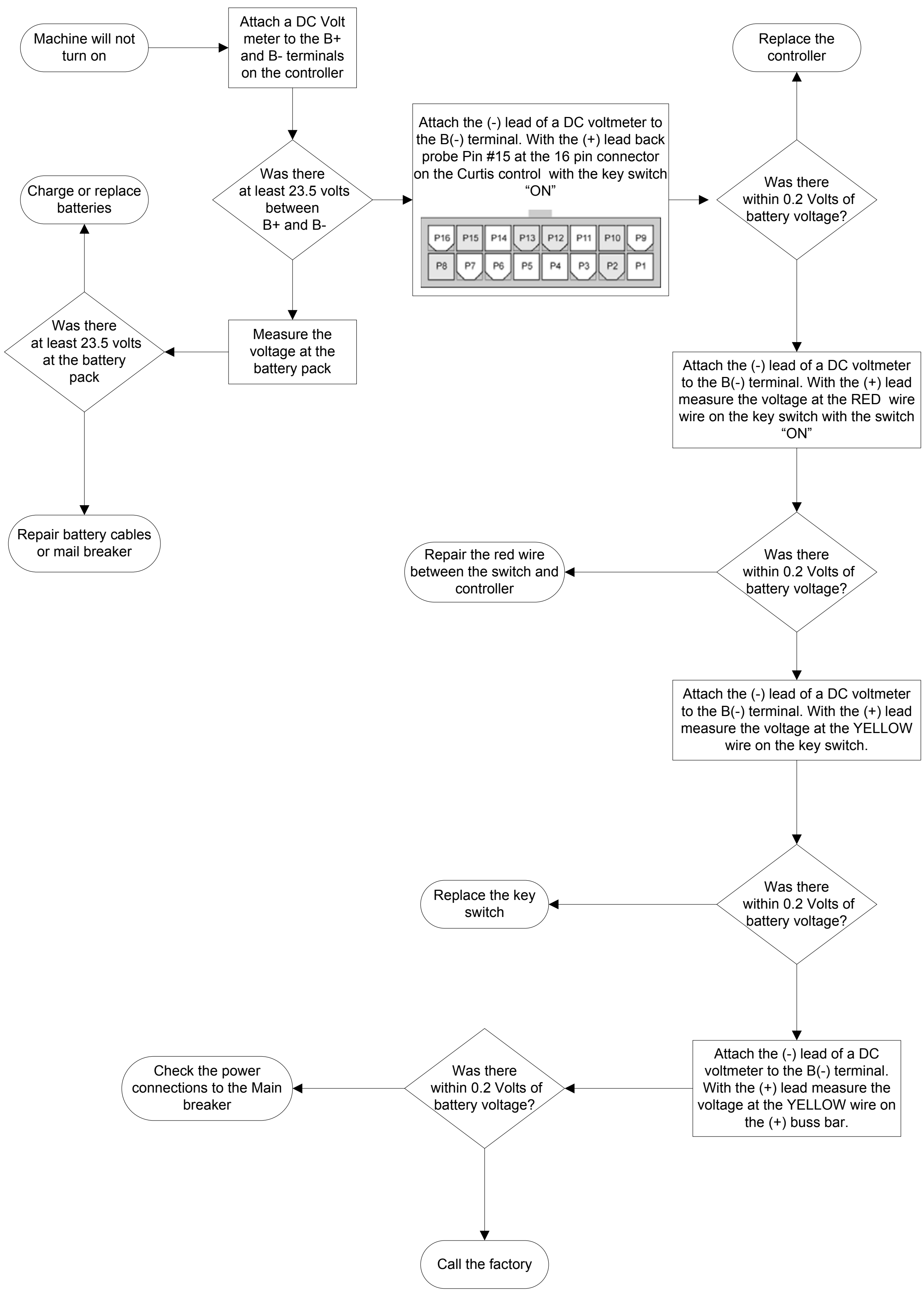
	LED CODES		EXPLANATION
	LED off	▬	no power or defective controller
	solid on	▭	controller operational; no faults
❊	1,1	¤ ¤	output fault or overcurrent fault
❊	1,2	¤ ¤¤	EEPROM, main contactor, precharge, or motor voltage fault
	1,3	¤ ¤¤¤	[not used]
	1,4	¤ ¤¤¤¤	[not used]
	2,1	¤¤ ¤	static return to off (SRO) fault
	2,2	¤¤ ¤¤	high pedal disable (HPD) fault
❊	2,3	¤¤ ¤¤¤	HPD latching (HPD fault for >5 sec)
	2,4	¤¤ ¤¤¤¤	speed limit pot fault
	3,1	¤¤¤ ¤	emerg. rev. wiring fault (BB wiring check)
	3,2	¤¤¤ ¤¤	electromagnetic brake driver fault
	3,3	¤¤¤ ¤¤¤	throttle fault
	3,4	¤¤¤ ¤¤¤¤	[not used]
	4,1	¤¤¤¤ ¤	battery undervoltage
	4,2	¤¤¤¤ ¤¤	battery overvoltage
	4,3	¤¤¤¤ ¤¤¤	thermal cutback, due to over/under temp
	4,4	¤¤¤¤ ¤¤¤¤	[not used]

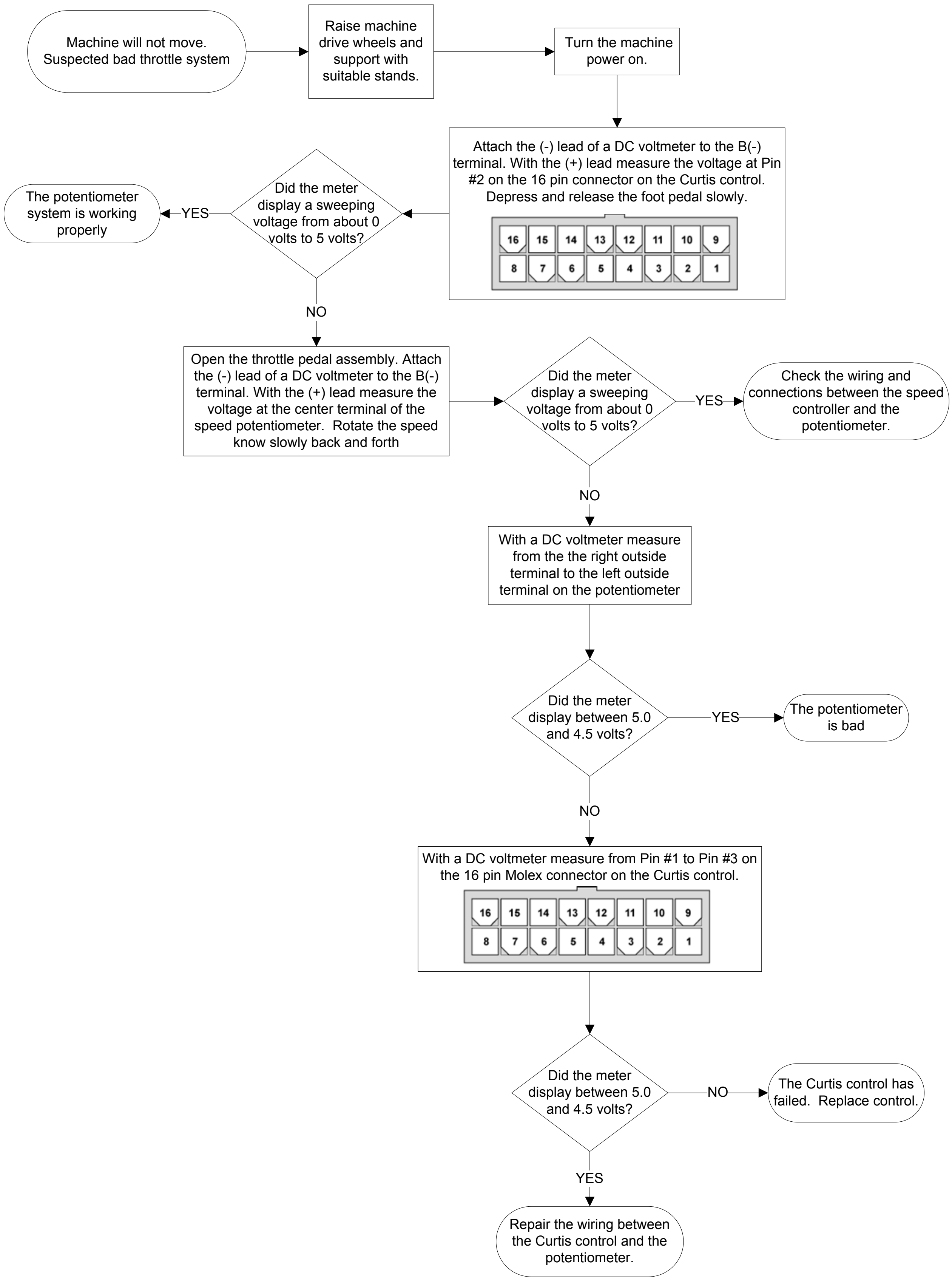
❊ = "Fast-flash" fault—must cycle keyswitch or power enable switch to clear.

Table 8 TROUBLESHOOTING CHART

LED CODE	PROGRAMMER LCD DISPLAY	EXPLANATION	POSSIBLE CAUSE
1,1	HARDWARE FAILSAFE 2	output fault	1. Short in motor or in motor wiring. 2. Controller failure.
	HARDWARE FAILSAFE 4	overcurrent fault	1. Short in motor or in motor wiring. 2. Controller failure.
1,2	HARDWARE FAILSAFE 1	EEPROM fault	1. EEPROM failure or fault.
	HARDWARE FAILSAFE 3	main contactor fault	1. Main contactor welded. 2. Main contactor driver fault. 3. Main contactor coil fault.
	PRECHARGE FAULT	precharge fault	1. Internal controller fault. 2. Low battery voltage.
	HW FAILSAFE	motor voltage fault	1. Motor voltage does not correspond to throttle request. 2. M1 or M2 output shorted to B- or B+. 3. Internal motor short. 4. Controller failure.
2,1	SRO	SRO fault	1. Improper sequence of KSI, power enable, and direction inputs. 2. Wrong SRO type selected. 3. Direction switch circuit open.
2,2	HPD	HPD fault	1. Improper sequence of KSI, power enable, and throttle inputs. 2. Misadjusted throttle pot.
2,3	PROC/WIRING FAULT	HPD fault present for >5 sec	1. Misadjusted throttle. 2. Broken throttle pot. 3. Broken throttle mechanism.
2,4	SPD LIMIT POT FAULT	speed limit pot fault	1. Speed limit pot wiper wire broken. 2. Broken speed limit pot.
3,1	BB WIRING CHECK	emerg. reverse wiring fault	1. BB wire open. 2. BB check wire open.
3,2	EM BRAKE DRVR FAULT	electromag. brake driver fault	1. Electromagnetic brake coil shorted or open. 2. Electromagnetic brake wiring open.
3,3	THROTTLE FAULT 1	throttle fault	1. Throttle input wire open. 2. Throttle input wire shorted to B- or B+. 3. Throttle pot defective. 4. Wrong throttle type selected.
4,1	LOW BATTERY VOLTAGE	low battery voltage	1. Battery voltage <16 volts (24V models), <21V (36V models), or <27V (48V models). 2. Corroded or loose battery terminal. 3. Loose controller terminal.
4,2	OVERVOLTAGE	overvoltage	1. Battery voltage >36 volts (24V models), >48V (36V models), or >60V (48V models). 2. Vehicle operating with charger attached.
4,3	THERMAL CUTBACK	over-/under-temp. cutbac	1. Temperature >95 °C or < -25°C. 2. Excessive load on vehicle. 3. Improper mounting of controller. 4. Operation in extreme environments.

CHECK VOLTAGE TO THE CONTROLLER




Machine will not move. Suspected bad throttle system
Raise machine drive wheels and support with suitable stands.
Turn the machine power on.
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at Pin #2 on the 16 pin connector on the Curtis control. Depress and release the foot pedal slowly.
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
The potentiometer system is working properly
NO
Open the throttle pedal assembly. Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the center terminal of the speed potentiometer. Rotate the speed know slowly back and forth
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Check the wiring and connections between the speed controller and the potentiometer.
NO
With a DC voltmeter measure from the the right outside terminal to the left outside terminal on the potentiometer
Did the meter display between 5.0 and 4.5 volts?
YES
The potentiometer is bad
NO
With a DC voltmeter measure from Pin #1 to Pin #3 on the 16 pin Molex connector on the Curtis control.
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
Did the meter display between 5.0 and 4.5 volts?
NO
The Curtis control has failed. Replace control.
YES
Repair the wiring between the Curtis control and the potentiometer.

CONNECTIONS

BATTERY

The connections from the controller to the battery are made via 0.25” quick connects (Spade terminals). The positive battery cable connects from the main circuit breaker to any one of the 3 terminals labeled “B+”. The negative battery cable connects to any one of the 3 terminals labeled “B-”.

POWER SWITCH

The power switch is a very simple circuit. +24 volts is taken from the main circuit breaker and it is switched on and off to the controller thru a SPST lighted switch. The signal is sent into the controller thru a 16 gauge red wire into pin #15 of the 16 pin Molex connector.

THROTTLE

The throttle uses a 5K hermetically sealed potentiometer to sum the high (4.8 Volts +/- 0.2 volts) and low (0.2 Volts +/-).2 volts) reference voltages from the controller. The output from the potentiometer is a varied voltage from +0.2 volts +/- 0.1 volt to 4.8 volts +/- 0.1 volt. This signal is then sent to the controller on pin #4 of the 16 pin Molex connector.

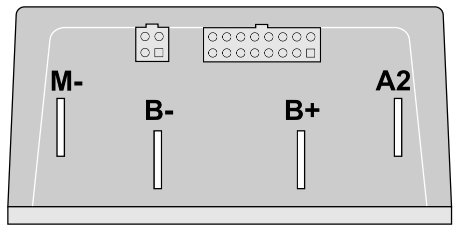
REVERSE SWITCH

The reverse switch sends +24 Volts DC from the positive buss bar to Pin #11 on the 16 pin Molex connector on the Curtis controller. This tells the controller that when it receives a throttle signal from the throttle potentiometer to move in a reverse direction.

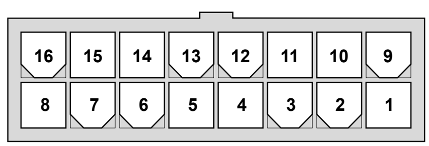
BRAKE OUTPUT

The brake output of the controller is used to turn a solenoid on and off the controls when the brushes run. This output is turned on by the controller immediately when the machine is put in motion and stays on for 1 second after the throttle input is turned off.

WIRING



M- = Drive Motor (-)
B- = Battery (-)
B+ = Battery (+)
A2 = Drive Motor (+)



Pin 1	pot high
Pin 2	pot wiper
Pin 3	pot low
Pin 4	speed limit pot wiper
Pin 5	push
Pin 6	inhibit
Pin 7	program 1 driver
Pin 8	main contactor coil driver
Pin 9	horn driver
Pin 10	emergency reverse(1237 only)
Pin 11	mode switch and LED driver
Pin 12	forward switch
Pin 13	direction/reverse switch and LED driver
Pin 14	power enable switch and Status LED driver
Pin 15	keyswitch input (KSI)
Pin 16	program 2 driver(1237 only)

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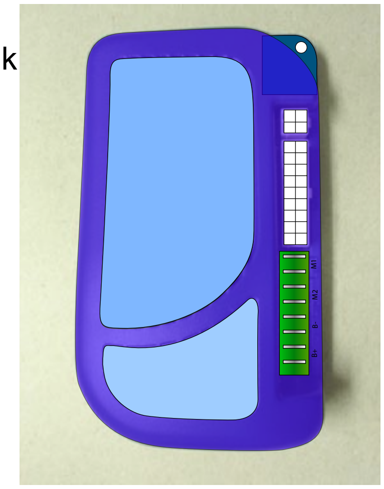
CURTIS 1228 CONTROLLER



The Curtis 1228 controller was used on the 20/2000 series of walk behind auto scrubbers and the 200 burnishers. The 1228 is a fully programmable controller and comes in 24 and 36 volt versions. This controller has regenerative breaking which provides downhill and deceleration speed control.

FEATURES

- Full bridge power MOSFET design
- Infinitely variable forward, reverse, drive and brake control
- Silent high frequency operation
- Fully programmable
- High pedal disable
- Drive motor limiting in both drive and braking modes
- Battery under voltage protection
- Power failure default breaking
- Thermal protection limits controller current

SPECIFICATIONS

Operation voltage: 24 and 36 volt versions
Controller capacity: 75 amps
Outputs
Drive
Auxiliary

Programmable parameters
Acceleration
Deceleration Rate
Top Forward Speed
Top Reverse Speed

CONNECTIONS

BATTERY

The connections from the controller to the battery are made via 0.25” quick connects (Spade terminals). The positive battery cable connects from the main circuit breaker to any one of the 3 terminals labeled “B+”. The negative battery cable connects to any one of the 3 terminals labeled “B-”.

POWER SWITCH

The power switch is a very simple circuit. We take +24 volts from the main circuit breaker and switch it on and off to the controller thru a SPST lighted switch. The signal is sent into the controller thru a 16 gauge red wire into pin #5 of the 18 pin Molex connector.

THROTTLE

The throttle uses a 5K hermetically sealed potentiometer to sum the high and low throttle reference voltages from the controller. The output from the potentiometer is a varied voltage from +0.2 volts +/- 0.1 volt to 4.8 volts +/- 0.1 volt. This signal is then sent to the reverse switch and the handle bar push button switch(es). Either one of these switches can close the circuit passing the varied voltage signal through to the controller on pin # of the 18 pin Molex connector.

REVERSE SWITCH

The reverse switch circuit is very simple. There are two pairs of wires that go tho the DPDT reverse switch. One pair (both black) send the throttle signal to the controller to move. The other pair (blue & green) send the signal to the controller telling it when it moves to move in the reverse direction.

BRAKE OUTPUT

The parking brake output of the controller is used to turn on and off a solenoid. This output is turned on immediately when the machine is put in motion and it stays on for 1 second after the throttle has been released.

DIAGNOSTICS

FLASH CODES

To assist in the diagnosis of problems the controller has a remote LED indicator that flashes diagnostic codes. This LED is located either on the side or on the bottom of the central command. During normal operation, with no faults present, the status LED is steadily on.
If the controller detects a fault, the status LED provides two types of information. First, it displays a slow flash (2 Hz or 2X a second) or a fast flash (4Hz or 4X a second) to indicate the severity of the fault. Slow flash faults are self-clearing; as soon as the fault is corrected, the machine will operate normally. Fast-flash faults (“*” in the table below) are considered to be more serious in nature and require that the key switch be cycled to resume operation after the fault is corrected.
After the severity indication has been active for 5 seconds, the Status LED flashes a 2-digit fault identification code continuously until the fault is corrected. For example, code “4.1” -- low battery voltage and code “3.2” -- electromagnetic brake driver appear as.:

☼☼☼☼ ☼ (4, 1) ☼☼☼☼ ☼ (4, 1) ☼☼☼☼ ☼ (4, 1)

☼☼☼ ☼☼ (3, 2) ☼☼☼ ☼☼ (3, 2) ☼☼☼ ☼☼ (3, 2)

Table 2 STATUS LED FAULT CODES

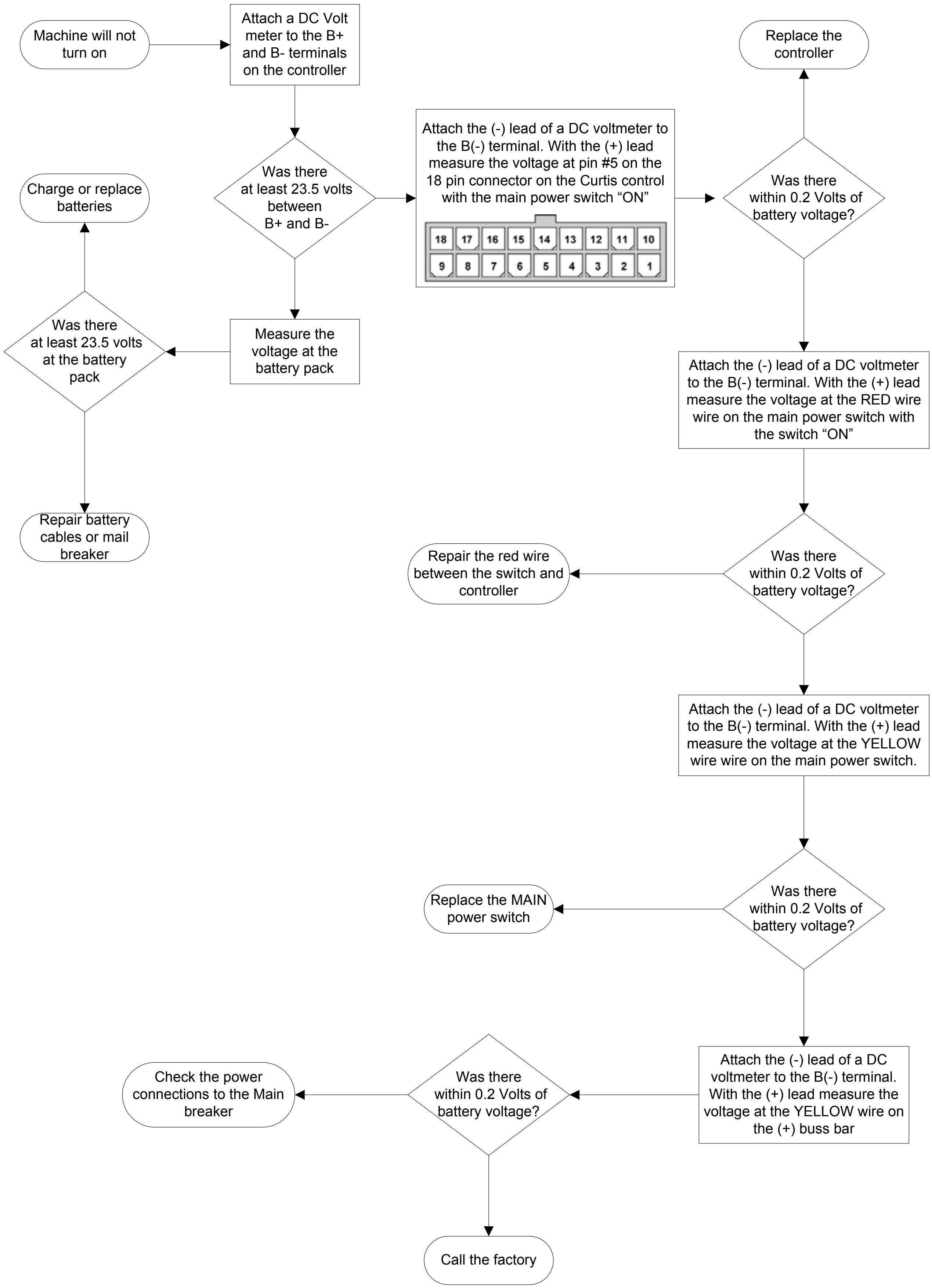
LED CODES			EXPLANATION
	LED off		no power or defective controller
	solid on		controller operational; no faults
	1,1	¤ ¤	thermal cutback fault
	1,2	¤ ¤¤	throttle fault
	1,3	¤ ¤¤¤	speed limit pot fault
	1,4	¤ ¤¤¤¤	undervoltage fault
	1,5	¤ ¤¤¤¤¤	overvoltage fault
	2,1	¤¤ ¤	main contactor driver Off fault
	2,3	¤¤ ¤¤¤	main contactor fault
	2,4	¤¤ ¤¤¤¤	main contactor driver On fault
❇	3,1	¤¤¤ ¤	HPD fault present for >10 seconds
	3,2	¤¤¤ ¤¤	brake On fault
	3,3	¤¤¤ ¤¤¤	precharge fault
	3,4	¤¤¤ ¤¤¤¤	brake Off fault
	3,5	¤¤¤ ¤¤¤¤¤	HPD (High Pedal Disable) fault
❇	4,1	¤¤¤¤ ¤	current sense fault
❇	4,2	¤¤¤¤ ¤¤	motor voltage fault (hardware failsafe)
❇ †	4,3	¤¤¤¤ ¤¤¤	EEPROM fault
❇	4,4	¤¤¤¤ ¤¤¤¤	power section fault

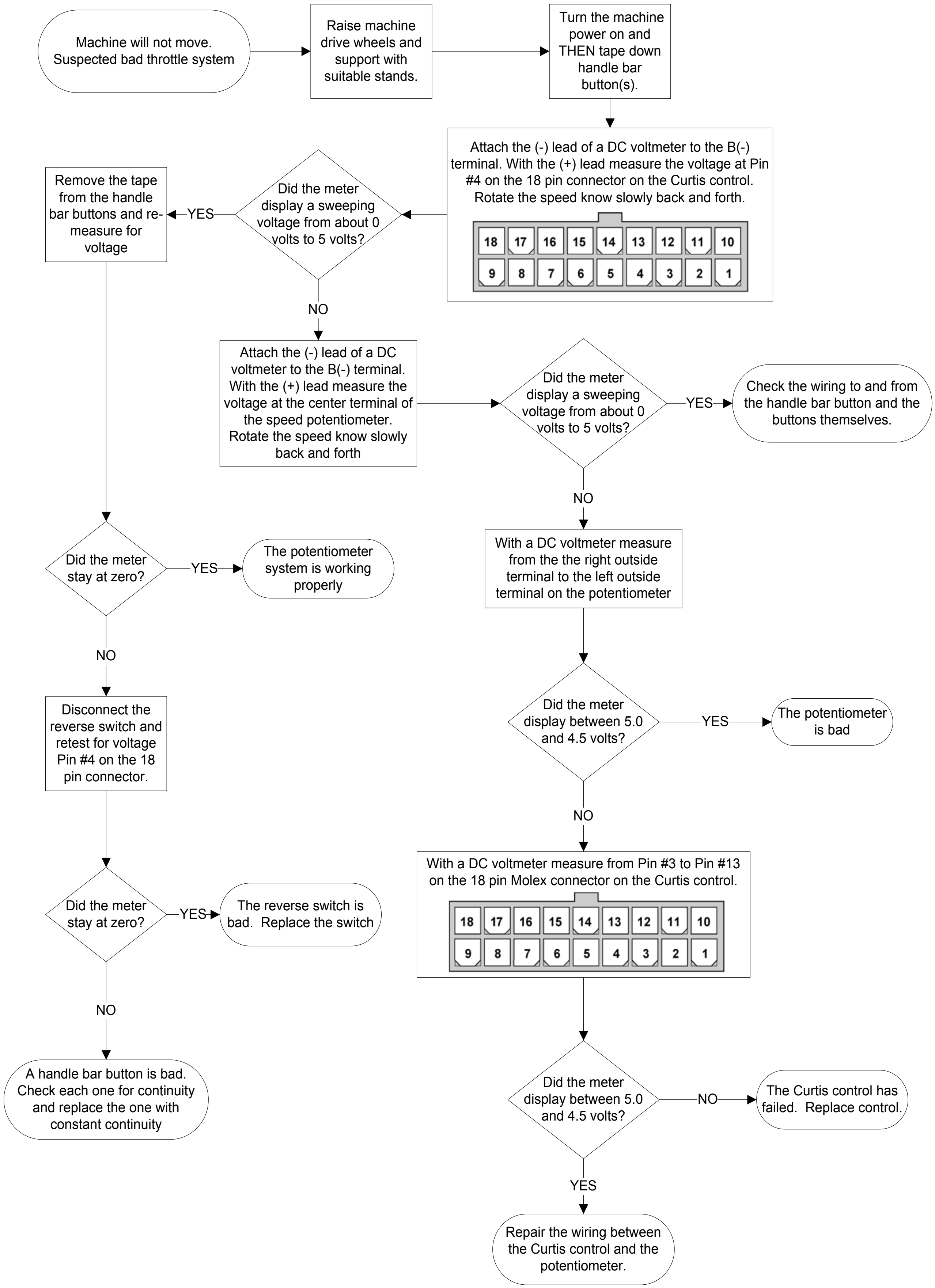
❇ = Must cycle keyswitch to clear.
† = Must use programmer to clear, as follows: select Program Menu, alter data value of any parameter, cycle keyswitch.

NOTE : Only one fault is indicated at a time, and faults are not queued up.

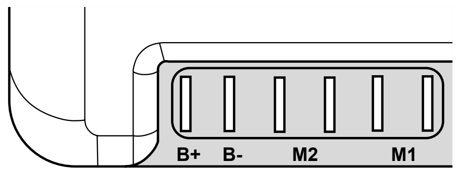
Table 3 TROUBLESHOOTING CHART

LED CODE	PROGRAMMER LCD DISPLAY	EXPLANATION	POSSIBLE CAUSE
1,1	THERMAL CUTBACK	over-/under-temperature cutback	1. Temperature >92°C or < -25°C. 2. Excessive load on vehicle. 3. Operation in extreme environments. 4. Electromagnetic brake not releasing.
1,2	THROTTLE FAULT 1	throttle fault	1. Throttle input wire open or shorted. 2. Throttle pot defective. 3. Wrong throttle type selected.
1,3	SPD LIMIT POT FAULT	speed limit pot fault	1. Speed limit pot wire(s) broken or shorted. 2. Broken speed limit pot.
1,4	LOW BATTERY VOLTAGE	battery voltage too low	1. Battery voltage <17 volts. 2. Bad connection at battery or controller.
1,5	OVERVOLTAGE	battery voltage too high	1. Battery voltage >36 volts. 2. Vehicle operating with charger attached. 3. Intermittent battery connection.
2,1	MAIN OFF FAULT	main contactor driver Off fault	1. Main contactor driver failed open.
2,3	MAIN CONT FLTS	main contactor fault	1. Main contactor welded or stuck open. 2. Main contactor driver fault. 3. Brake coil resistance too high.
2,4	MAIN ON FAULT	main contactor driver On fault	1. Main contactor driver failed closed.
3,1	PROC/WIRING FAULT	HPD fault present for >10 sec.	1. Misadjusted throttle. 2. Broken throttle pot or throttle mechanism.
3,2	BRAKE ON FAULT	brake On fault	1. Electromagnetic brake driver shorted. 2. Electromagnetic brake coil open.
3,3	PRECHARGE FAULT	precharge fault	1. Low battery voltage. 2. KSI and throttle turned on at same time.
3,4	BRAKE OFF FAULT	brake Off fault	1. Electromagnetic brake driver open. 2. Electromagnetic brake coil shorted.
3,5	HPD	HPD (High Pedal Disable) fault	1. Improper sequence of throttle and KSI, push, or inhibit inputs. 2. Misadjusted throttle pot.
4,1	CURRENT SENSE FAULT	current sense fault	1. Short in motor or in motor wiring. 2. Controller failure.*
4,2	HW FAILSAFE	motor voltage fault (hardware failsafe)	1. Motor voltage does not correspond to throttlerequest. 2. Short in motor or in motor wiring. 3. Controller failure.*
4,3	EEPROM FAULT	EEPROM fault	1. EEPROM failure or fault.
4,4	POWER SECTION FAULT	power section fault	1. EEPROM failure or fault. 2. Short in motor or in motor wiring. 3. Controller failure.*

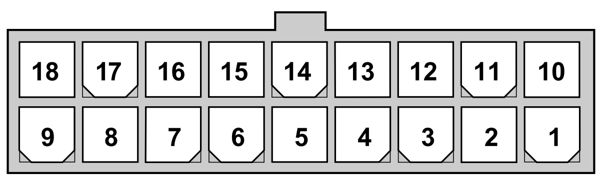

Machine will not turn on
Attach a DC Volt meter to the B+ and B- terminals on the controller
Was there at least 23.5 volts between B+ and B-
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at pin #5 on the 18 pin connector on the Curtis control with the main power switch "ON"
18 17 16 15 14 13 12 11 10
9 8 7 6 5 4 3 2 1
Was there within 0.2 Volts of battery voltage?
Replace the controller
Charge or replace batteries
Was there at least 23.5 volts at the battery pack
Measure the voltage at the battery pack
Repair battery cables or mail breaker
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the RED wire wire on the main power switch with the switch "ON"
Was there within 0.2 Volts of battery voltage?
Repair the red wire between the switch and controller
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire wire on the main power switch.
Was there within 0.2 Volts of battery voltage?
Replace the MAIN power switch
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the YELLOW wire on the (+) buss bar
Was there within 0.2 Volts of battery voltage?
Check the power connections to the Main breaker
Call the factory


Machine will not move. Suspected bad throttle system
Raise machine drive wheels and support with suitable stands.
Turn the machine power on and THEN tape down handle bar button(s).
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at Pin #4 on the 18 pin connector on the Curtis control. Rotate the speed know slowly back and forth.
18 17 16 15 14 13 12 11 10
9 8 7 6 5 4 3 2 1
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Remove the tape from the handle bar buttons and re-measure for voltage
NO
Attach the (-) lead of a DC voltmeter to the B(-) terminal. With the (+) lead measure the voltage at the center terminal of the speed potentiometer. Rotate the speed know slowly back and forth
Did the meter display a sweeping voltage from about 0 volts to 5 volts?
YES
Check the wiring to and from the handle bar button and the buttons themselves.
NO
With a DC voltmeter measure from the the right outside terminal to the left outside terminal on the potentiometer
Did the meter stay at zero?
YES
The potentiometer system is working properly
NO
Disconnect the reverse switch and retest for voltage Pin #4 on the 18 pin connector.
Did the meter stay at zero?
YES
The reverse switch is bad. Replace the switch
NO
A handle bar button is bad. Check each one for continuity and replace the one with constant continuity
Did the meter display between 5.0 and 4.5 volts?
YES
The potentiometer is bad
NO
With a DC voltmeter measure from Pin #3 to Pin #13 on the 18 pin Molex connector on the Curtis control.
18 17 16 15 14 13 12 11 10
9 8 7 6 5 4 3 2 1
Did the meter display between 5.0 and 4.5 volts?
NO
The Curtis control has failed. Replace control.
YES
Repair the wiring between the Curtis control and the potentiometer.

WIRING



B+ = Battery Positive (+)
B- = Battery Negative (-)
M2 = Traction Drive Motor
M1 = TRACTION DRIVE MOTOR



J10 **Pin 1**	B- (for logic circuit or battery charger)
J10 **Pin 2**	B- (for logic circuit or battery charger)
J10 **Pin 3**	pot high output
J10 **Pin 4**	pot wiper input; 5V throttle input
J10 **Pin 5**	keyswitch input (KSI)
J10 **Pin 6**	electromagnetic brake input (brake -)
J10 **Pin 7**	push switch input
J10 **Pin 8**	mode switch input—M1 (open), M2 (closed)
J10 **Pin 9**	status LED output
J10 **Pin 10**	B+ (for logic circuit or battery charger)
J10 **Pin 11**	B+ (for logic circuit or battery charger)
J10 **Pin 12**	inhibit input
J10 **Pin 13**	pot low input
J10 **Pin 14**	electromagnetic brake output (brake +)
J10 **Pin 15**	BDI output
J10 **Pin 16**	horn input
J10 **Pin 17**	reverse switch input
J10 **Pin 18**	speed limit pot wiper input

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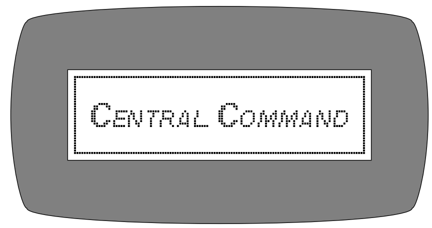
CENTRAL COMMAND II

The Central Command II control system implemented on majority our machines in September of 2002. This new control system utilized a controller Manufactured by P&G Drives of the UK. The new P&G controller is feature-rich and simplified our control systems.

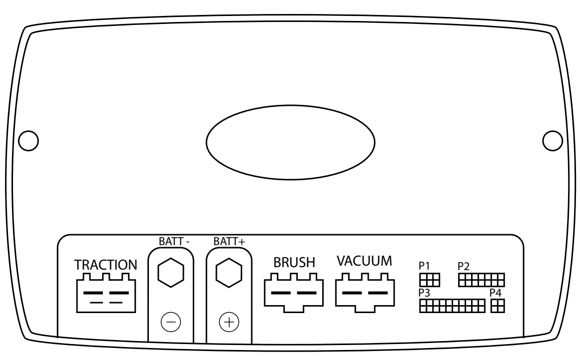
IDENTIFICATION

Machines built with the Central Command II system are easily identifiable by the LCD display on the control panel. All machine that are equipped with Central Command II have this display. The display is the same on all of our machines and is fully interchangeable from machine to machine regardless of type or voltage.



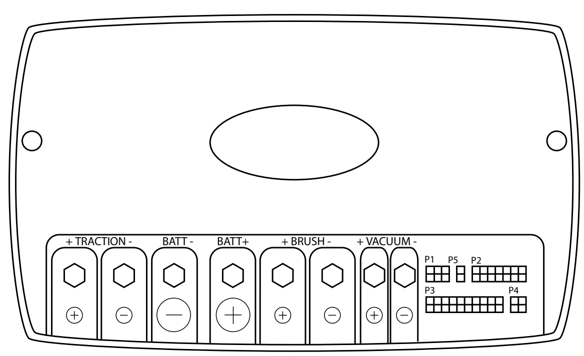
CONTROLLER IDENTIFICATION

To date of this publication we have used 3 versions of the P&G controller. These versions are easily identifiable. The V.2 (Trio) and V.3 (Trio +) controls can be identified by unplugging any of the high amperage output plugs; Brush, Vacuum, Traction. When the plug is out. Look down into the cavity of the controller that the plug was in and note the color of the circuit board. If the circuit board is GREEN the controller is a V.2 (Trio). If the circuit board is BLUE the controller is a V.3 (Trio +). If the controller has 8 lug terminals across the front and NO high amperage plugs the controller is a V.4 (Trio + HD).



V.2 & V.3 CONTROLLER

V.2 Circuit Board = GREEN
V.3 Circuit Board = BLUE



V.4 CONTROLLER

CONTROLLER OVERVIEW

The controller used in the Central Command II system is manufactured by P&G drives and is much more than a standard speed controller. The controllers heart is an industrial micro computer. The P&G series of controllers used in the Central Command II is the “Trio” series that was designed primarily for the commercial and industrial cleaning equipment segment. This controller has the capability to run on 24 or 36 volts DC so the same controller works across nearly our entire product line.

CONTROLLER OPERATION

The controller operation is unlike previous control systems on our machines and differs in a number of ways. The first of these differences is the lack of battery voltage on most of our control switches. The majority of switches on the control panel are now used to send very low voltage signals to and from the computer. They must be diagnosed in a special way or the controller may be permanently damaged. There are no longer separate circuit breakers or contactors for each device; the circuit switching and protection is handled by the controller. The control panel switches are no longer connected directly to a solenoid that turns on a component, they are connected to the input circuits of the controller and send a signal to the controller and then the controller turns on the component based on certain criteria set by the controllers parameters.

INPUTS

The switches in the Central Command II System receive reference voltages from the controller and then send these signals, in the form of low or high reference voltages, to the controller. The controller interprets these signals and then the program inside the controller decides what device output is being requested and how it should operate the output.

TRI-STATE LOGIC

The Central Command II system uses very low voltage throughout its control system, this is called tri-state logic. The voltages used are less than battery voltage and the controller will be destroyed if battery voltage is introduced into the control circuits. The tri-state logic uses 3 voltages as follows;

LOW = 0.0 - 0.3 volts
MID = 0.8 - 2.7 volts
HIGH = 4.8 - 5.2 volts

The low and high voltages are reference voltages created by the controller. These voltages are sent to the various controller inputs via the control panel switches. The controller then makes the machine operate a certain way based on the input voltage. All inputs at the controller, with the exception of the throttle input, are at a voltage of 0.8 to 2.6 volts when they are at a “MID” or un-switched state. When a signal is sent to an input via a switch it is either a “LOW” or “HIGH” reference signal. The computer monitors the input terminal many times a second and when the voltage of it changes, the computer reacts accordingly to the program turning the outputs of the controller on or off. The P&G controller has two types of inputs, ON/OFF and Varied Voltage.

ON-OFF (CENTER OFF)

For the controller to switch a connected component on and off it must receive an input signal from one of the switches on the machine. The controller knows to turn components on and off based on the signal it receives from that switch . These switches are part of a tri-state logic system that the controller uses to interpret the input from the switches. The switches for the inputs are fed a reference voltage that is created by the controller. This reference voltage is either, Low, (0.1 volt +/- 0.1 volt), or High, (4.9 volts +/- 0.1 volt). The input circuits on the controller have an unaffected (nothing connected) state of 0.8 to 2.5 volts +/- 0.2 volts (Mid). When you turn a switch for a component on, a switched reference voltage is applied to the input circuit causing the input voltage to either go High (4.9 Volts +/- 0.1 volt) or Low (0.1 volt +/- 0.1 volt).

VARIED VOLTAGE

For circuits that require a varied output such as the throttle and solution output, we use a varied voltage input. The way these inputs work is a Low (0.1 volt +/- 0.1 volt) reference voltage is sent to one side of the coil on a 5K potentiometer and a High, (4.9 volts +/- 0.1 volt), reference voltage is sent to the other side of the coil on the same 5K potentiometer. The potentiometer sums the voltage together and the outputs a varied voltage signal from (Low), 0.1 volt +/- 0.1 volt to, (High) 4.9 volts +/- 0.1 volt. on the center pin, (wiper), of the potentiometer. This voltage is then fed to the input of the controller. When the controller receives the varied voltage signal from the potentiometer it controls the relative output accordingly.

IMPORTANT NOTE: The throttle signal on our machines is the only input on our control system with an unaffected (Low) input voltage of 0.1 +/- 0.1 volt.

OUTPUTS

The outputs on the Central Command II system that are controlled by the controller operate quite different than previous control systems. They no longer have a circuit breaker or a direct mechanical link to a switch on the machine. The outputs are turned on by the controller, based on numerous inputs and internal calculations. These outputs are pulse-width modulated outputs which allows us to soft start our components, control their operating speeds, dynamically control down-pressure and turn components on and off based on other functions of the machine.

IMPORTANT NOTE: When measuring outputs you must have within 1 volt of battery voltage to consider the output on.

CONTINUITY TESTS

The controller in our Central Command II system has onboard testing capabilities that test the fitness of different circuits on the machine. These circuits are the Drive Motor, Brush Motor, Vacuum Motor and Parking Brake. To do this the controller sends out voltage on one of the output terminals for a circuit and watches to assure the voltage is returned on the other terminal of the output circuit. If the controller does not see the voltage sent out one terminal return to the other is calculates that their is a fault in the circuit it is testing and displays an error code on the LCD display on the control panel. Depending on which circuit it is analyzing, a detected fault can disable the machine until the fault is corrected. The current sent out to test these circuits is extremely low and is not enough to run any of these components but it is enough current for you to see the voltage on your volt meter when testing. For this reason, for an output to be considered turned “On” by the controller you would have to see within 1 volt of battery voltage coming out of the output.

PULSE WIDTH MODULATION

The P&G Controller used in our Central Command II machines uses a technology called Pulse Width Modulation (PWM). PWM controls a circuit by switching the power on and off to it many times a second. By switching the voltage to the circuit on and off many times a second the controller operates efficiency by not wasting electricity by lowering the voltage through resistance. By using PWM we are able to control how an output circuit starts and stops, as well as to control the speed that a device runs at when a motor is being controlled.

SOFT START

When a output circuit is powered with PWM we are able to “Soft Start” a motor, meaning we start the motor gently and then increase its speed over a duration of 1 second. This method of controlling a motor is much gentler and greatly extends motor life as well as all the componentry that may be driven by the motor, such as drive shafts or chains. Three of the outputs; traction, brush & vacuum, have a soft start function on them. This function provides the ability to start and stop a motor gradually over a measured period of time, 0-10 seconds. This aids in the longevity of the motors and anything driven by them as it greatly decreases the shock load on them. The soft start settings are changed through the controller programming.

DOWN PRESSURE CONTROL

The down pressure of the scrub deck is monitored and maintained by the controller. It is adjusted many times a second to deliver consistent brush pressure with changing floor conditions. The controller monitors the amp draw of the scrub motors which increases and decreases with brush deck pressure and floor surface change. The amp draw has a target value and the controller works to keep the motors at the selected amp draw by increasing or decreasing brush pressure. The target pressure is represented on the LCD display and changed using the brush pressure switch on the control panel.

TIMED CIRCUITS

The controller has the capability to control a circuit with a certain amount of logic. We can customize the operation of a component beyond the simple on off operation. Timers are used for our vacuum motors and our squeegee actuators to make the machine operation more user friendly. The timer settings are changed through the controller programming.

BATTERY METER

The battery meter is integrated into the controller and the status of the battery is displayed on the LCD screen. The battery condition is monitored very differently from a traditional battery meter. The battery condition is calculated by measuring the internal resistance of the battery pack. The battery meter is designed to read properly when the battery is under load. It is not uncommon for the battery gauge to climb when the machine is under load.

OUTPUT NAMES & OPERATION:

The controller refers to the different outputs as follows;

Brush = Brush deck output

The brush deck output is turned on and off by the controller based on its parameters. The output is a pulse width modulated output that is soft started according to the controllers parameters. The output amperage is monitored via the controller and its “Down pressure Control” circuit.

Vac = Vacuum motor output

The vacuum motor output is turned on and off by the controller based on its parameters. The output is a pulse width modulated output that is soft started according to the controllers parameters. The motor is turned after a delay controlled by the controller’s program.

Drive = Drive motor output

The traction drive motor is turned on and off by the controller in relation to the throttle input and the reverse switch, The acceleration and deceleration rates are controlled by the controllers program.

Aux 1 = Brush deck actuator

The brush deck actuator output is turned on and off by the controller based on its program. EVERY TIME the controller is powered up the Aux 1 output is powered for 4 seconds to raise the bush deck to the top of it’s travel. When the brushes are turned on the brush deck actuator will lower the brushes for 3 -6 seconds depending on the controller’s program. When the machine starts scrubbing the Aux 1 output drives the brush deck up and down relative to the “Down Pressure Control” direction. When the machine is stopped, the controller will raise the brush deck for 1 - 3 seconds dependent on the controller’s program to assure the scrub brushes start under reduced load. When the brushes are turned off the controller raises the brushes for 3 -6 seconds depending on the controller’s program.

A**ux 2 = Squeegee lift actuator**

The squeegee actuator output is turned on and off by the controller, based on its program. EVERY TIME the controller is powered up Aux 2 is powered for 4 seconds to raise the squeegee to the top of it’s travel. When the squeegee switch or Uni-Touch switch is turned on, the squeegee drops to the floor. If the machine is switched into reverse, the Aux 2 raises the squeegee lift immediately. When the machine is switched back into forward, the squeegee lowers itself again. When the Squeegee or Uni-Touch switch is turned off the squeegee will stay down for 10 seconds after it is turned off and then it will raise.

Aux 3 = Solution solenoid circuit

The solution solenoid output is turned on and off 2 times per second (2 Hz). The length of the "On Cycle" is determined by the position of the potentiometer on the control panel if the machine is so equipped.

Aux 4 = Auxiliary circuit - Varied usage on specific machines

This auxiliary circuit has been used for different items on different machines

250

High Vacuum alert - On the 250 machines we utilize the Aux 4 circuit to turn on the high recovery light and turn off the vacuum in the event that the recovery tank should become full or the squeegee hose should become clogged.

390

Under seat fan - On Mid Production 390 machines the Aux 4 was used to run an under seat fan.

420

Under seat fan- On Mid Production 420 machines the Aux 4 was used to run an under seat fan.

CONNECTIONS

There are 3 different types of connections that are used on the controller.

MOLEX MINI FIT JR.

The Molex Mini Fit Jr. connectors are used for all of the inputs and the low amperage outputs. They require special tools to service and replace them. See the "Electrical System" Section 12 for serving information.

AMP TERMINALS

The AMP terminals are specially designed terminals capable of handling high amperage connections. These are used on the high amp outputs on the V.3 controls. See the "Electrical System" Section 12 for serving information.

BINDING POST TERMINALS

Binding post terminals offer the best connection available and are used for the main battery terminals on both the V.3 & V.4 controllers. On the V.4 controllers the high output connections have been changed to the binding post type.

LCD DISPLAY

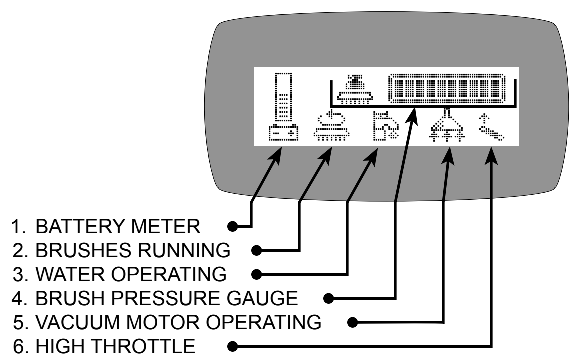
The LCD display is a multi-function display that conveys machine information to the operator about the operation state of the machine and diagnostic information in the event of a malfunction. The LCD display communicates to the controller on a serial data connection that is made via the 6 wire connector running from the display to the controller. The LCD display has 4 different screens with different information presented on each.

There are four versions of the LCD display. The first version of the LCD display has 3 screens that you can page through with the page button plus a diagnostic code screen. The second, third & fourth versions of the LCD display have two screen you can page through and a diagnostic code screen.

VERSION 1

SCREEN 1

Screen 1 is the default screen that appears after the machine has powered up.



1: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary up and down during usage of the machine.

2: BRUSHES RUNNING - This icon shows when the controller receives an input to run the scrub brushes.

3: SOLUTION DISPENSING - This icon indicates that the controller is receiving an input to dispense water. The icon flashes in relationship to the amount of time the valve is on for. This is controlled by the solution potentiometer on the control panel.

4: BRUSH PRESSURE GAUGE - This icon is a bar graph representation of the desired brush pressure. It is divided into 5 segments and each segment indicates more pad pressure.

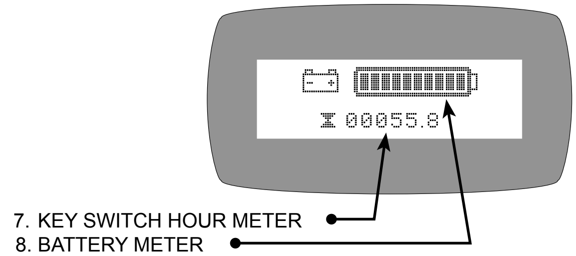
5: VACUUM MOTOR - This icon indicates the controller is receiving an input to run the vacuum motor.

6: HIGH THROTTLE - This icon indicates one or more throttle inputs, such as the green handle bar buttons or the reverse switch, were activated when the machine was powered on. To clear this icon make sure no buttons or switches are depressed and cycle the power to the machine.

SCREEN 2

To access screen 2, push the green page button on the control panel once.

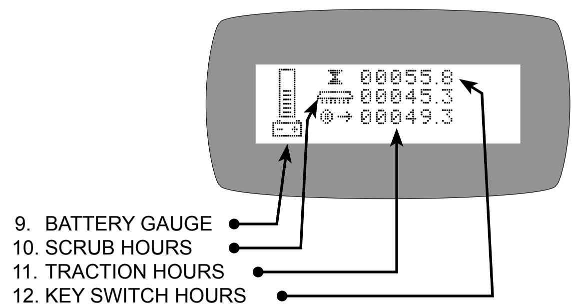
7: KEY SWITCH HOUR METER
This hour meter represents the total number of hours the machine has been powered on. This does not mean, however, that the machine has been used this long, just that it has had the power on for the time indicated.



8: BATTERY METER
This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use, and therefore will vary both up and down during usage of the machine.

SCREEN 3

To access this from screen 1 press the green page button twice.



9: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary both up and downduring usage of the machine.

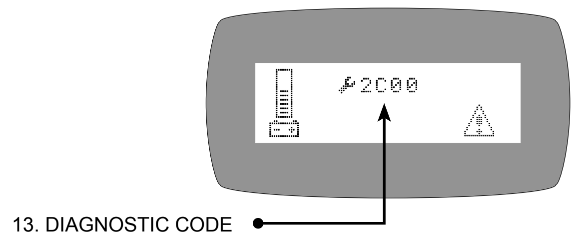
10: SCRUB HOURS - The hour total listed here indicates the total number of hours the brush deck has been operated on the machine.

11: TRACTION HOURS - The hour total listed here indicates the total number of hours the traction drive has been operated on the machine.

12: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long, just that it has had the power on for the time indicated.

SCREEN 4

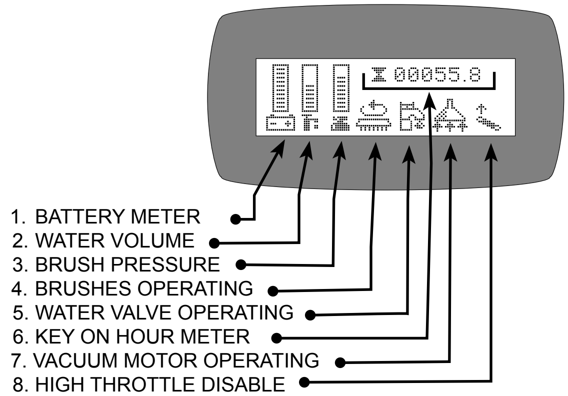
This screen will appear automatically in the event of a fault being present in the machine. Machine operation will be suspended in most cases until the cause of the code is remedied.



VERSION 2

SCREEN 1

Screen 1 is the default screen that appears after the machine has powered up.



1: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary both up and down during usage of the machine.

2: WATER VOLUME - This icon shows when the output volume that the controller has set.

3: BRUSH PRESSURE GAUGE - This icon is a bar graph representation of the desired brush pressure. It is divided into 5 segments and each segment indicates more pad pressure.

4: BRUSHES OPERATING - This icon shows when the controller receives an input to run the scrub brushes

5: WATER VALVE OPERATING - This icon indicates that the controller is receiving an input to dispense water. The icon flashes in relationship to the amount of time the valve is on for. This is controlled by the solution potentiometer or solution toggle switch on the control panel.

6: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean, however, that the machine has been used this long just that it has had the power on for the time indicated.

7: VACUUM MOTOR - This icon indicates the controller is receiving an input to run the vacuum motor.

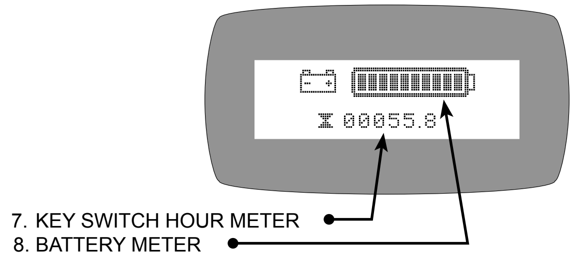
8: HIGH THROTTLE DISABLE - This icon indicates one or more throttle inputs, such as the green handle bar buttons or the reverse switch, were activated when the machine was powered on. Make sure no buttons or switches are depressed and cycle the power to the machine.

SCREEN 2

To access screen 2, push the green page button on the control panel once.

7: KEY SWITCH HOUR METER
This hour meter represents the total number of hours the machine has been powered on. This does not mean, however, that the machine has been used this long, just that it has had the power on for the time indicated.

8: BATTERY METER
This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use, and therefore will vary both up and down during usage of the machine.



SCREEN 3

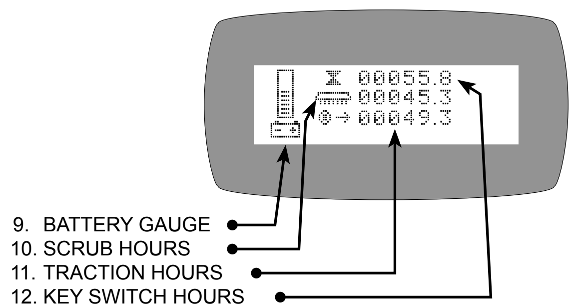
To access this from screen 1, press the green page button twice.

9: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.

10: SCRUB HOURS - The hour total listed here indicates the total number of hours the brush deck has been operated on the machine.

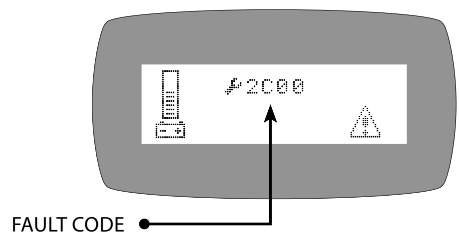
11: TRACTION HOURS - The hour total listed here indicates the total number of hours the traction drive has been operated on the machine.

12: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long just that it has had the power on for the time indicated.



SCREEN 4

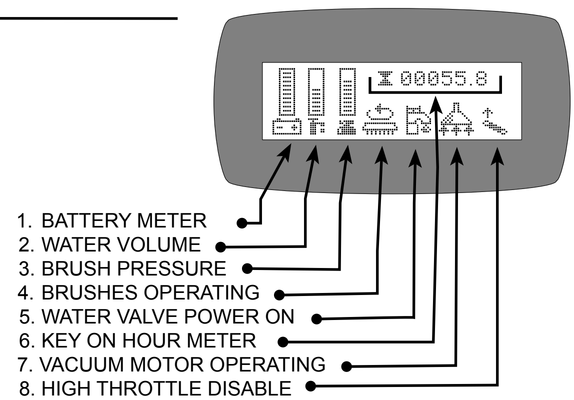
This screen will appear automatically in the event of a fault being present in the machine. Machine operation will be suspended until the cause of the code is remedied.



VERSION 3

SCREEN 1

Screen 1 is the default screen that appears after the machine has powered up.



1: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary both up and down during usage of the machine.

2: WATER VOLUME - This icon shows when the output volume that the controller has set.

3: BRUSH PRESSURE GAUGE - This icon is a bar graph representation of the desired brush pressure. It is divided into 5 segments and each segment indicates more pad pressure.

4: BRUSHES OPERATING - This icon shows when the controller receives an input to run the scrub brushes

5: WATER VALVE OPERATING - This icon indicates that the controller is receiving an input to dispense water. The icon flashes in relationship to the amount of time the valve is on for. This is controlled by the solution potentiometer or solution toggle switch on the control panel.

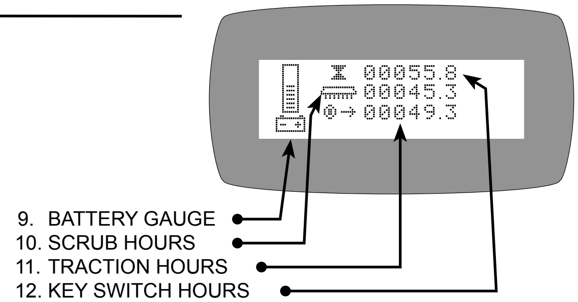
6: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean, however, that the machine has been used this long just that it has had the power on for the time indicated.

7: VACUUM MOTOR - This icon indicates the controller is receiving an input to run the vacuum motor.

8: HIGH THROTTLE DISABLE - This icon indicates one or more throttle inputs, such as the green handle bar buttons or the reverse switch, were activated when the machine was powered on. Make sure no buttons or switches are depressed and cycle the power to the machine.

SCREEN 2

To access this from screen 1, press the green page button twice.



9: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.

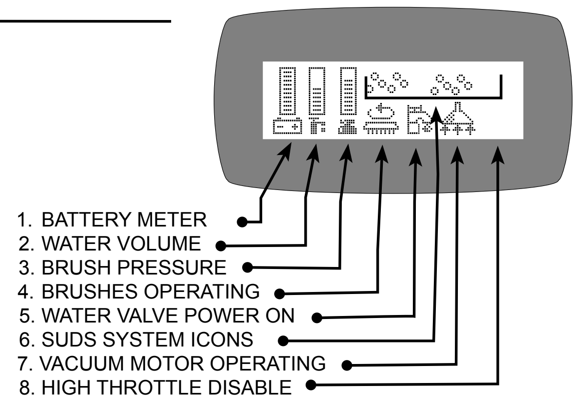
10: SCRUB HOURS - The hour total listed here indicates the total number of hours the brush deck has been operated on the machine.

11: TRACTION HOURS - The hour total listed here indicates the total number of hours the traction drive has been operated on the machine.

12: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long just that it has had the power on for the time indicated.

VERSION 4

SCREEN 1



Screen 1 is the default screen that appears after the machine has powered up.

1: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary both up and down during usage of the machine.

2: WATER VOLUME - This icon shows when the output volume that the controller has set.

3: BRUSH PRESSURE GAUGE - This icon is a bar graph representation of the desired brush pressure. It is divided into 5 segments and each segment indicates more pad pressure.

4: BRUSHES OPERATING - This icon shows when the controller receives an input to run the scrub brushes

5: WATER VALVE OPERATING - This icon indicates that the controller is receiving an input to dispense water. The icon flashes in relationship to the amount of time the valve is on for. This is controlled by the solution potentiometer or solution toggle switch on the control panel.

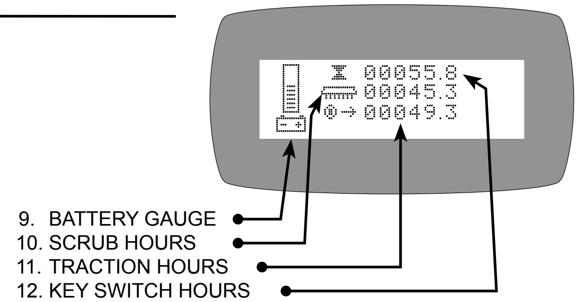
6: SUDS SYSTEM ICON - This icon indicates that the SUDS system in turned on. When the SUDS system is on setting 1 there are 2 sets of bubbles that show and when the SUDS system is on setting 2 (HI) there are 4 sets of bubbles that show..

7: VACUUM MOTOR - This icon indicates the controller is receiving an input to run the vacuum motor.

8: HIGH THROTTLE DISABLE - This icon indicates one or more throttle inputs, such as the green handle bar buttons or the reverse switch, were activated when the machine was powered on. Make sure no buttons or switches are depressed and cycle the power to the machine.

SCREEN 2

To access this from screen 1, press the green page button twice.



9: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.

10: SCRUB HOURS - The hour total listed here indicates the total number of hours the brush deck has been operated on the machine.

11: TRACTION HOURS - The hour total listed here indicates the total number of hours the traction drive has been operated on the machine.

12: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long just that it has had the power on for the time indicated.

ON-BOARD DIAGNOSTICS

The Central Command II control system utilizes a Diagnostic Code system that displays diagnostic codes on the LCD display should a malfunction of the machine occur. The diagnostic code can be looked up in the diagnostic code chart and it will assist you in determining the cause of malfunction. The diagnostic codes are slightly different from the V.2 to the V.3 controller, while the diagnostic codes are the same for the V.3 and V.4 controllers.

DIAGNOSING THE CONTROL SYSTEM

The Central Command II system with all its robust capabilities is also very easy to diagnose and repair. To diagnose the system a clamp type DC amp meter and high impedance DC Volt meter are required. The machine's LCD display will also be utilized. It is important never to use jumper wires connected to battery power or ground for testing as this can instantly destroy the controller.

The controller is not field serviceable in any way and needs to be replaced in the event of failure.

METERS

It is important to use a high quality meter when diagnosing the control systems on our equipment as a low quality meter can ruin a controller just by taking a measurement. A good rule of thumb is if you didn't pay at least $50 for your meter don't use it on our equipment. NEVER use analog meters for diagnosing the controller systems on our machines as they WILL damage the machine. A DC amp clamp is imperative for diagnosis of the control systems; most DC amp clamps have a built in DC volt meter too. In addition to your meter(s) you should have a quality set of test leads that have alligator clamps on the ends.

MEASUREMENTS

When measuring for voltage in the control system unless otherwise specified you will always set your meter to the DC volts scale and connect your negative (-) test lead to the negative (-) battery cable or buss bar. When measuring for amp draw you will always measure around ONLY 1 wire (+) OR (-) going to the device in question. Place the meter clamp on the wire with power off to the device. Zero out the meter and then power up the device and take your readings.

LCD DISPLAY

The LCD is a critical component and can cause the machine to operate improperly or not operate at all, There is a computer data link that is established between the LCD and the computer when the machine is powered on and all the computer information is routed in a loop through the LCD display. For this reason if an LCD fails it can cause a variety of results from making the machine not turn on to making it not turn off.

PROGRAMMING

We use the same controllers on nearly all of our machines. The controller's embedded computer needs a set of instructions to operate the machine. The instructions are the program the computer runs and we can modify this program by changing it's "parameters". This is what makes it possible to use the same controller in most of our machines but have each one of them react differently. By changing these parameters we can make the piece of equipment function in different ways. An example of this is by changing the parameters we can make brush deck of a machine drop to the floor when the machine starts scrubbing and then pick itself up when the machine stops. If we adjusted another parameter we could make the brushes raise up when the machine went in reverse without having the operator manipulate a switch. In order to change the parameters in a controller a T-194 programing kit is necessary. With a laptop computer and the programming kit access can be gained to the parameters of the machine and they can be modified to make the machine react differently.

The controller has 135 parameters that can be modified through programming. To program the controller a programming kit and special software are necessary. The kit for this is available from the factory. The part number for the kit is T-194 and it includes the following:

1	Central Command II Programmer CD
1	Controller computer interface cable
1	USB serial port adapter
1	Controller protected power cable
1	Jumper key
1	Latest version of the Electrical Service Guide
1	T-194 programming guide
1	Aluminum briefcase

This kit is required to make any changes in the program for the computer.

TRIO CONTROLLER - V.2

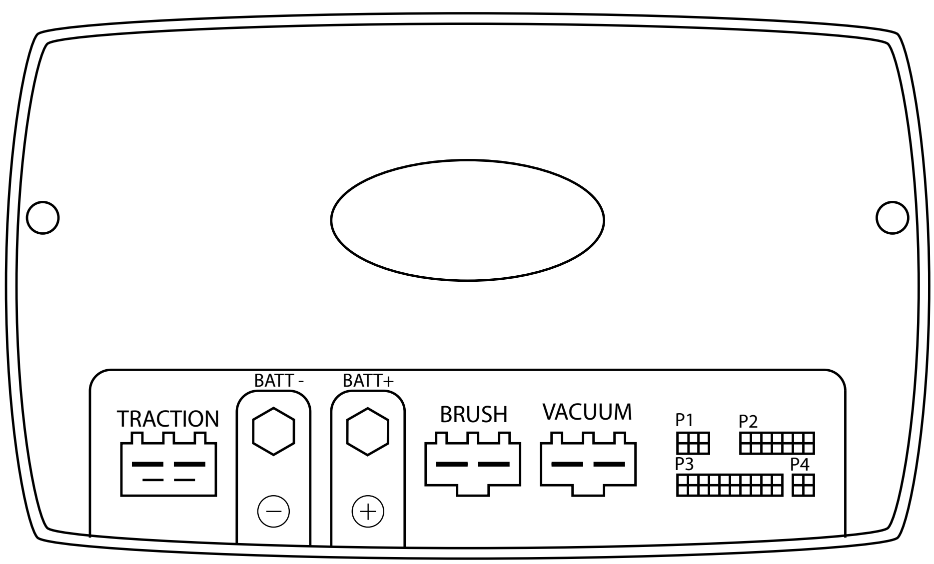
The Trio controller was the first controller manufactured by P&G Drives of the UK that we used in our machines.   This controller is identifiable by the l"ime green" colored circuit board that it is built on. This Trio controller with the "lime green" circuit board is called the V.2.

The V.2 controller was used from September 2002 until March 2004 across our full line and was used on the 390/420 line of machines until June of 2007.

The V.2 controllers did not have on board protection of the auxiliary circuits so in the event of an overload the controller could be damaged. To alleviate this electronic circuit breakers were added to the wiring harness to protect the controller in the event of an overload.

The V.2 controller's high amp connections; Brush, Vacuum & Traction, could become corroded due to contamination or physical wear of the contacts.   If this was to occur the contacts could develop excessive resistance leading to the plugs and the controller case to melt. This condition is remedied by replacing the controller and the end of the wiring harness that plug into the High Amp outputs. There are 2 kits, 250W for walk behinds and 250R for riders. These kits include 3 new high amp plugs and the connectors required to install them. Note that the new connectors are pre loaded with contact grease. This grease helps to seal the connectors from contaminants and lubricate the terminals to help alleviate physical abrasion of them from normal use.

One of the strengths of the V.2 controller is its ability to clime a ramp. That is why we continued in production with it on out large frame 390/420 machines until May of 2007.



THE V.2 Controller has a "LIME GREEN" circuit board.

Central Command II V. 2 Fault Codes		
Code	**Probable Cause**	**Service Action**
0003 **0100** **0204**	Memory corrupt	Replace Controller if not cleared by disconnecting batteries for 1 min
0705 **0706**	All 070x codes -Wiring short circuit between Tiller Hi and Lo Ref	Check for wiring short circuits on the 20 way connector on the Trio, the 16 way connector on the LCD (if used) and the wiring to the front panel switches & controls and those switches & controls themselves.
0810 **0811** **0812** **0813** **0814** **0815** **0816** **0817** **0818**	All 081x codes – Throttle wiring short or open circuits. 0816 and 0817 can be caused by incorrect programming of the ISO test parameter	Check for wiring short circuits or broken wires on the 20 way connector on the Trio, the 5 way connector on the LCD (if used) and the wiring to the front panel speed / throttle control and the speed / throttle control itself.
0A01	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
0B0B	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
1310	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
1500 **1501** **1507**	All 150x codes - Check brake & wiring for open or short circuit	Check the Traction motor connection on the Trio and check the wiring from this connector down to the Traction motor and checking connections all the way. Otherwise possible fault in electro brake on traction motor or possible Controller fault.
1600	Voltage exceeds maximum	Can be caused by poor or corroded connections to the batteries or a battery charger being connected.
1704 **1705** **1706** **1800** **1802** **1B20** **1B21**	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
1D02	Tiller settings updated in programming	Cycle the power via the keyswitch
1E03 **1E04**	Inhibit inputs - Exact usage dependent on programming	Remove or correct what is causing the inhibit. Otherwise check for wiring short circuits or broken wires on the 20 way connector on the Trio and the wiring elsewhere on the machine. Otherwise incorrect programming or operation of machine.
2102 **2103**	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
2C00 **2C01**	Low voltage warning	Recharge batteries immediately
2C02	Dependent on programming	Recharge batteries immediately
2D01	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
2F01	Throttle in drive position during switch on	Incorrect operation of machine. Otherwise check the mechanical condition of the throttle mechanism. Otherwise check for wiring short circuits on the 20 way connector on the Trio, the 16 way connector on the LCD (if used) and the wiring to the front panel switches & controls and those switches & controls themselves.
3100 **3101** **3102** **3103** **3104** **3105**	All 310x codes - Probable short circuit of output device or wiring - can sometimes cause permanent Controller fault.	Check the Traction, Brush and Vac motor connections on the Trio and check the wiring from these connectors down to the Traction, Brush and Vac motors checking connections all the way and also checking for short circuits. Check for wiring short circuits or broken wires on the 14 way connector on the Trio and the wiring elsewhere on the machine. Otherwise replace Controller.
3201 **3210** **3211** **3212** **3213** **3214**	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min
3601 **3602** **3603** **3608** **3609** **360A** **360B** **360C** **360D** **360E**	Possible Controller fault	Replace Controller if not cleared by disconnecting batteries for 1 min

7000	All 70xx codes – Check wiring of brake and freewheel switch	Check for wiring short circuits on the 20 way connector on the Trio, the 16 way connector on the LCD (if used) and the wiring to the ffreewheel switch and the switch itself.. Check the Traction motor connection on the Trio and check the wiring from this connector down to the electromagnetic brake on the Traction motor and check connections all the way. Can be caused by excessive pushing or rolling down a slope or incorrect operation of the machine.
7001		
7500	Wiring fault on 6-way serial link between Trio and LCD	Check the wiring and connectors on the 6 way connections on the Trio and LCD
7501	LCD memory corrupt	Disconnect batteries and wait for 1 min before re-applying power
7600	Open circuit on brush motors or brush motor wiring	Check the Brush motor connection on the Trio and check the wiring from this connector down to the Brush moto and checking connections all the way. Otherwise possible Brush motor fault.
7601	Brush current overload (“thermal” trip)	Incorrect programming, incorrectly specified Brush motor, Brush motor developing a fault, excessive resistance on brushes or brushes pushing down too hard on floor.
7602	Brush current overload (“magnetic” trip)	Incorrectly specified Brush motor, Brush motor developing a fault
7603	Possible short circuit on brush motors or wiring	Check the Brush motor connection on the Trio and check the wiring from this connector down to the Brush moto and checking connections all the way. Otherwise possible Brush motor fault.
7604	Dependent on programming	Incorrect software program - check program, otherwise possible controller fault.
7700	Open circuit on vac motors or vac motor wiring	Check the Vac motor connection on the Trio and check the wiring from this connector down to the Vac motor and checking connections all the way. Otherwise possible Vac motor fault.
7701	Vacuum current overload (“thermal” trip)	Incorrect programming, incorrectly specified Vac motor, Vac motor developing a fault, debris in Vac motor or airways blocked by debris
7702	Vacuum current overload (“magnetic” trip)	Incorrectly specified Vac motor, Vac motor developing a fault
7703	Possible short circuit on vacuum motors or wiring	Check the Vac motor connection on the Trio and check the wiring from this connector down to the Vac motor and checking connections all the way. Otherwise possible Vac motor fault.
7800	Open circuit on traction motor or traction motor wiring	Check the Traction motor connection on the Trio and check the wiring from this connector down to the Traction motor and checking connections all the way. Otherwise possible Traction motor fault.
7801	Possible short circuit on Traction motor or wiring	Check the Traction motor connection on the Trio and check the wiring from this connector down to the Traction motor and checking connections all the way. Otherwise possible Traction motor fault.
7802	Traction motor current has exceeded current limit for the foldback time	Excessive driving up an incline, or machine driven up against an obstacle or step.
7900	E-stop input active or wiring fault	Check for wiring short circuits on the 20 way connector on the Trio, the 16 way connector on the LCD (if used) and the wiring to the emergency stop switch and the emergency stop switch itself. Otherwise incorrect operatior of machine.
7901	E-stop input active or wiring fault (programmed as belly button)	Check for wiring short circuits on the 20 way connector on the Trio, the 16 way connector on the LCD (if used) and the wiring to the belly button stop switch and the belly button switch itself. Otherwise incorrect operation of machine.

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TRIO PLUS CONTROLLER - V.3

The Trio Plus controller was put into our production in March of 2004. The Trio Plus controller is called the V.3 Controller and is readily identified buy the Blue circuit board that it is built on. The V.3 controller replaced all controllers used across our entire line with Central Command II with the exception of the 390/420 line which still used the V.2 controller.

The V.3 controller was an evolutionary design that made improvements over the very capable V.2 controller

Improvements

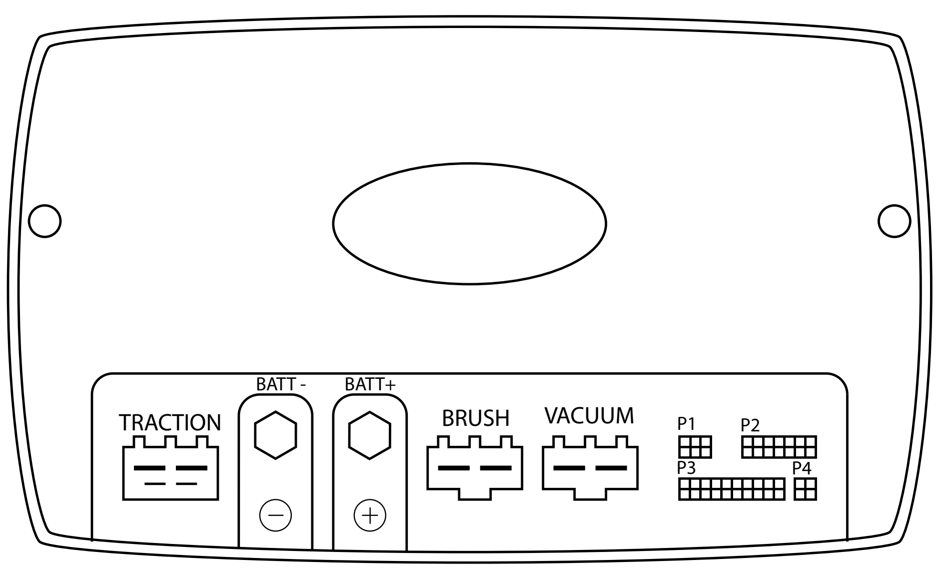
Better circuit protection - The V.3 controller was re engineered with faster response to current overload. This meant that when an overload occurred the controller could shut down the output before there was permanent damage to the controller in most situations.

Additional Relays - Additional relays were added to the circuit board to further protect the controller and the machine in the event of a controller failure or overload.

Improved Diagnostic codes - The diagnostic code list was expanded allowing the codes to be more specific in nature aiding in the diagnosis of a problem.

Limitations

With the improvements of the controller there was one limitation that arose with this controller. The new faster acting limiting circuitry worked across the board including on the traction drive circuit. This meant that the new controller did not climb hills as smoothly as the older V.2 controller on the very large 390/420 machines. For these machines the V.2 controller was still used until May of 2007



THE V.2 Controller has a “BLUE” circuit board.

FACTORY CAT

CENTRAL COMMAND II
V.3 SYSTEM DIAGNOSTIC CODES

TOMCAT

Code	Fault Description	Course of correction
0700	Bias Voltage Error	High reference signal is grounded
0701	Mid Rail Voltage High	
0702	Mid rail bias voltage high	
0704	12V supply failure	
0705	2.5 V reference error	
0706	High reference ground fault	
0810	Throttle High reference error	For all Throttle Diagnostic Codes
0811	Throttle Max Wiper Difference Error	Check throttle wiring for shorts or opens. Repair or replace as necessary.
0812	Throttle Max Pull Down Difference Error	If diagnostic code is not cleared, then replace the throttle potentiometer
0813	Throttle Max Pull Safe Difference Error	
0814	Throttle Reference Error	
0815	Throttle Lo Reference Error	
0816	Throttle Hi Reference ISO Error	
0817	Throttle Lo Reference ISO Error	
0818	Throttle Error: Both have Readings	
0A01	Power down error	Check the wiring to the the main power switch. This code indicates rapid power cycling
1310	Excessive Current Trip	Current Draw on Control exceeds maximum limit of 250 amps
		Resistance in the machine's Main Breaker and/or battery cable to control
		Gives a false reading to the control.
1311	Brush head actuator, excessive current	Device connected to the brush head actuator has exceeded maximum
		limit of 21 amps surge value and 7 amps continuous.
		Check that the arms are not too tight (torque = 25 inch lbs, almost finger
		loose). check that actuator system is not binding.
1312	Squeegee actuator, excessive current	Device connected to squeegee actuator (on riders) has exceeded max
		limit of 21 amps surge value and 7 amps continuous load.
		Check that the arms are not too tight (torque = 25 inch lbs, almost finger
		loose). check that actuator system is not binding.
1313	Solution valve circuit, excessive current	Current exceeded seven amps max. Check valve operation. Coil may
		be corroded, or short in wires.
1314	Soft Aux 4 Over current Occurred	Aux 4 is not used by us at this time.
1318	Soft Brake light Over current Occurred	Brake light circuit not used by us at this time.
131C	Backup Alarm Over current occurred	Backup alarm drew more than 2 amps max allowed. Check inline resistor
		on some models. If resistor is bad, remove it, and put piece of duct tape
		over speaker of alarm. (Reverse EMF from the echo is causing the problem)
1321	Aux 1 (Brush Actuator) Over current 2 Occurred	Brush actuator exceeded 12 amps for less than 0.1 sec.
		See notes for 1311
1322	Aux 2 (Squeegee Actuator) Over current 2 Occurred	Squeegee actuator exceeded 12 amps for less than 0.1 sec.
		See notes for 1312
1400	Bridge Fault 1 - Brush or traction motor not in correct voltage range.	Possible short between B+ and the high amperage outputs
1401	Bridge Fault 2 - Voltage difference on traction bridge too great	
1402	Brush Bridge Fault - Battery/Brush bridge voltage difference too great	
1411	Brush actuator positive wire is shorting	Find appropriate wire and remove short.
1412	Brush actuator negative wire is shorting	Find appropriate wire and remove short.
1413	Squeegee actuator positive wire is shorting	Find appropriate wire and remove short.
1414	Squeegee actuator negative wire is shorting	Find appropriate wire and remove short.
1500	Brake Fault - Solenoid brake circuit is open	Parking Brake is disconnected or coil of brake is open.
1501	Brake Fault - Solenoid brake circuit is shorted	Parking Brake coil or wiring is shorted.
1502	Brake Fault - Brake Over Current Error	Parking brake coil is shorted internally or wiring too it is shorted
1503	Solenoid brake driver fault	
1504	Solenoid brake interlock fault	
1507	Brake Over current	Parking Brake is drawing too much power. Check wiring and brake.
1600	High Battery Error	Battery voltage is too high. Batteries hooked up wrong, or still on charger.
1D02	Spec Change Trip	This is normal--comes up when you reprogram the control. Turn key off and
		on to reset the program.
1E03	Inhibit activated	Inhibit is power signal intended to turn off control. We don't use it.
1E04	Inhibit Activated 2	Inhibit is power signal intended to turn off control. We don't use it.
1E06	Inhibit Input Out of Range	Inhibit circuit voltage is too low or high to work. We don't use Inhibit.
2C00	Low Battery Error	Voltage in battery is too low (18 volts min on 24V system; 28V on 36V system)
2C01	Low Battery Error--2	Recharge the battery in either case. check voltage under load to see if bad
2C02	Battery lockout occurred	cell is pulling down voltage.
2C03	Battery Lockout occurred--2	
2F01	Throttle Displaced Error	Pedal was pushed before key turned on. Not a problem. Restart machine.
3A00	Bad Program Settings	You reprogrammed the control with settings that are not authorized.
3100	Low bridge voltage	Probable short circuit of output device or wiring
3101	Traction bridge fault	
3102	Brush/Vac bridge fault	
3103	Waiting for bridge to charge	
7000	Startup With Push Selected	Freewheel input signal selected at startup. Disconnect freewheel switch.

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REVISED :7/3/2007

FACTORY CAT

CENTRAL COMMAND II
V.3 SYSTEM DIAGNOSTIC CODES

TOMCAT

Code	Fault Description	Course of correction
7001	Push Activated in Drive Mode	Freewheel input signal activated while driving. Disconnect freewheel switch.
		NOTE: As of this reading, we do not use Freewheel. This permits pushing
		machine more easily by disconnecting traction motor from control.
7500	Throttle Comms Time Out	Problem with LCD dash module or with wiring to it. Check and replace as necessary.
7501	LCD Module settings corrupt	Disconnect batteries and wait 2 minutes to reconnect
7600	Brush motor not connected	Check for open circuit
7601	Soft Brush Current Fold back	Too much load on brush motor. May be from hitting a bump or wire tangled in
		brush drive mechanism. Possible wiring or brush motor short.
7602	Soft Brush Current Foldback--2	Same as above.
7603	Soft Brush Current Foldback--3	Same as above.
7604	Brush Inhibit is on	We do not use Brush Inhibit at this time.
7605	Brush startup over current detection	You may have started brushes on carpet or rubber or other high resistance material.
		This may have stalled motor before actuator could react to lift brush head up.
		If chronic problem, call Factory to discuss reprogramming machine for application.
7700	Soft Vacuum Motor Disconnected Error	Check wiring to vac motor. On 390, check wiring to Hella relay for vac motor
7701	Vac Motor Current Fold back	Too much amp load on vac circuit. Check wiring. May come from picking up
		large column of water.
7702	Soft Vacuum Current Foldback--2	Same as above
7703	Soft Vacuum Current Foldback--3	Same as above
7800	Traction Motor Fault No. 1	Check traction motor wiring and connectors. Include connector at steering pivot under
		floor cover!
7801	Traction Motor Over current Error	Too much current due to bad motor or wiring to motor.
7802	Soft Traction Motor in Fold back State	Traction motor being overloaded, or ramp climbing that took longer than 60 seconds.
		(Fold back means normal low amp setting to motor. There is one minute ramp climbing
		surge that may be 4 times as high as the fold back rate).
7803	Motor Line Voltages Instability Timeout	May be loose wire at motor or at control. Possible motor problem
7880	Traction Speed Input Out of Range	Throttle setting wrong for motor speed. Check throttle pot. and wiring.
7900	Emergency Stop Error	Emergency Stop Button is Actuated when you tried to move. Optional button.
7901	Soft Belly Button Actuated	Belly Button Switch activated. We don't use this.
8000	Service Mode	Service Timer Limits have been reached. We don't normally use them; they are
		dealer option.
9000	Brushes not fitted	Check brush deck to make sure brushes are on, and on securely.
0003	Possible terminal short in system	For all of these Diagnostic Codes:
0100		1. Turn off keyswitch and disconnect battery for two minutes, using your watch to
0204		measure time.
0705		2. When you reconnect battery, you must see a spark. This shows the control's
0706		on-board capacitor has been discharged and has been refilled.
0A01		3. Restore the battery connection. Make sure battery cable is on tight before trying
0B02		machine or you could burn battery posts and cable.
1704		4. Turn on machine. If diagnostic code still shows, then replace the control.
1705		
1706		
1800		
1802		
1B20		
1B21		
2102		
2103		
2D01		
3100		
3101		
3102		
3103		
3104		
3105		
3200		
3201		
3210		
3211		
3212		
3213		
3214		
3601		
3602		
3603		
3608		
3609		
360a		
360b		
360d		
360e		
7501		

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TRIO PLUS HD CONTROLLER - V.4

The Trio Plus HD controller called the V.4. This controller is easily identified by all of the high amp terminals being the lug style terminals.

The V.4 controller was another evolutionary design from the V.2 and V.3 controls with marked improvement.

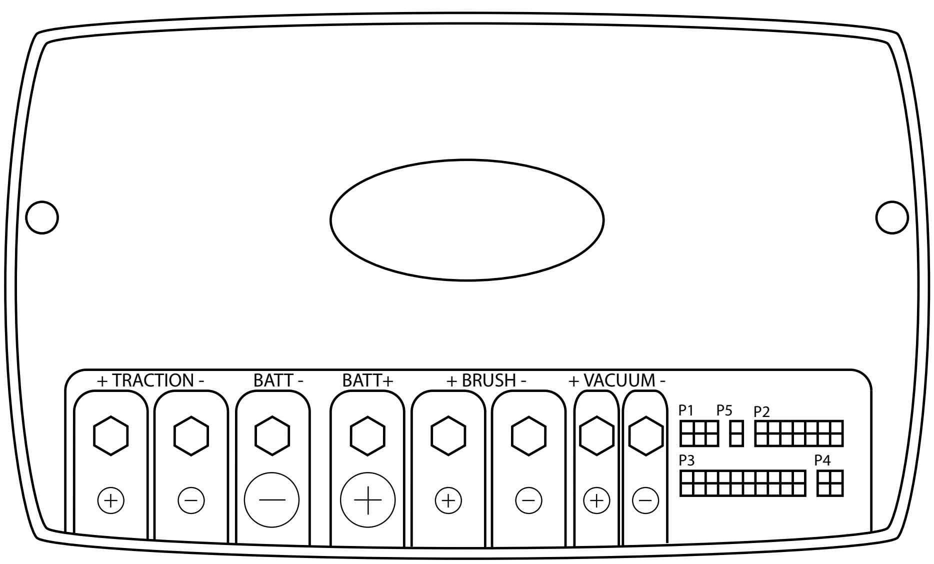
Improvements

Boost Mode- The V.4 controller has new software that allows the machine to safely climb ramps better than the V.2 or V.3 controller. This is done with a “Boost Mode” that allows a high amp output for a given amount of time and then not allowing the controller to climb again for a predetermined amount of time to assure that the drive motor does not over heat and become damaged.

Lug Terminals - All of the high amp outputs are lug style terminals. These terminals provide more dependable higher quality connection for the wiring. These connections also make in field wiring repairs easier on these machines.

Extended Code List - An even more extensive code list was created for the V.4 controllers breaking the diagnostic codes down into more specific faults.

Backwards Compatibility - The V.4 controller is backward compatible for replacement on all of our machines with central command II.



THE V.4 controller has all luged high amp output terminals.

FACTORY CAT

CENTRAL COMMAND II
V.3 SYSTEM DIAGNOSTIC CODES

TOMCAT

Code	Fault Description	Course of correction
0700	Bias Voltage Error	High reference signal is grounded
0701	Mid Rail Voltage High	
0702	Mid rail bias voltage high	
0704	12V supply failure	
0705	2.5 V reference error	
0706	High reference ground fault	
0810	Throttle High reference error	For all Throttle Diagnostic Codes
0811	Throttle Max Wiper Difference Error	Check throttle wiring for shorts or opens. Repair or replace as necessary.
0812	Throttle Max Pull Down Difference Error	If diagnostic code is not cleared, then replace the throttle potentiometer
0813	Throttle Max Pull Safe Difference Error	
0814	Throttle Reference Error	
0815	Throttle Lo Reference Error	
0816	Throttle Hi Reference ISO Error	
0817	Throttle Lo Reference ISO Error	
0818	Throttle Error: Both have Readings	
0A01	Power down error	Check the wiring to the the main power switch. This code indicates rapid power cycling
1310	Excessive Current Trip	Current Draw on Control exceeds maximum limit of 250 amps
		Resistance in the machine's Main Breaker and/or battery cable to control
		Gives a false reading to the control.
1311	Brush head actuator, excessive current	Device connected to the brush head actuator has exceeded maximum
		limit of 21 amps surge value and 7 amps continuous.
		Check that the arms are not too tight (torque = 25 inch lbs, almost finger
		loose). check that actuator system is not binding.
1312	Squeegee actuator, excessive current	Device connected to squeegee actuator (on riders) has exceeded max
		limit of 21 amps surge value and 7 amps continuous load.
		Check that the arms are not too tight (torque = 25 inch lbs, almost finger
		loose). check that actuator system is not binding.
1313	Solution valve circuit, excessive current	Current exceeded seven amps max. Check valve operation. Coil may
		be corroded, or short in wires.
1314	Soft Aux 4 Over current Occurred	Aux 4 is not used by us at this time.
1318	Soft Brake light Over current Occurred	Brake light circuit not used by us at this time.
131C	Backup Alarm Over current occurred	Backup alarm drew more than 2 amps max allowed. Check inline resistor
		on some models. If resistor is bad, remove it, and put piece of duct tape
		over speaker of alarm. (Reverse EMF from the echo is causing the problem)
1321	Aux 1 (Brush Actuator) Over current 2 Occurred	Brush actuator exceeded 12 amps for less than 0.1 sec.
		See notes for 1311
1322	Aux 2 (Squeegee Actuator) Over current 2 Occurred	Squeegee actuator exceeded 12 amps for less than 0.1 sec.
		See notes for 1312
1400	Bridge Fault 1 - Brush or traction motor not in correct voltage range.	Possible short between B+ and the high amperage outputs
1401	Bridge Fault 2 - Voltage difference on traction bridge too great	
1402	Brush Bridge Fault - Battery/Brush bridge voltage difference too great	
1411	Brush actuator positive wire is shorting	Find appropriate wire and remove short.
1412	Brush actuator negative wire is shorting	Find appropriate wire and remove short.
1413	Squeegee actuator positive wire is shorting	Find appropriate wire and remove short.
1414	Squeegee actuator negative wire is shorting	Find appropriate wire and remove short.
1500	Brake Fault - Solenoid brake circuit is open	Parking Brake is disconnected or coil of brake is open.
1501	Brake Fault - Solenoid brake circuit is shorted	Parking Brake coil or wiring is shorted.
1502	Brake Fault - Brake Over Current Error	Parking brake coil is shorted internally or wiring too it is shorted
1503	Solenoid brake driver fault	
1504	Solenoid brake interlock fault	
1507	Brake Over current	Parking Brake is drawing too much power. Check wiring and brake.
1600	High Battery Error	Battery voltage is too high. Batteries hooked up wrong, or still on charger.
1D02	Spec Change Trip	This is normal--comes up when you reprogram the control. Turn key off and
		on to reset the program.
1E03	Inhibit activated	Inhibit is power signal intended to turn off control. We don't use it.
1E04	Inhibit Activated 2	Inhibit is power signal intended to turn off control. We don't use it.
1E06	Inhibit Input Out of Range	Inhibit circuit voltage is too low or high to work. We don't use Inhibit.
2C00	Low Battery Error	Voltage in battery is too low (18 volts min on 24V system; 28V on 36V system)
2C01	Low Battery Error--2	Recharge the battery in either case. check voltage under load to see if bad
2C02	Battery lockout occurred	cell is pulling down voltage.
2C03	Battery Lockout occurred--2	
2F01	Throttle Displaced Error	Pedal was pushed before key turned on. Not a problem. Restart machine.
3A00	Bad Program Settings	You reprogrammed the control with settings that are not authorized.
3100	Low bridge voltage	Probable short circuit of output device or wiring
3101	Traction bridge fault	
3102	Brush/Vac bridge fault	
3103	Waiting for bridge to charge	
7000	Startup With Push Selected	Freewheel input signal selected at startup. Disconnect freewheel switch.

FORM 10003

1 OF 2

REVISED :7/3/2007

FACTORY CAT

CENTRAL COMMAND II
V.3 SYSTEM DIAGNOSTIC CODES

TOMCAT

Code	Fault Description	Course of correction
7001	Push Activated in Drive Mode	Freewheel input signal activated while driving. Disconnect freewheel switch.
		NOTE: As of this reading, we do not use Freewheel. This permits pushing
		machine more easily by disconnecting traction motor from control.
7500	Throttle Comms Time Out	Problem with LCD dash module or with wiring to it. Check and replace as necessary.
7501	LCD Module settings corrupt	Disconnect batteries and wait 2 minutes to reconnect
7600	Brush motor not connected	Check for open circuit
7601	Soft Brush Current Fold back	Too much load on brush motor. May be from hitting a bump or wire tangled in
		brush drive mechanism. Possible wiring or brush motor short.
7602	Soft Brush Current Foldback--2	Same as above.
7603	Soft Brush Current Foldback--3	Same as above.
7604	Brush Inhibit is on	We do not use Brush Inhibit at this time.
7605	Brush startup over current detection	You may have started brushes on carpet or rubber or other high resistance material.
		This may have stalled motor before actuator could react to lift brush head up.
		If chronic problem, call Factory to discuss reprogramming machine for application.
7700	Soft Vacuum Motor Disconnected Error	Check wiring to vac motor. On 390, check wiring to Hella relay for vac motor
7701	Vac Motor Current Fold back	Too much amp load on vac circuit. Check wiring. May come from picking up
		large column of water.
7702	Soft Vacuum Current Foldback--2	Same as above
7703	Soft Vacuum Current Foldback--3	Same as above
7800	Traction Motor Fault No. 1	Check traction motor wiring and connectors. Include connector at steering pivot under
		floor cover!
7801	Traction Motor Over current Error	Too much current due to bad motor or wiring to motor.
7802	Soft Traction Motor in Fold back State	Traction motor being overloaded, or ramp climbing that took longer than 60 seconds.
		(Fold back means normal low amp setting to motor. There is one minute ramp climbing
		surge that may be 4 times as high as the fold back rate).
7803	Motor Line Voltages Instability Timeout	May be loose wire at motor or at control. Possible motor problem
7880	Traction Speed Input Out of Range	Throttle setting wrong for motor speed. Check throttle pot. and wiring.
7900	Emergency Stop Error	Emergency Stop Button is Actuated when you tried to move. Optional button.
7901	Soft Belly Button Actuated	Belly Button Switch activated. We don't use this.
8000	Service Mode	Service Timer Limits have been reached. We don't normally use them; they are
		dealer option.
9000	Brushes not fitted	Check brush deck to make sure brushes are on, and on securely.
0003	Possible terminal short in system	For all of these Diagnostic Codes:
0100		1. Turn off keyswitch and disconnect battery for two minutes, using your watch to
0204		measure time.
0705		2. When you reconnect battery, you must see a spark. This shows the control's
0706		on-board capacitor has been discharged and has been refilled.
0A01		3. Restore the battery connection. Make sure battery cable is on tight before trying
0B02		machine or you could burn battery posts and cable.
1704		4. Turn on machine. If diagnostic code still shows, then replace the control.
1705		
1706		
1800		
1802		
1B20		
1B21		
2102		
2103		
2D01		
3100		
3101		
3102		
3103		
3104		
3105		
3200		
3201		
3210		
3211		
3212		
3213		
3214		
3601		
3602		
3603		
3608		
3609		
360a		
360b		
360d		
360e		
7501		

FORM 10003

2 OF 2

REVISED :7/3/2007

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TRIO PROGRAMMING

We use the same controllers on nearly all of our machines. The controller's embedded computer needs a set of instructions to operate the machine. The instructions are the program the computer runs and we can modify this program by changing it's "parameters". This is what makes it possible to use the same controller in most of our machines but have each one of them react differently. By changing these parameters we can make the piece of equipment function in different ways. An example of this is by changing the parameters we can make brush deck of a machine drop to the floor when the machine starts scrubbing and then pick itself up when the machine stops. If we adjusted another parameter we could make the brushes raise up when the machine went in reverse without having the operator manipulate a switch. In order to change the parameters in a controller a T-194 programing kit is necessary. With a laptop computer and the programming kit access can be gained to the parameters of the machine and they can be modified to make the machine react differently.

The controller has 135 parameters that can be modified through programming. To program the controller a programming kit and special software are necessary. The kit for this is available from the factory. The part number for the kit is T-194 and it includes the following:

1	Central Command II Programmer CD
1	Controller computer interface cable
1	USB serial port adapter
1	Controller protected power cable
1	Jumper key
1	Latest version of the Electrical Service Guide
1	T-194 programming guide
1	Aluminum briefcase

This kit is required to make any changes in the program for the computer.

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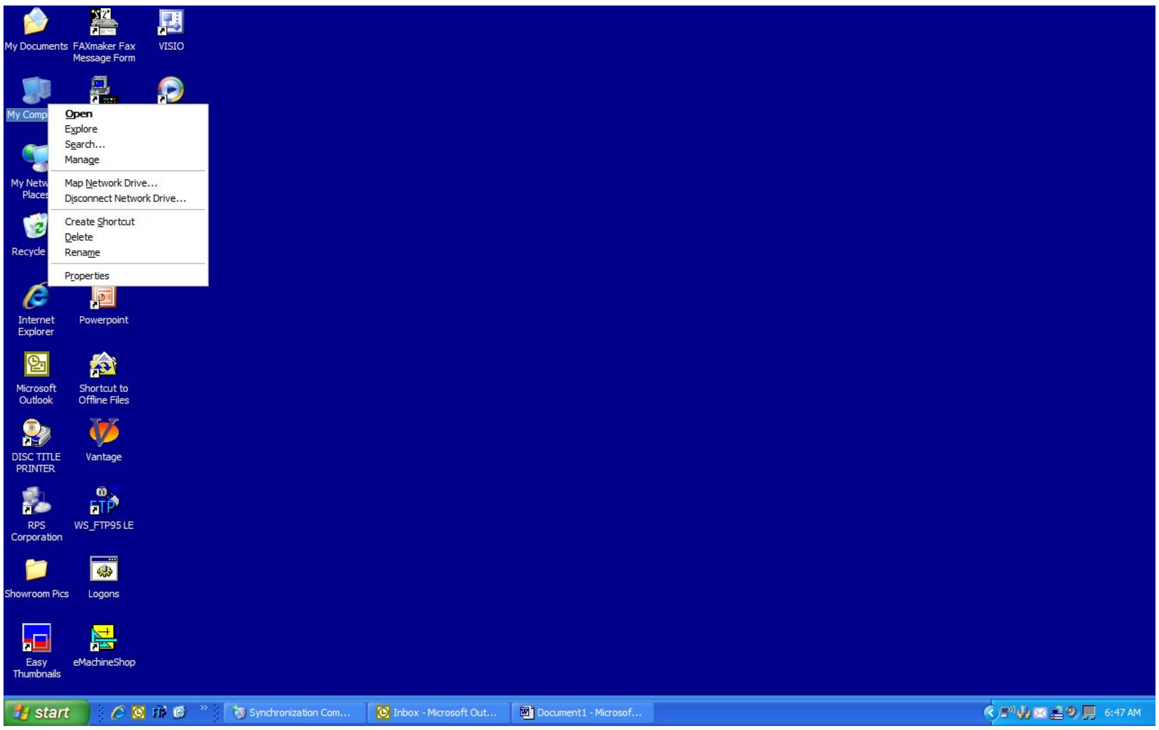
PROGRAMMING THE CONTROLLER

1. Start your computer.

2. Plug in the Belkin USB adapter with the programming cable attached

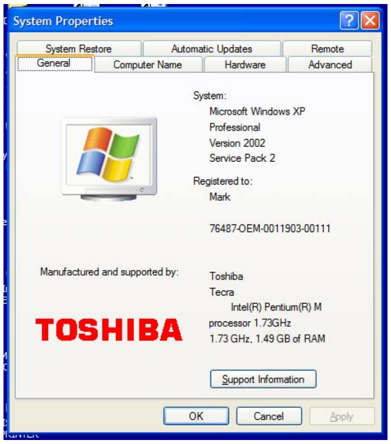
3. Move your cursor over “My Computer”

4. [Right Click] your mouse button while your cursor is over “My Computer”

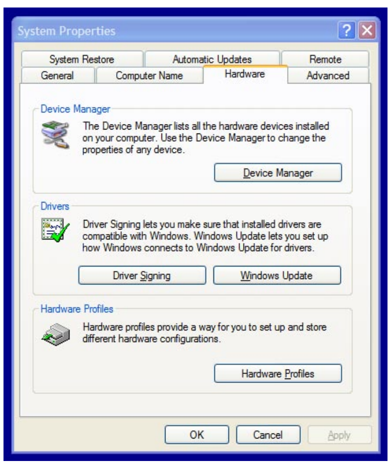


5. [Left Click] on “Properties” from the bottom of the drop down menu.

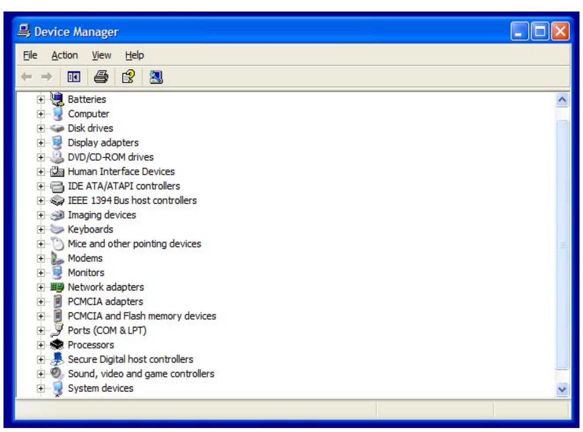
6. The “System Properties” windows will appear [Left Click] on the “Hardware Tab”



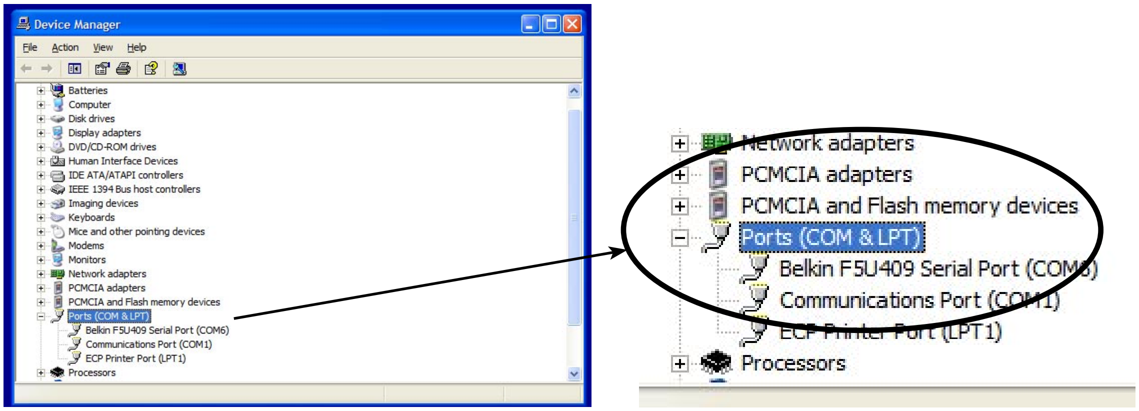
7. [Left Click] on the “Device Manager” button.



8. [Left Click] on the “+” symbol on the left side of the word “Ports (COM & LPT)”



9. Observe the COM port number listed next to the words “Belkin F5U409 Serial Port”

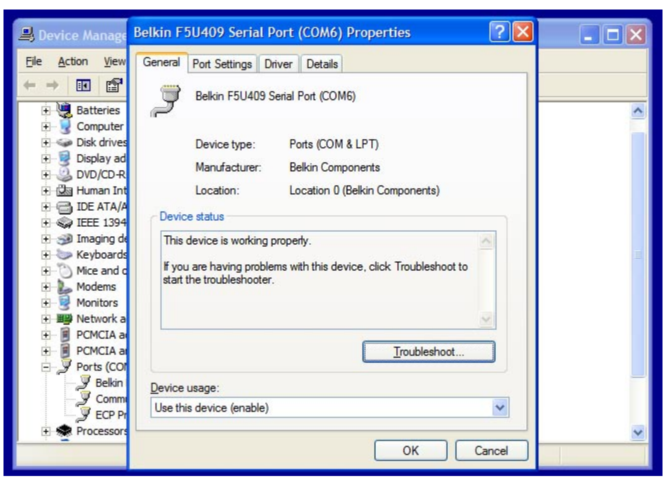


10. If the port listed is “(COM6)” or lower, record the COM# and close out all windows and then proceed to step 23.

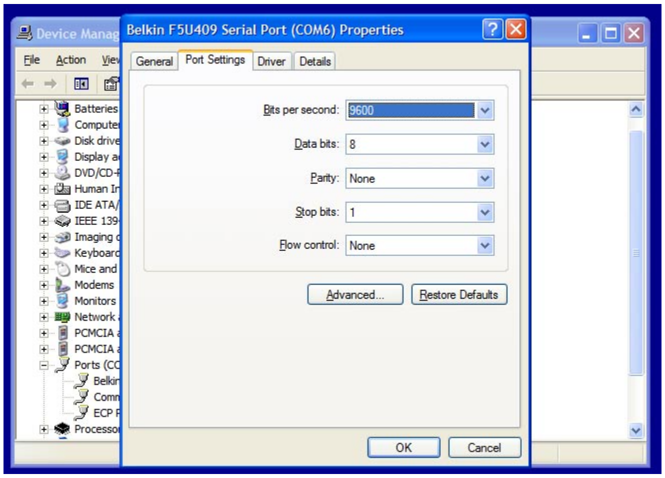
11. If the port listed is higher than (COM6) you must manually reset the port number as follows.

12. Double “Left Click” on words “Belkin F5U409 Serial Port (COM#)”

13. The “Belkin F5U409 Serial Port (Com#) Properties” window will show.

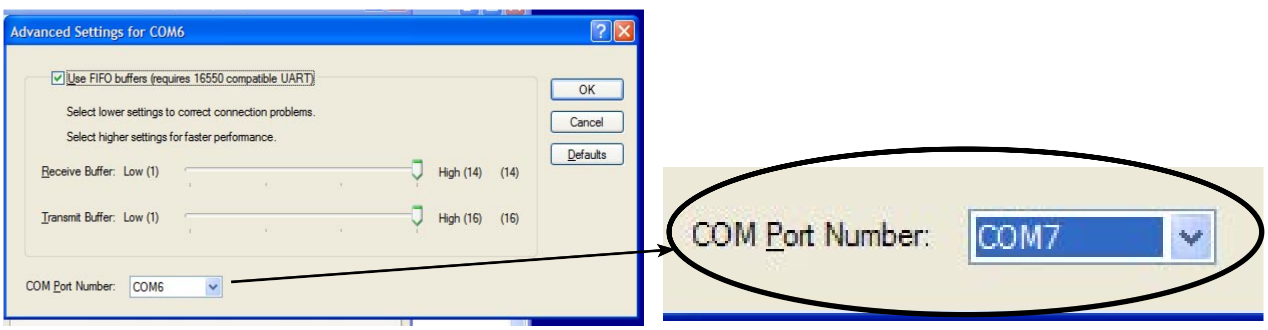


14. [Left Click] on the “Port Settings” tab.



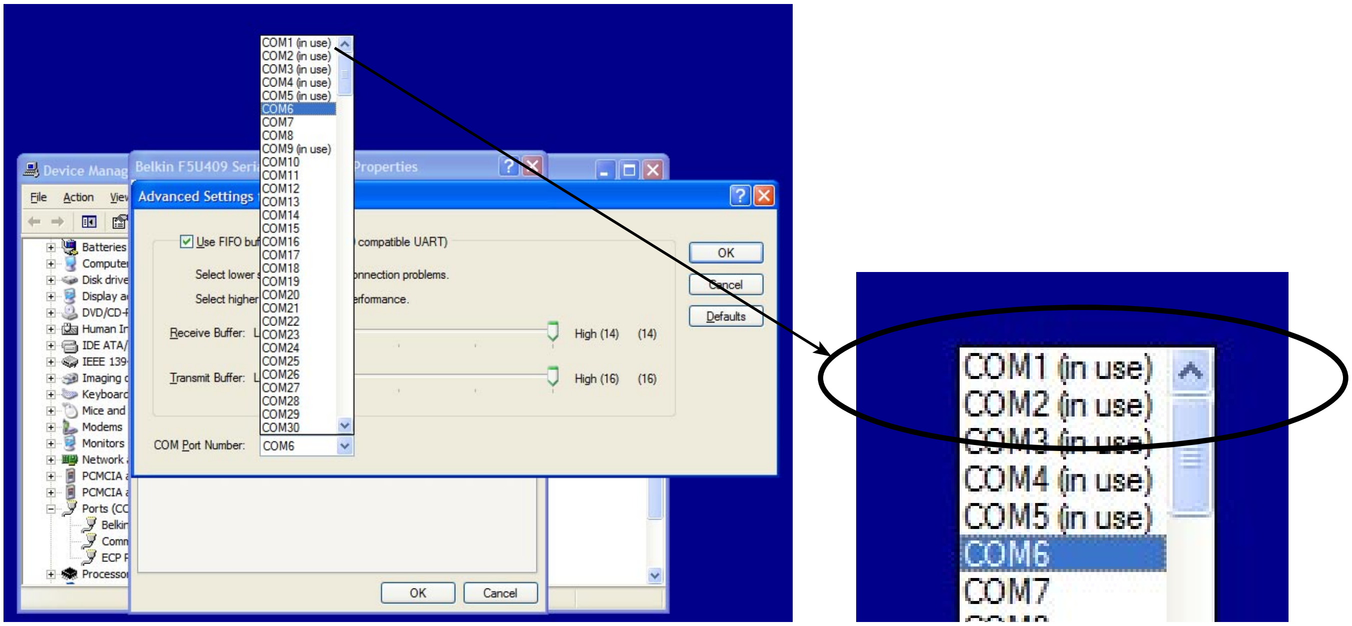
15. [Left Click] on the “Advanced...” button.

16. The “Advanced Settings for Com#” window will show.

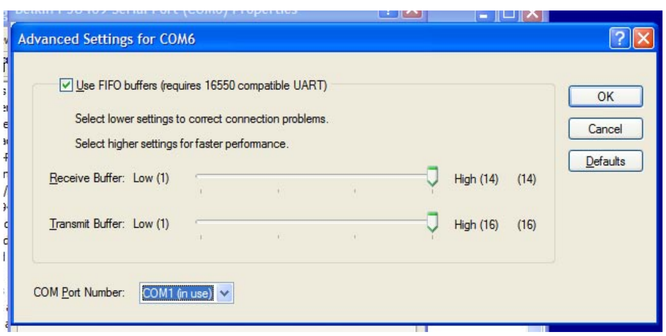


17. [Left Click] on the drop down arrow next to the com port listing.

18. The following drop down list will appear. [Left Click] on “COM1”
    It may or may not be followed by “(in use)”

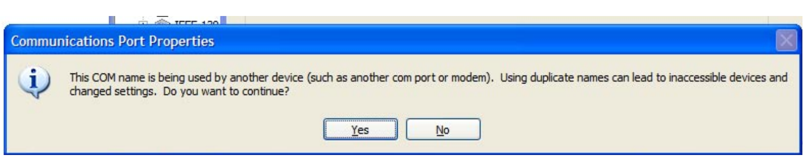


19. The window will then look like below. [Left Click] on the “OK” button.



20. The following window may or may not appear. “Communications Port Properties”

21. If it does appear [Left Click] on the “Yes” button.

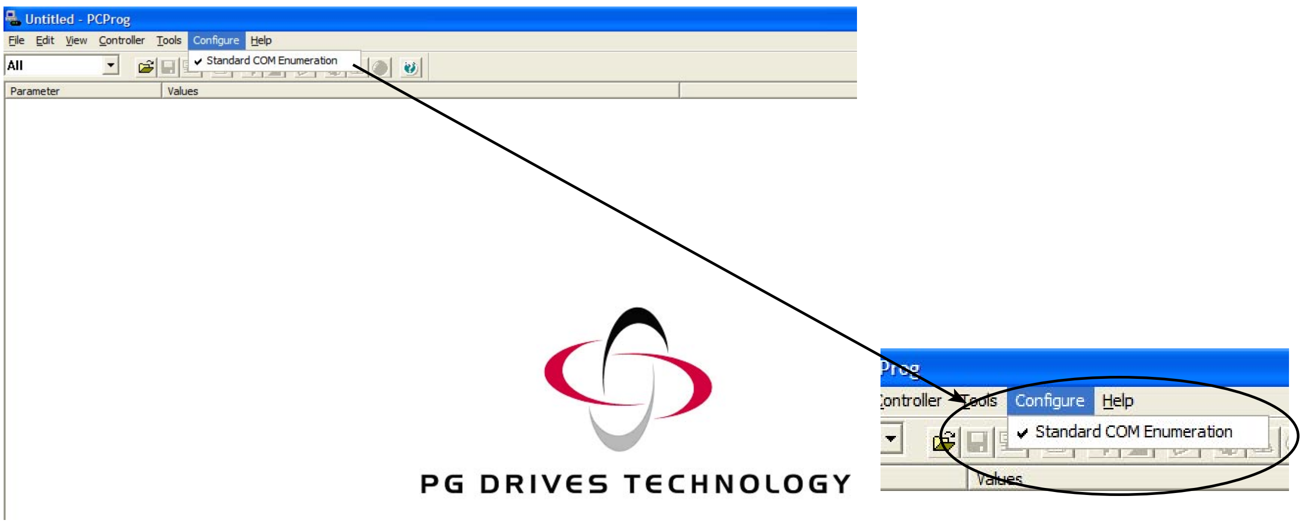


22. Close out all remaining windows.

23. Open INDUSTRIAL/PC Programmer

24. When you open INDUSTRIAL/PC Programmer you may get an error window that says “Can’t open Serial port” click the “OK” button.

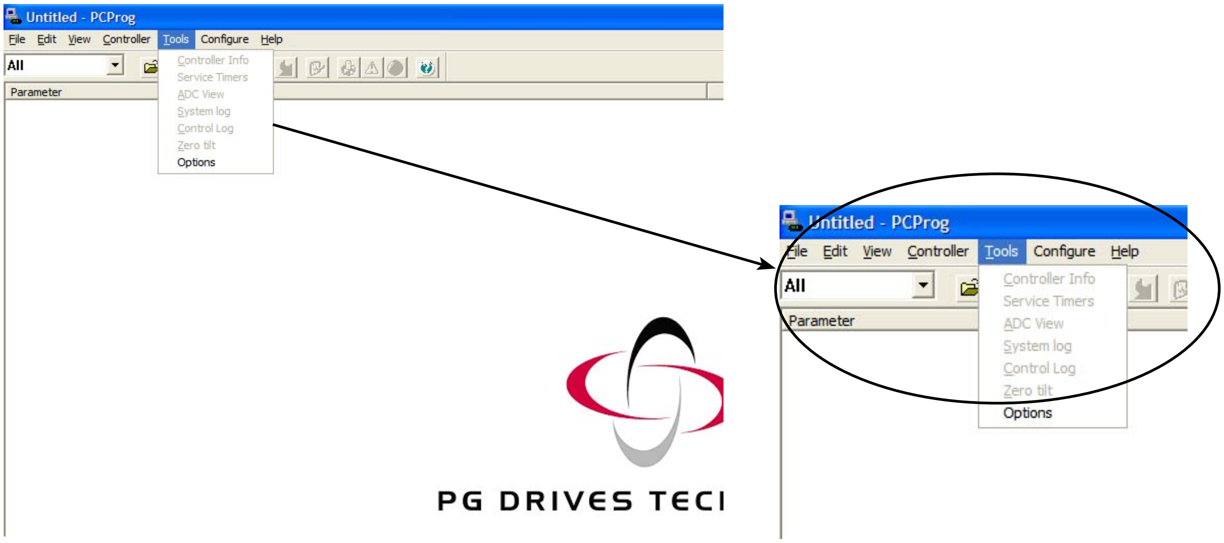
25. When the “Industrial Programmer” window opens up click on the “Configure” tab on the top of the window.



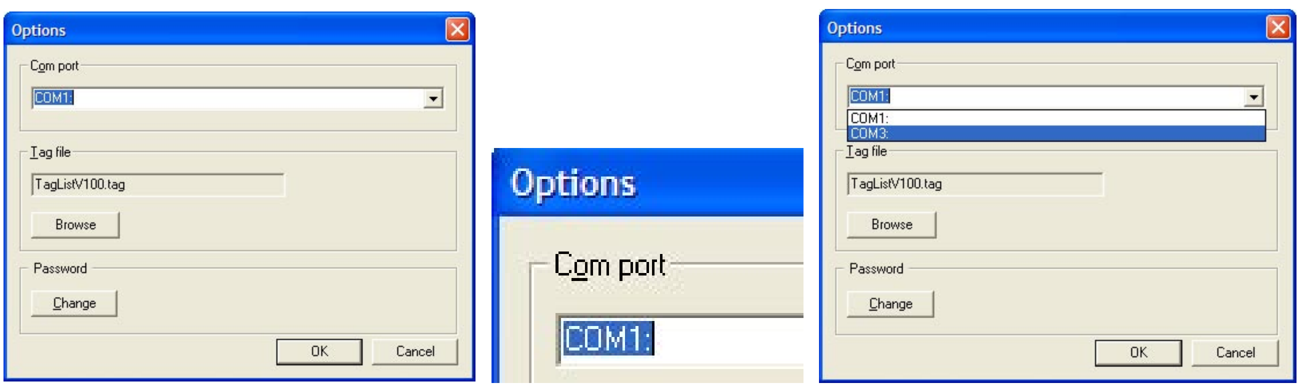
26. You do not want the check mark next to the “Standard COM Enumeration”. If there is a check mark there click on the check mark and it will go away.

27. Click on the “Tools” tab on the top of the window.

28. [Left Click] on “Options” on the drop down menu.



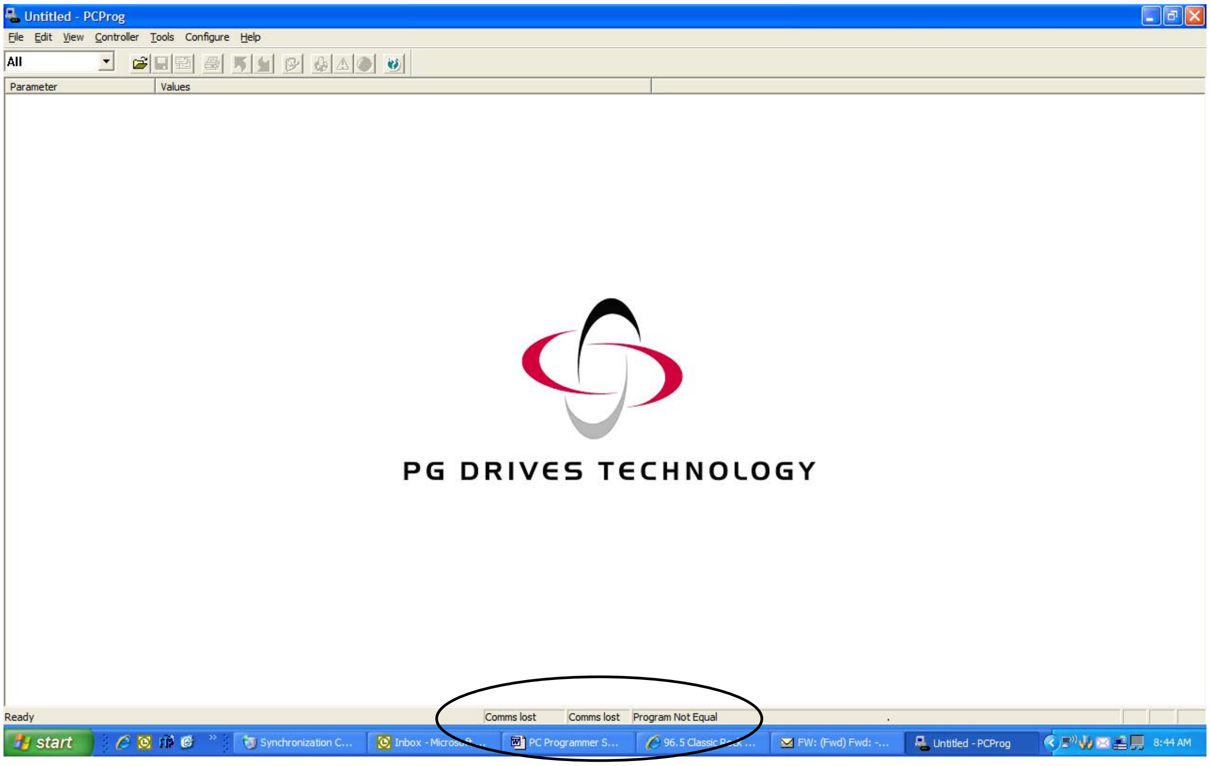
29. The following window will show after the [Left Click]. Observe the “Com port” listed in this window. If the “Com port” listed is the same as the one you recorded earlier then [Left Click] on the “OK “ button. If it does not match then [Left Click] on the drop down arrow to the right of the “Com port” listed. [Left Click] on the corresponding COM # to the one you recorded earlier. Then [Left Click] on the “OK” button.



30. With the power turned off on the machine plug he programming cable into the controller.

31. Turn on power to the machine.

32. Watch at the bottom of the Industrial Programmer window for the place where it says "Comms lost" to change to OK. When this occurs the link is established between the computer and the controller.

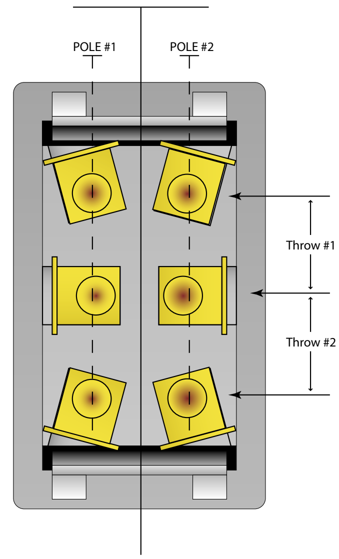


33. If the controller will not link up to your computer call the factory @ 1-800-634-4060

COMPONENTS

SWITCHES

We use a number of different switches on our machines. Many of them look very similar on the outside but it is the configuration of the contacts inside that makes them function differently.

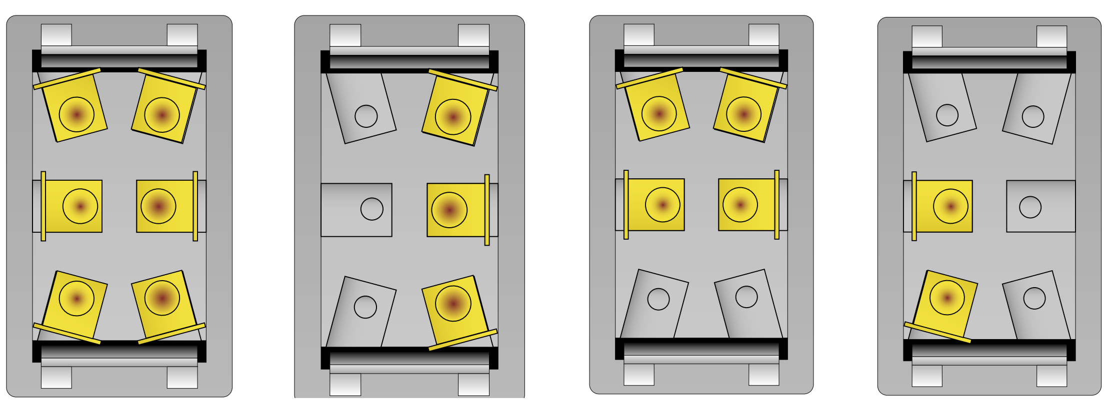


Switches are defined in 3 ways; poles, throws and action.
A POLE refers to the number of cirrcuits in a switch.
A THROW refers to the number of ways a pole can connect.
The ACTION is how a switch responds to being moved. It can either creata a momentary contact or a maintained contact.

Poles:
SINGLE pole allows 1 circuit to be switched (***SP***ST)
Double poles allow 2 circuits to be switched (***DP***ST)

Throws
Single Throw (SP***ST***)
Double Throw (SP***DT***)

TYPICAL SWITCH CONTACT CONFIGURATIONS



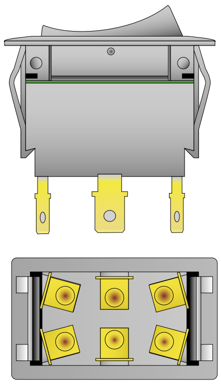
DPDT
DOUBLE POLE
DOUBLE THROW

SPDT
SINGLE POLE
DOUBLE THROW

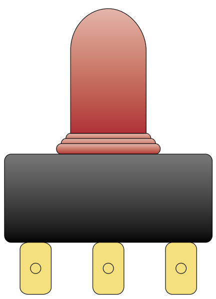
DPST
DOUBLE POLE
SINGLE THROW

SPST
SINGLE POLE
SINGLE THROW

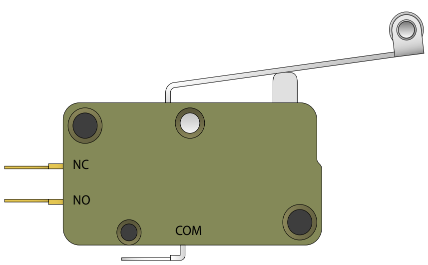
ROCKER SWITCHES

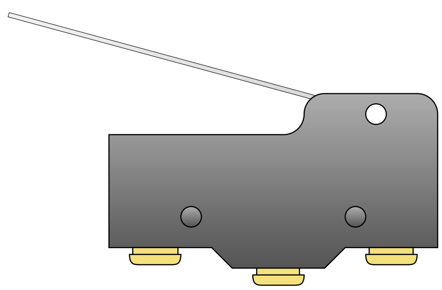


TOGGLE SWITCHES



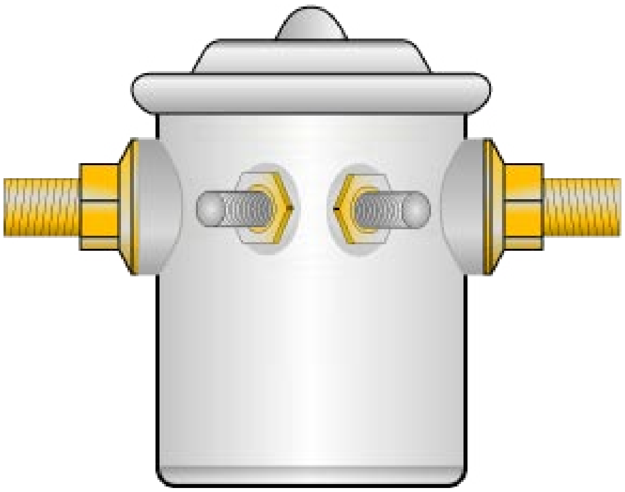
LIMIT SWITCHES

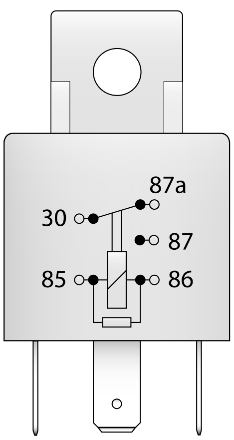




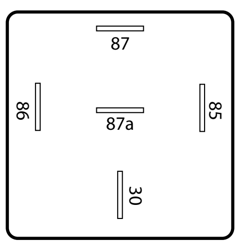
RELAYS

In our machines we use relays which are also refered to as contactors and solenoids.

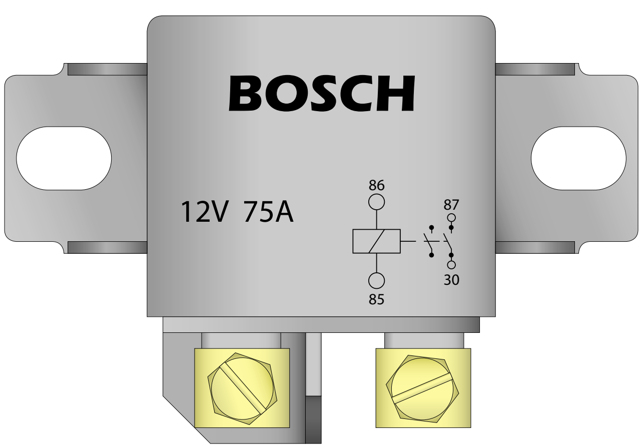




COIL SECTION
85 COIL LEAD
86 COIL LEAD



SWITCH SECTION
30 COMMON
87 NORMALLY OPEN
87a NORMALLY CLOSED



DIODES

Diodes are devices that only allow electricity to flow in one dorection. We use 2 types of diodes on our equpment. Supression diodes and bridge rectifier diodes.

Testing diodes.
There are two methods of testing diodes. The first is with a meter with a diode checking function and the second is with a meter without a integrated diode checker.

For meters with a Diode Checker:
Set the meter to the diode checker range.
Test the diode in one direction and then the other direction.
You should hear the beeper sound in on direction and then not the other.

For meters without a diode checker funcion:
Set your meter to the DC volts seting.
Attach the black meter lead on the (-) battery terminal.
Attach the red meter lead to one diode lead. Touch the other diode lead to (+) battery terminal. Revers the diode and repeat the proceedure. You should seee voltage in one direction but not in the other. If you see voltage in both directions or in neither direction the diode is bad.

RESISTORS

Resistors are devices that reduce the flow of electricity. We use them in our machines to reduce the voltage going to certain componenets.

TERMINALS

We use a number of different terminals on our equipment. We use traditional insulated terminals, bare terminals for battery cables and Molex terminals.

Insulated Terminals

Bare Terminals

Molex Terminals

BATTERY CHARGERS

A number of different types of battery chargers are used on our equipment. They are Ferro Resonnant, Linear Wound, SCR and High Frequency chargers. Each one has it's own virtues and therefore is used is different scenarios.

FERRO- RESONANT

These are

Ferro-Resonant Brands
- Power Cat
- Lester
- Ferro Five
- M.A.C.

LINEAR

These are

Linear Wound
- Quick Charge

SCR

These are
- Lester Electric

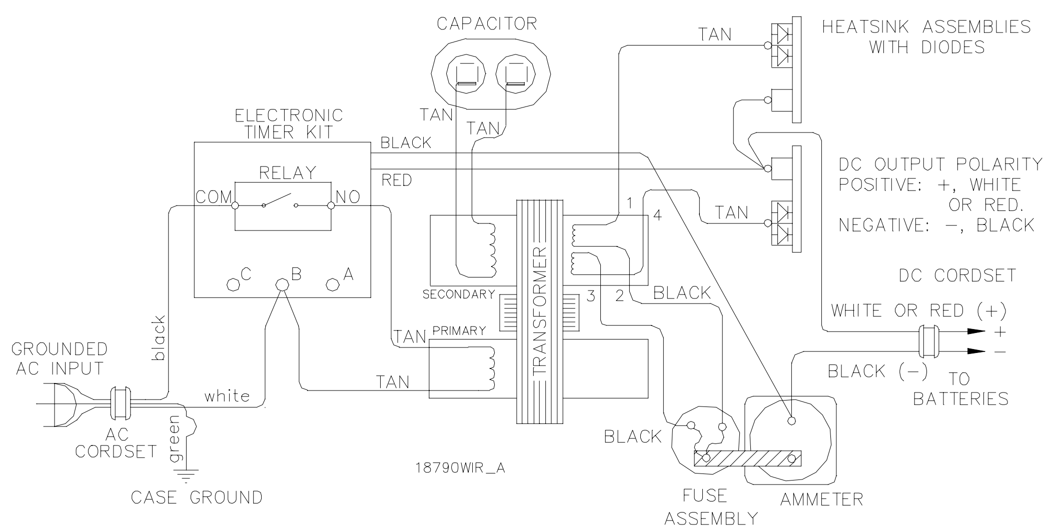
HIGH-FREQUENCY

These are
- SPE

POWER CAT
LESTER

7-243 CHARGER PARTS LIST

WIRING DIAGRAM

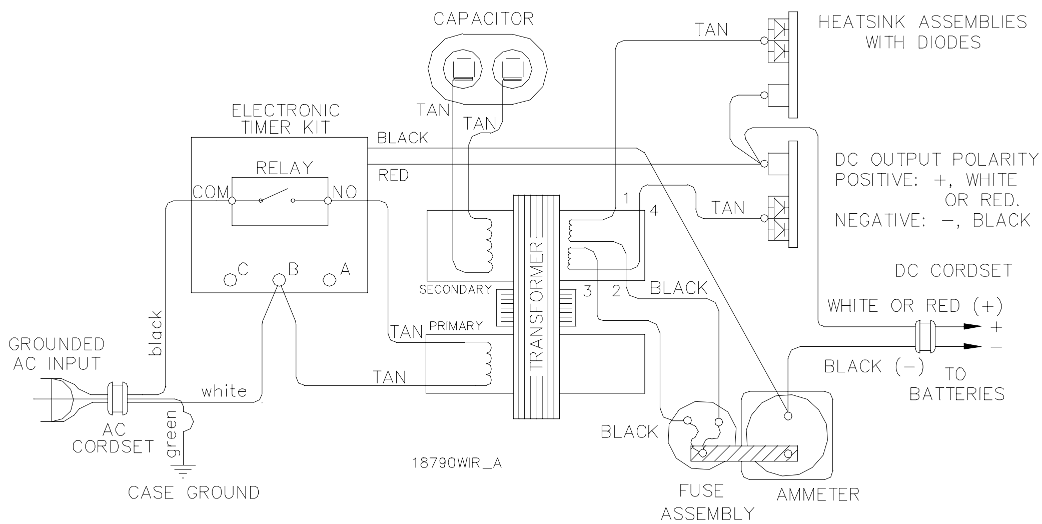


PARTS LIST FOR POWERCAT CHARGER
PART# 7-243
115 VAC / 60 HZ
24 VDC 36A

PART NO.	QTY.	DESCRIPTION
7-244A	1	CASE ASSEMBLY
7-224TR	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6 MFD, 660 VAC
7-244H	2	HEATSINK ASSEMBLY W/ 2 DIODES IN PARALLEL
7-244F	1	FUSE ASSEMBLY
7-244G	1	AMMETER, 50 AMP, W/ CORNER MOUNTING STUDS
7-244T	1	ELECTRONIC, TIMER ASSEMBLY
7-244C	1	CORDSET BUSHING, 7W-2, FOR INPUT CORDSET
7-244D	1	CORDSET BUSHING, 8P-2, FOR OUTPUT CORDSET
7-244E	1	AC CORDSET, 14/3, 86" W/ 125V/15A PLUG
7-244J	1	DC CORDSET, 10/2, 108", W/ SB50 RED PLUG
7-244K	1	DC CORDSET, 10/2, 108", W/ SB175 RED PLUG

7-244 CHARGER PARTS LIST

WIRING DIAGRAM

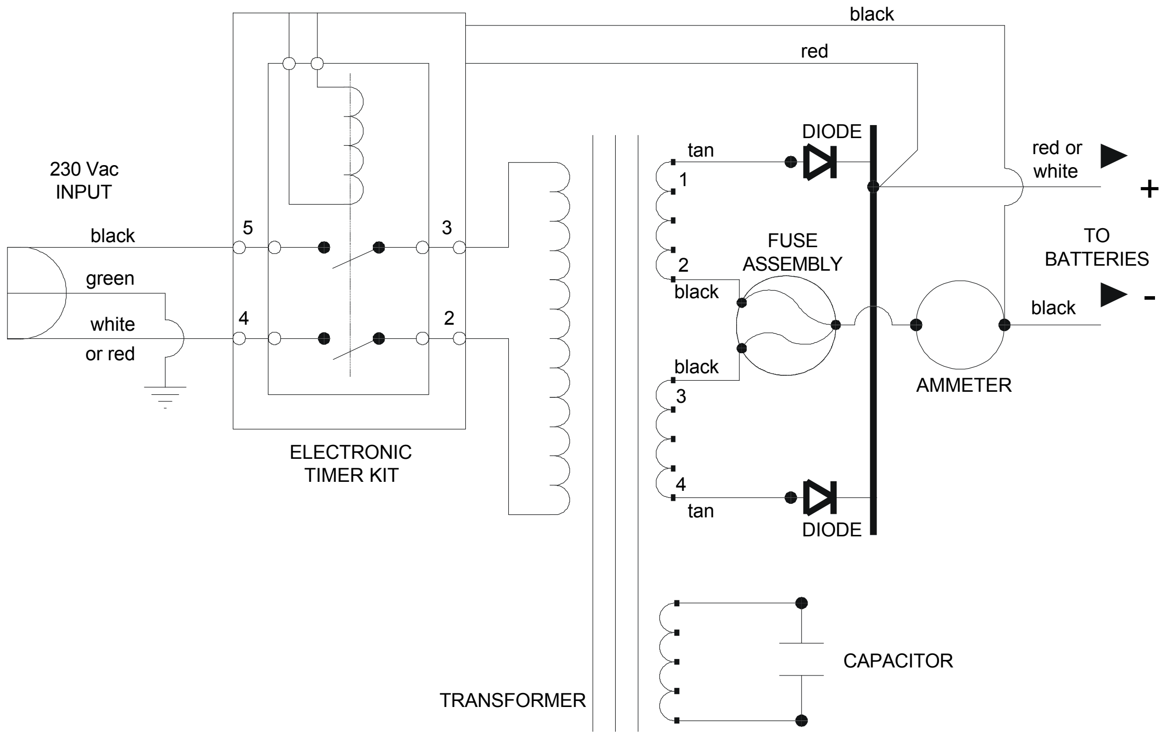


PARTS LIST FOR POWERCAT CHARGER
PART# 7-243
115 VAC / 60 HZ
24 VDC 36A

PART NO.	QTY.	DESCRIPTION
7-244A	1	CASE ASSEMBLY
7-224TR	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6 MFD, 660 VAC
7-244H	2	HEATSINK ASSEMBLY W/ 2 DIODES IN PARALLEL
7-244F	1	FUSE ASSEMBLY
7-244G	1	AMMETER, 50 AMP, W/ CORNER MOUNTING STUDS
7-244T	1	ELECTRONIC, TIMER ASSEMBLY
7-244C	1	CORDSET BUSHING, 7W-2, FOR INPUT CORDSET
7-244D	1	CORDSET BUSHING, 8P-2, FOR OUTPUT CORDSET
7-244E	1	AC CORDSET, 14/3, 86" W/ 125V/15A PLUG
7-244J	1	DC CORDSET, 10/2, 108", W/ SB50 RED PLUG
7-244K	1	DC CORDSET, 10/2, 108", W/ SB175 RED PLUG

7-251 CHARGER PARTS LIST

WIRING DIAGRAM



PARTS LIST FOR POWER CAT CHARGER
PART# 7-251
230 VAC 50 HZ
24 VDC 40 A

PART NO.	QTY.	DESCRIPTION
7-251TR	1	TRANSFORMER ASSEMBLY
7-251HS	1	HEATSINK ASSEMBLY, W/ DIODES
7-251N	1	DIODE ASSEMBLY
7-251G	1	AMMETER
7-251T	1	ELECTRONIC TIMER ASSEMBLY (RELAY-03861)
7-244B	1	CAPACITOR, 6.0 MFD, 660 VAC
7-251C	1	BUSHING, USR400, INSULATOR FOR AC CORD
7-251D	1	BUSHING, 9P-2, INSULATOR FOR DC CORD
7-244D	1	BUSHING, 8P-2, INSULATOR FOR DC CORD
7-251L	1	CORDSET, AC, 1.0mm 2 /3, 42", NO PLUG
7-244S	1	CORDSET,DC, 10/2, 108", SB50 PLUG
7-244F	1	FUSE ASSEMBLY

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Racine, WI 53404

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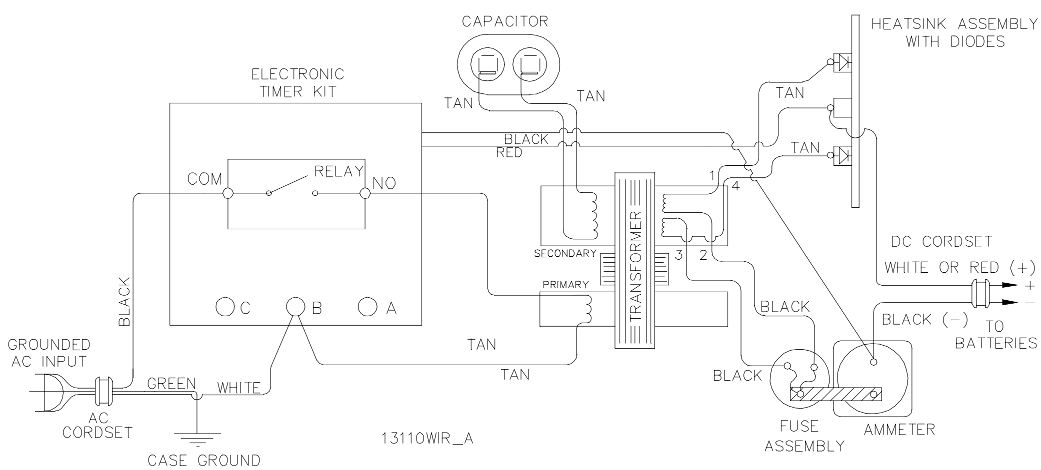
21-2440 CHARGER PARTS LIST

WIRING DIAGRAM



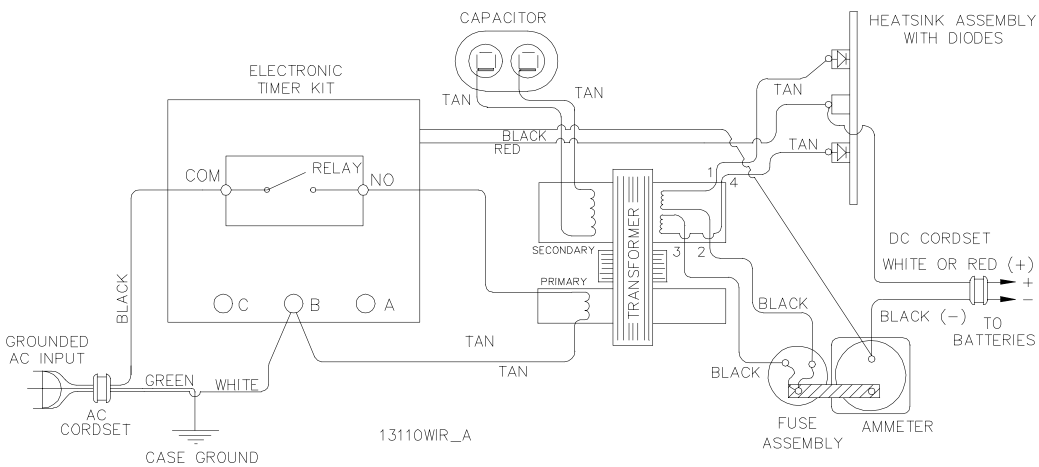
PARTS LIST FOR POWERCAT CHARGER
PART# 21-2440
115 VAC / 60 HZ
24 VDC 25 A

	PART NO.	QTY.	DESCRIPTION
	21-2446	1	CASE ASSEMBLY
	21-2447	1	TRANSFORMER ASSEMBLY
	21-2445	1	HEATSINK ASSEMBLY, W/ DIODES
	21-2448	1	AMMETER
	21-2440T	1	ELECTRONIC TIMER ASSEMBLY
*	7-244M	1	RELAY, FOR TIMER ASSEMBLY
**	7-244RE	1	RELAY, FOR TIMER ASSEMBLY
	7-244B	1	CAPACITOR, 6.0 MFD, 660 VAC
	21-2444	1	FUSE ASSEMBLY
	7-244C	1	BUSHING, 7W-2, INSULATOR FOR DC CORD
	21-2449	1	BUSHING, 7K-2, INSULATOR FOR AC CORD
	21-2450	1	CORDSET, AC, 14/3, 80”, MOLDED PLUG
	21-2451	1	CORDSET, DC, 12/2, W/ RED 50 AMP ANDERSON
	S/O	1	CORDSET, DC, 12/2, W/ RED 175 AMP ANDERSON
	4-257	1	PLUG ASSEMBLY, DC, RED 50 AMP ANDERSON PLUG
	5-260	1	PLUG ASSEMBLY, DC, RED 175 AMP ANDERSON PLUG

* FOR USE WITH CHARGERS BUILT BEFORE 47/03
** FOR USE WITH CHARGERS BUILT AFTER 47/03

21-2441 CHARGER PARTS LIST

WIRING DIAGRAM

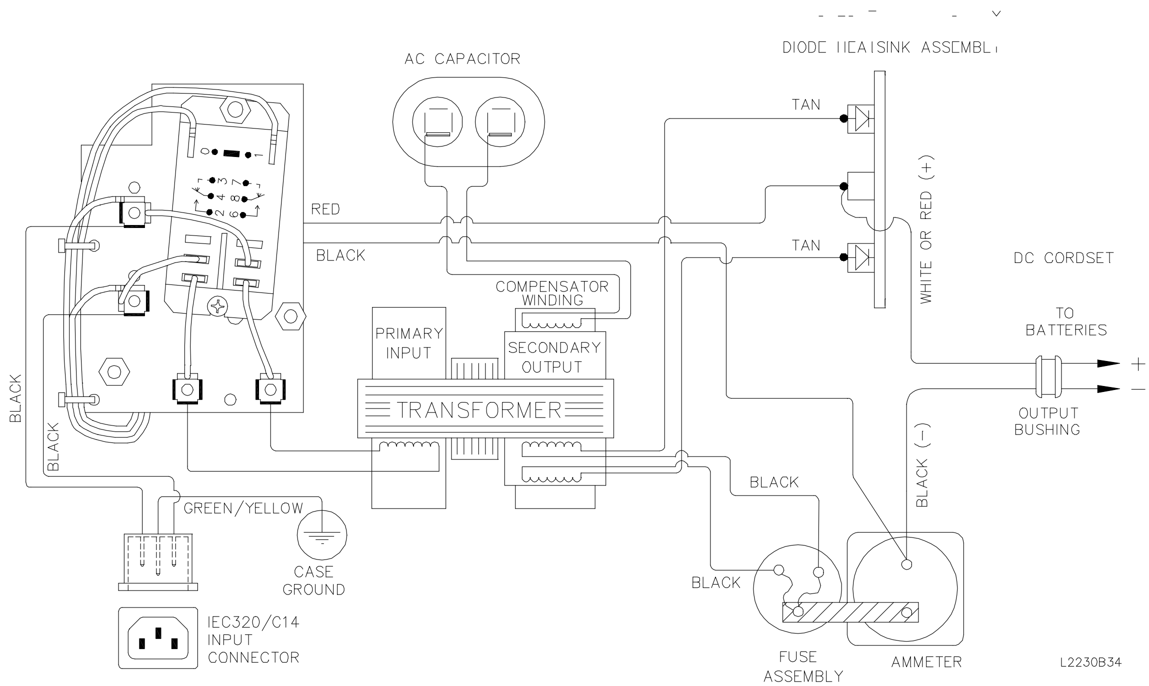


PARTS LIST FOR POWERCAT CHARGER
PART# 21-2441
115 VAC / 60 HZ
24 VDC 25 A

PART NO.	QTY.	DESCRIPTION
21-2446	1	CASE ASSEMBLY
21-2447	1	TRANSFORMER ASSEMBLY
21-2445	1	HEATSINK ASSEMBLY, W/ DIODES
21-2448	1	AMMETER
21-2440T	1	ELECTRONIC TIMER ASSEMBLY
7-244B	1	CAPACITOR, 6.0 MFD, 660 VAC
21-2444	1	FUSE ASSEMBLY
7-244C	1	BUSHING, 7W-2, INSULATOR FOR DC CORD
21-2449	1	BUSHING, 7K-2, INSULATOR FOR AC CORD
21-2450	1	CORDSET, AC, 14/3, 80", MOLDED PLUG
21-2451	1	CORDSET, DC, 12/2, W/ RED 50 AMP ANDERSON
S/O	1	CORDSET, DC, 12/2, W/ RED 175 AMP ANDERSON
4-257	1	PLUG ASSEMBLY, DC, RED 50 AMP ANDERSON PLUG
5-260	1	PLUG ASSEMBLY, DC RED175 AMP ANDERSON PLUG

21-2442 CHARGER PARTS LIST

WIRING DIAGRAM

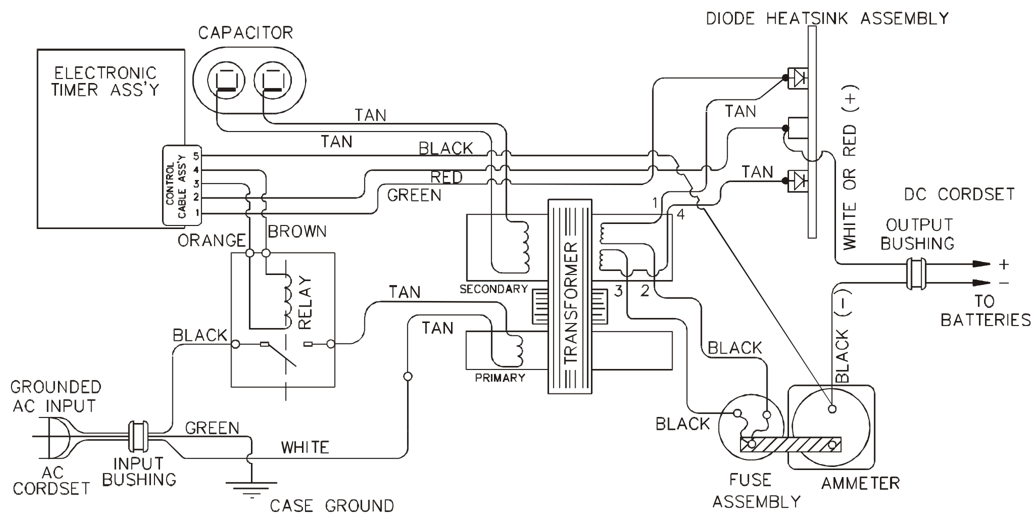


PARTS LIST FOR POWERCAT CHARGER
PART# 21-2442
230 VAC / 50 HZ
24 VDC 25 A

PART NO.	QTY.	DESCRIPTION
S/O	1	CASE ASSEMBLY
S/O	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6MFD, 660VAC/70C, 600VAC/90C
21-2445	1	HEATSINK ASSEMBLY, W/ DIODES
21-2440F	1	FUSE ASSEMBLY
S/O	1	AMMETER, 0-30 AMP, CORNER MOUNTING STATUS
21-2440E	1	ELECTRONIC TIMER KIT, 24 VDC
7-244C	1	INSULATOR BUSHING FOR DC CORDSET
21-2451	1	DC CORDSET, 12/2, 108", SB50 RED
S/O	1	DC CORDSET, 12/2, 108", SB175 RED PLUG, MODEL 20630-84

190-2440 CHARGER PARTS LIST

WIRING DIAGRAM



PARTS LIST FOR POWERCAT CHARGER
PART# 190-2440
115 VAC / 60 HZ
24 VDC 18 A

PART NO.	QTY.	DESCRIPTION
S/O	1	CASE ASSEMBLY POWER CAT
S/O	1	TRANSFORMER ASSEMBLY
21-2440F	1	FUSE ASSEMBLY
S/O	1	ELECTRONIC TIMER ASSEMBLY
21-2445	1	HEATSINK ASSEMBLY W/ DIODES
S/O	1	AMMETER, 25 AMP, CORNER MOUNT
7-244C	1	BUSHING, 7W-2, INSULATOR FOR DC CORD
21-2449	1	BUSHING, 7K-2, INSULATOR FOR AC CORD
S/O	1	CAPACITOR, 4.0 MFD, 660 VAC
S/O	1	CORDSET, AC, MOLDED PLUG
21-2451	1	CORDSET, DC, 108", SB50 PLUG, RED
S/O	1	CORDSET, DC, 108", SB175 PLUG, RED

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Racine, WI 53404

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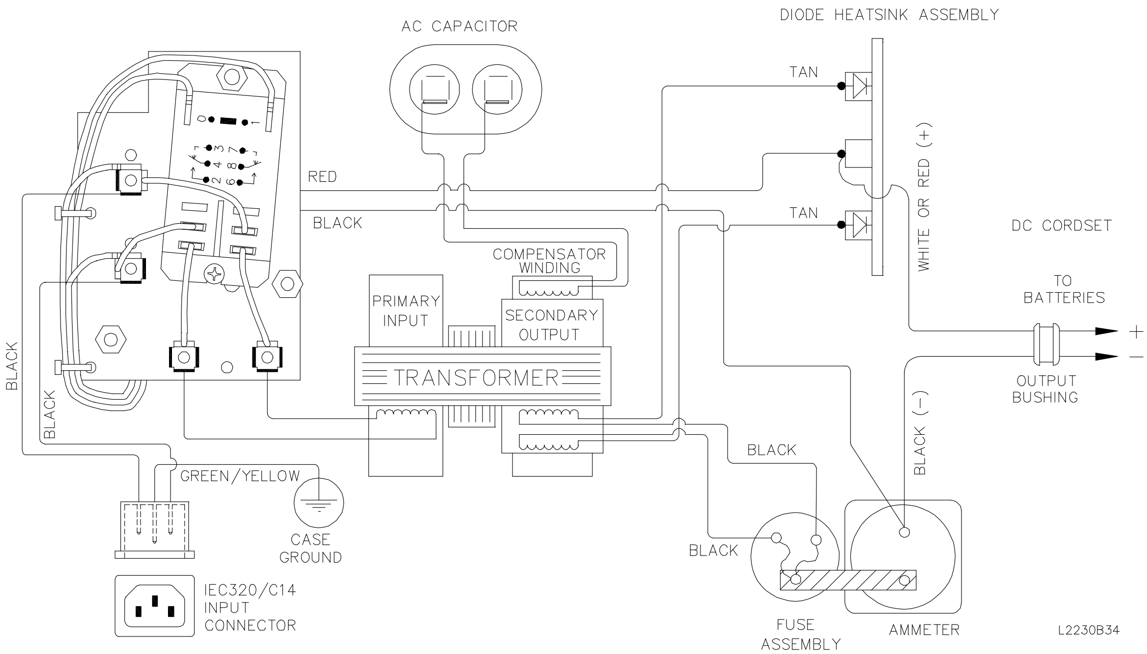
7

190-2442 CHARGER PARTS LIST

WIRING DIAGRAM

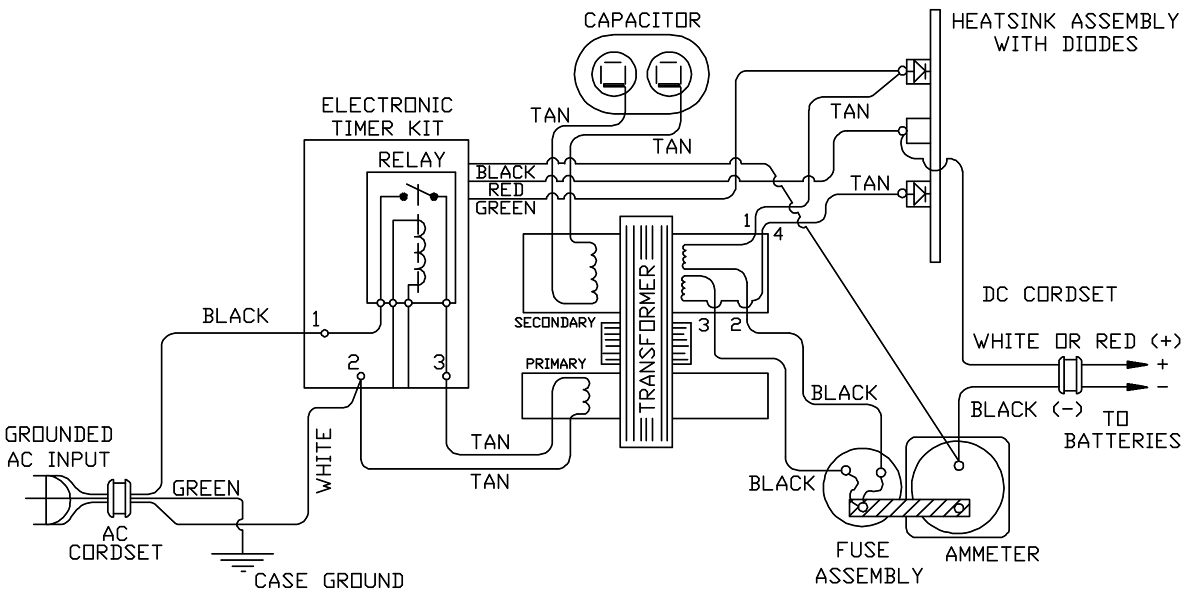


PARTS LIST FOR POWERCAT CHARGER
PART# 190-2442
250 VAC / 50 HZ
24 VDC 25 A

PART NO.	QTY.	DESCRIPTION
S/O	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6MFD, 660VAC/70C, 600VAC/90C
21-2445	1	HEATSINK ASSEMBLY, W/ DIODES
21-2440F	1	FUSE ASSEMBLY
S/O	1	AMMETER, 0-30 AMP, CORNER MOUNTING STATUS
S/O	1	ELECTRONIC TIMER KIT, 24VDC
244-C	1	INSULATOR BUSHING FOR DC CORDSET
21-2451	1	DCCORDSET, 12/2, 108", SB50 RED
S/O	1	DCCORDSET, 12/2, 108", SB175 RED PLUG

250-2440 CHARGER PARTS LIST

WIRING DIAGRAM

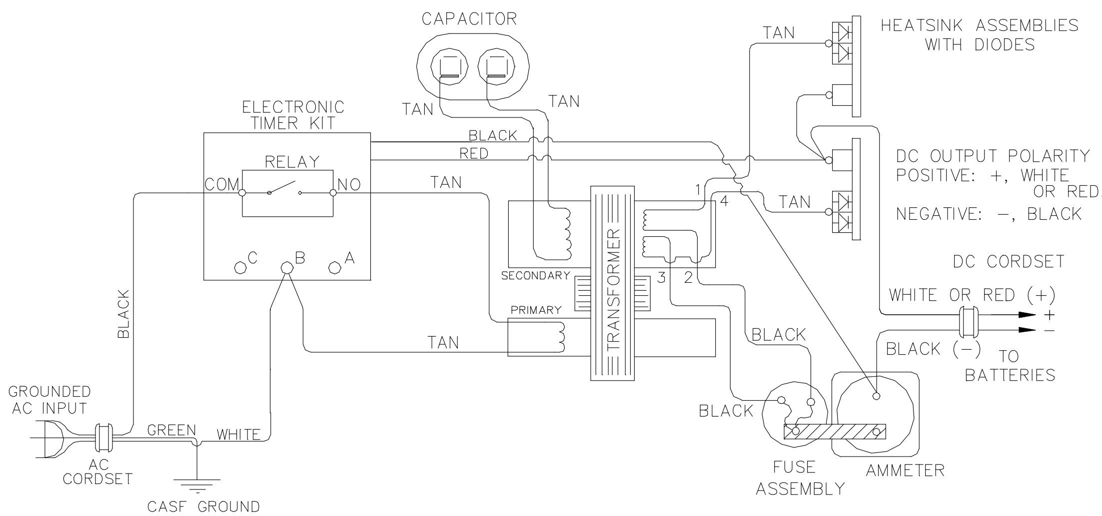


PARTS LIST FOR POWERCAT CHARGER
PART# 250-2440
115 VAC / 60 HZ
36 VDC 25A

PART NO.	QTY.	DESCRIPTION
S/O	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6.0 MFD, 660 VAC
21-2444	1	HEATSINK ASSEMBLY, W/ DIODES
21-2440F	1	FUSE ASSEMBLY
S/O	1	AMMETER, 0-30 AMP
S/O	1	ELECTRONIC TIMER ASSEMBLY
7-244C	1	BUSHING, 7W-2, INSULATOR FOR DC CORD
21-2450	1	CORDSET, AC, 14/3, 80", MOLDED PLUG
S/O	1	CORDSET, DC, 12/2, 108", SB50 GRAY PLUG
S/O	1	CORDSET, DC, 12/2, 108", SB175 GRAY PLUG
4-260	1	HOUSING ASSEMBLY, DC, SB50 GRAY PLUG
390-2575	1	HOUSING ASSEMBLY, DC, SB175 GRAY PLUG

390-2440 CHARGER PARTS LIST

WIRING DIAGRAM

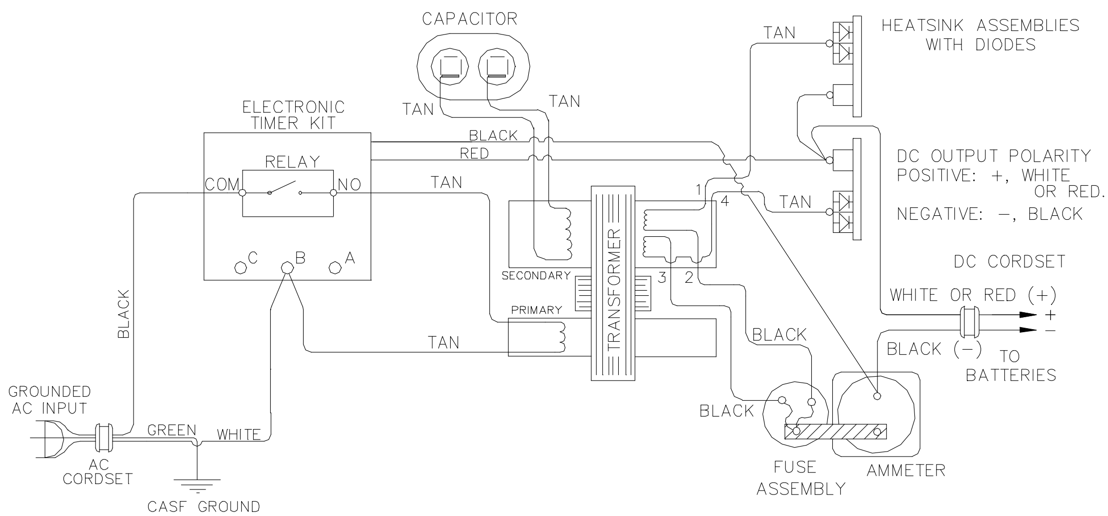


PARTS LIST FOR POWERCAT CHARGER
PART# 390-2440
115 VAC / 60 HZ
36 VDC 36A

PART NO.	QTY.	DESCRIPTION
390-2443	1	CASE ASSEMBLY FOR 10/2 DC CORD
S/O	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6 MFD, 660 VAC
7-244HS	2	HEATSINK ASSEMBLY W/ 2 DIODES IN PARALLEL
7-244F	1	FUSE ASSEMBLY
7-244G	1	AMMETER, 50 AMP, W/ CORNER MOUNTING STUDS
390-2440T	1	ELECTRONIC TIMER KIT
7-244C	1	CORDSET BUSHING, 7W-2, FOR 14/3 INPUT CORDSET
7-244D	1	CORDSET BUSHING, 8P-2, FOR 10/2 OUTPUT CORDSET
7-251D	1	CORDSET BUSHING, 9P-2, FOR 8/2 OUTPUT CORDSET
S/O	1	AC CORDSET, 14/3, 72" W/125V/15A PLUG
S/O	1	AC CORDSET, 14/3, 108", W/ 125V/15A PLUG
7-244H	1	DC CORDSET, 10/2, 108", W/ SB50 GRAY PLUG
7-244L	1	DC CORDSET, 10/2, 108", W/ SB175 GRAY PLUG
S/O	1	DC CORDSET, 10/2, 108", W/ SB350 GRAY PLUG

390-2441 CHARGER PARTS LIST

WIRING DIAGRAM



PARTS LIST FOR POWERCAT CHARGER
PART# 390-2441
115 VAC / 60 HZ
36 VDC 36 A

PART NO.	QTY.	DESCRIPTION
390-2443	1	CASE ASSEMBLY FOR 10/2 DC CORD
S/O	1	TRANSFORMER ASSEMBLY
7-244B	1	CAPACITOR, 6 MFD, 660 VAC
7-244HS	2	HEATSINK ASSEMBLY W/ 2 DIODES IN PARALLEL
7-244F	1	FUSE ASSEMBLY
7-244G	1	AMMETER, 50 AMP, W/ CORNER MOUNTING STUDS
390-2440T	1	ELECTRONIC TIMER KIT
7-244C	1	CORDSET BUSHING, 7W-2, FOR 14/3 INPUT CORDSET
7-244D	1	CORDSET BUSHING, 8P-2, FOR 10/2 OUTPUT CORDSET
7-251D	1	CORDSET BUSHING, 9P-2, FOR 8/2 OUTPUT CORDSET
S/O	1	AC CORDSET, 14/3, 72" W/125V/15A PLUG
S/O	1	AC CORDSET, 14/3, 108", W/ 125V/15A PLUG
7-244H	1	DC CORDSET, 10/2, 108", W/ SB50 GRAY PLUG
7-244L	1	DC CORDSET, 10/2, 108", W/ SB175 GRAY PLUG
S/O	1	DC CORDSET, 10/2, 108", W/ SB350 GRAY PLUG

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APPENDIX A

METERS

Meters come in varius style and configurations. They come in both analog (with a needle type indicator) and digital (with a digital readout). DO NOT use an analog meter on the controll systems of the machine or you can destroy the controller instantaneously. We re-comened a high quality non auto ranging “High Imedance” Multi-Meter with an integral DC AMP clamp such as the Fluke 336. As a basic rule of thumb do not use a meter that cost less than $50.00 as these meters can also damage our controllers and are not accurate.

The different functions and ranges of a meter are displpayed on the meter controlls with icon. A indicator of these icons is as folows.

V~ Volts AC - This setting is used to measure Alternaing current like the electricity that is in wall outlets. Folllow proper safet precautions when measur ing and voltage from a wall outlet!

V Volts DC This setting is used to measure “Direct Current” such is the type we use on our machines that comes from batteries.

Ω Ohms This setting is used to measure resistance is a circut. Some meters have a number of different ranges you can select. They are described below.

200	200 Ohms - Most suitable for our machines
2k	2,000 Ohms - For fine testing of our machines
20k	20,000 Ohms - Too sensitive for our machines
200k	200,000 Ohms - Too sensitive for our machines

•))) Continuity Test This feature sounds an audiable tone when there is less than 30 ohms of resistance between the probes.

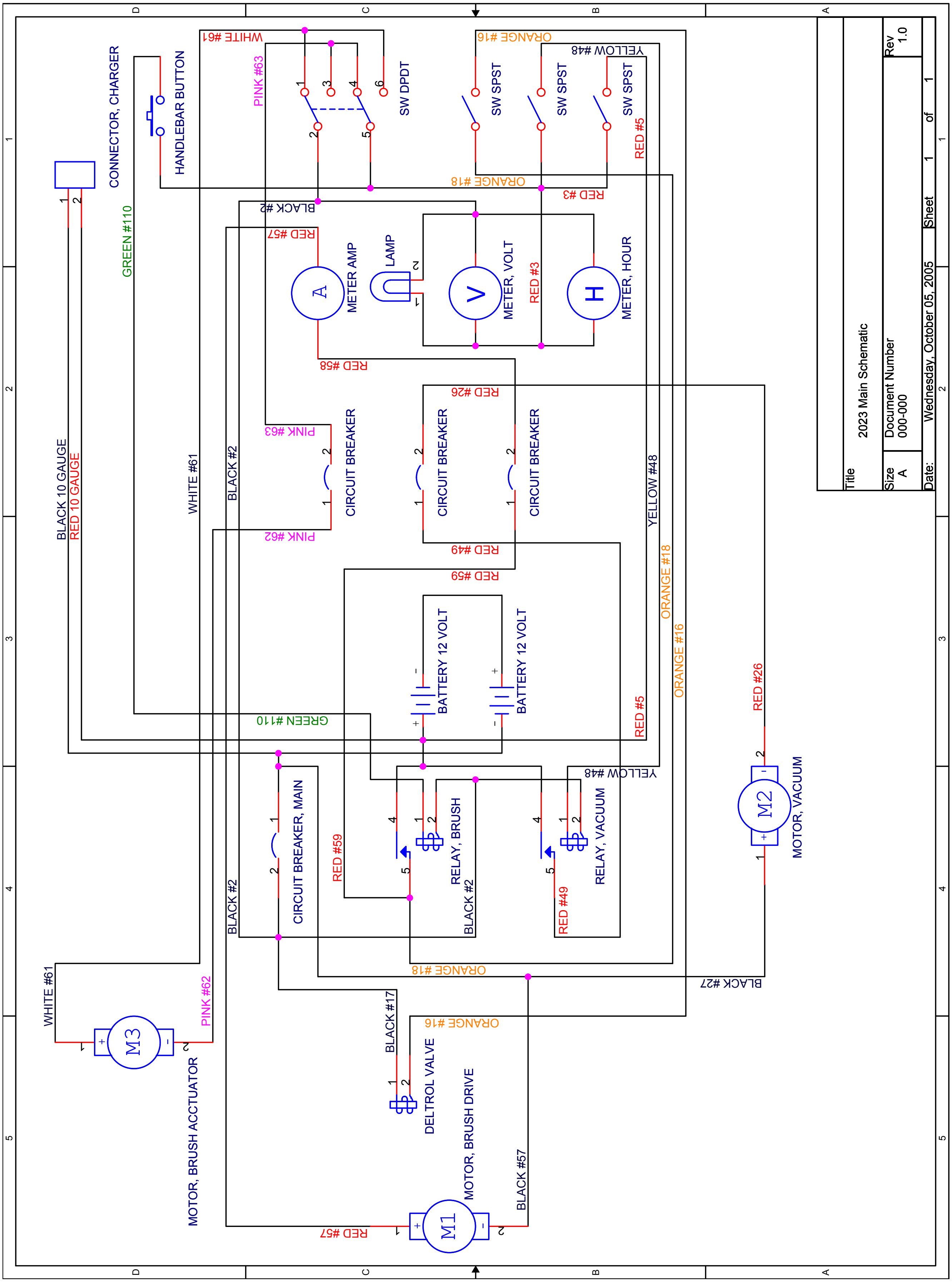
→⊢ Diode Test This setting is used to test diodes for proper operation

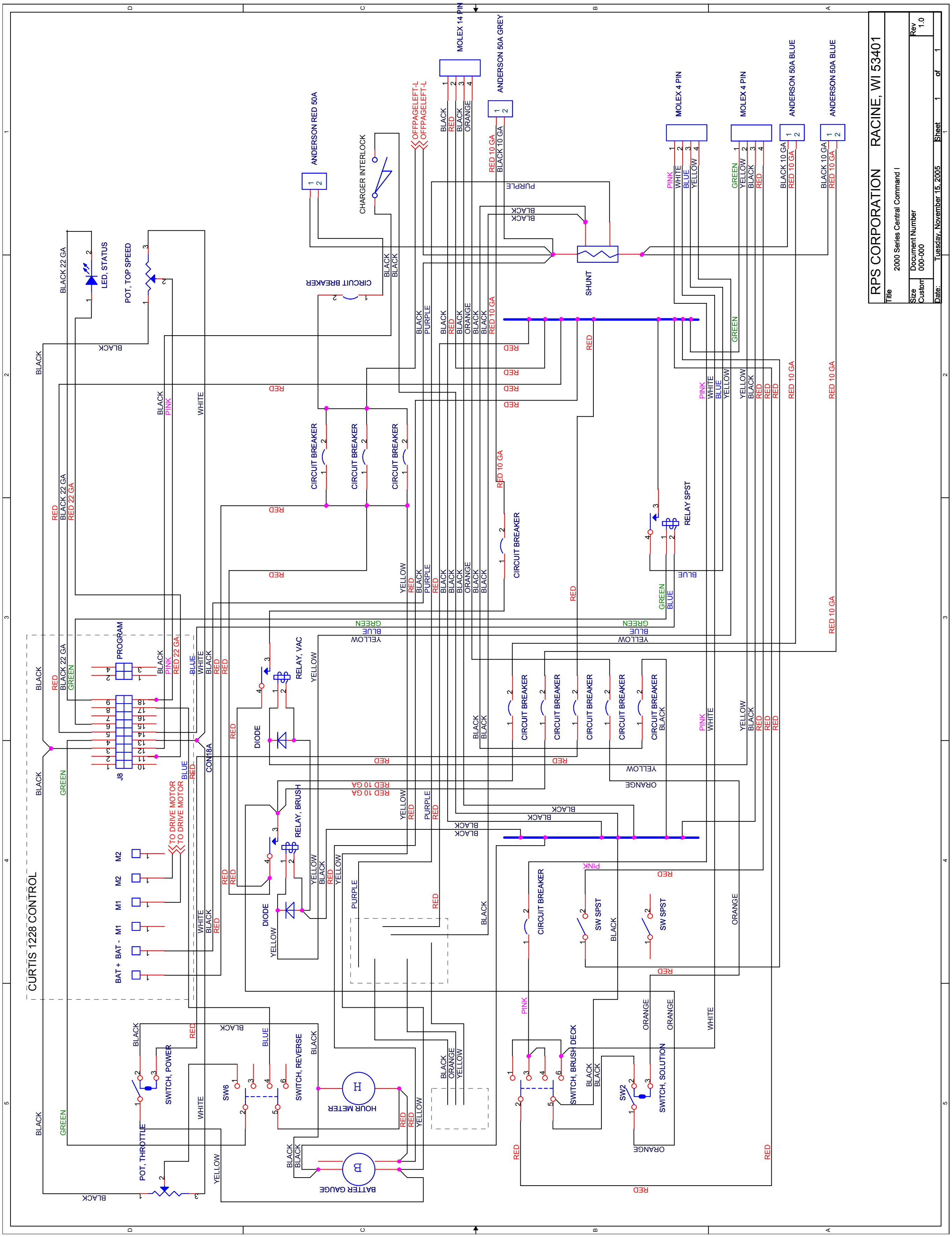
A~ Amps - AC This setting is used to measure AC amp flow through a circuit.

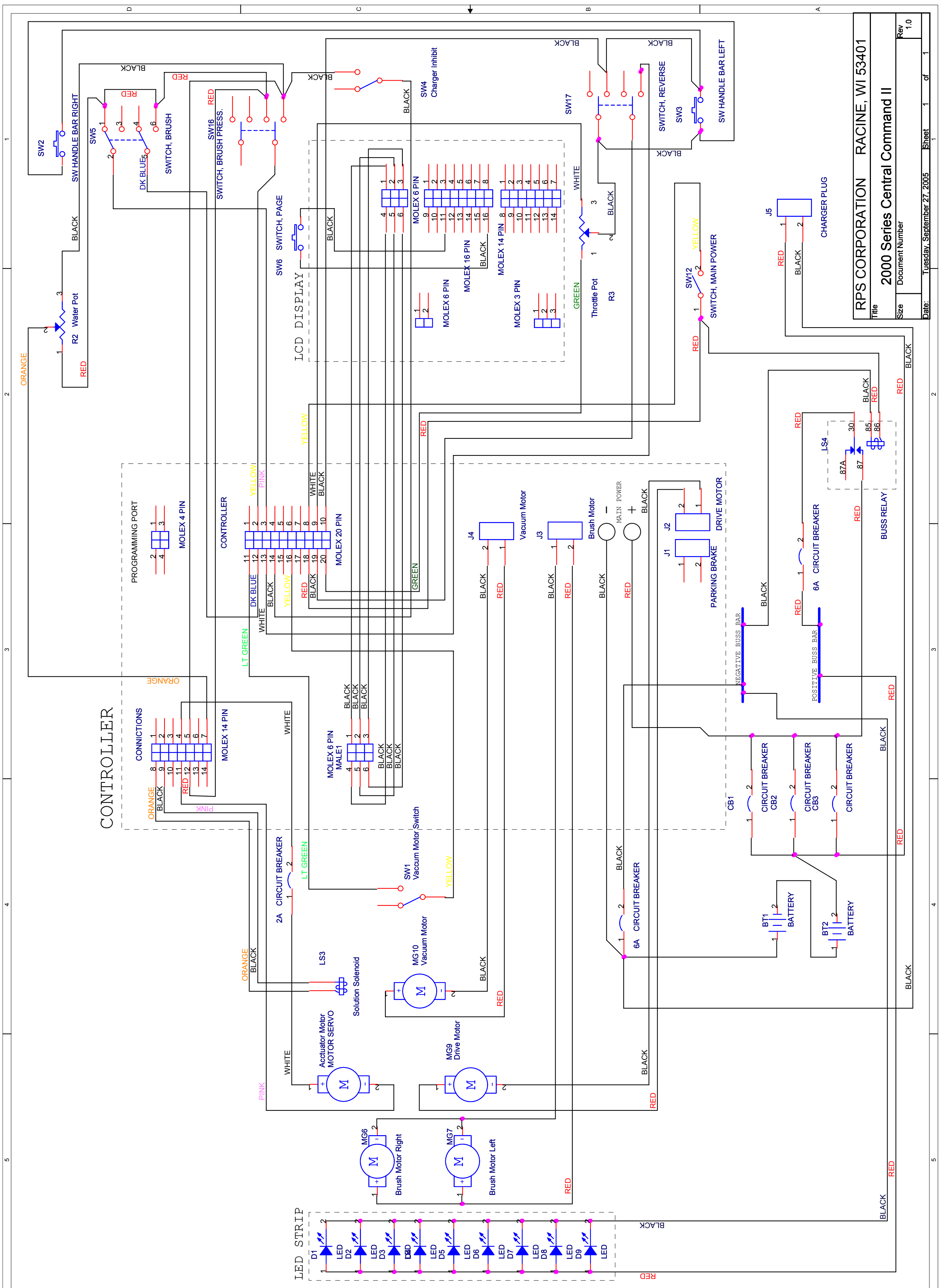
A Amps - DC This setting is used to measure DC amp flow through a circuit.

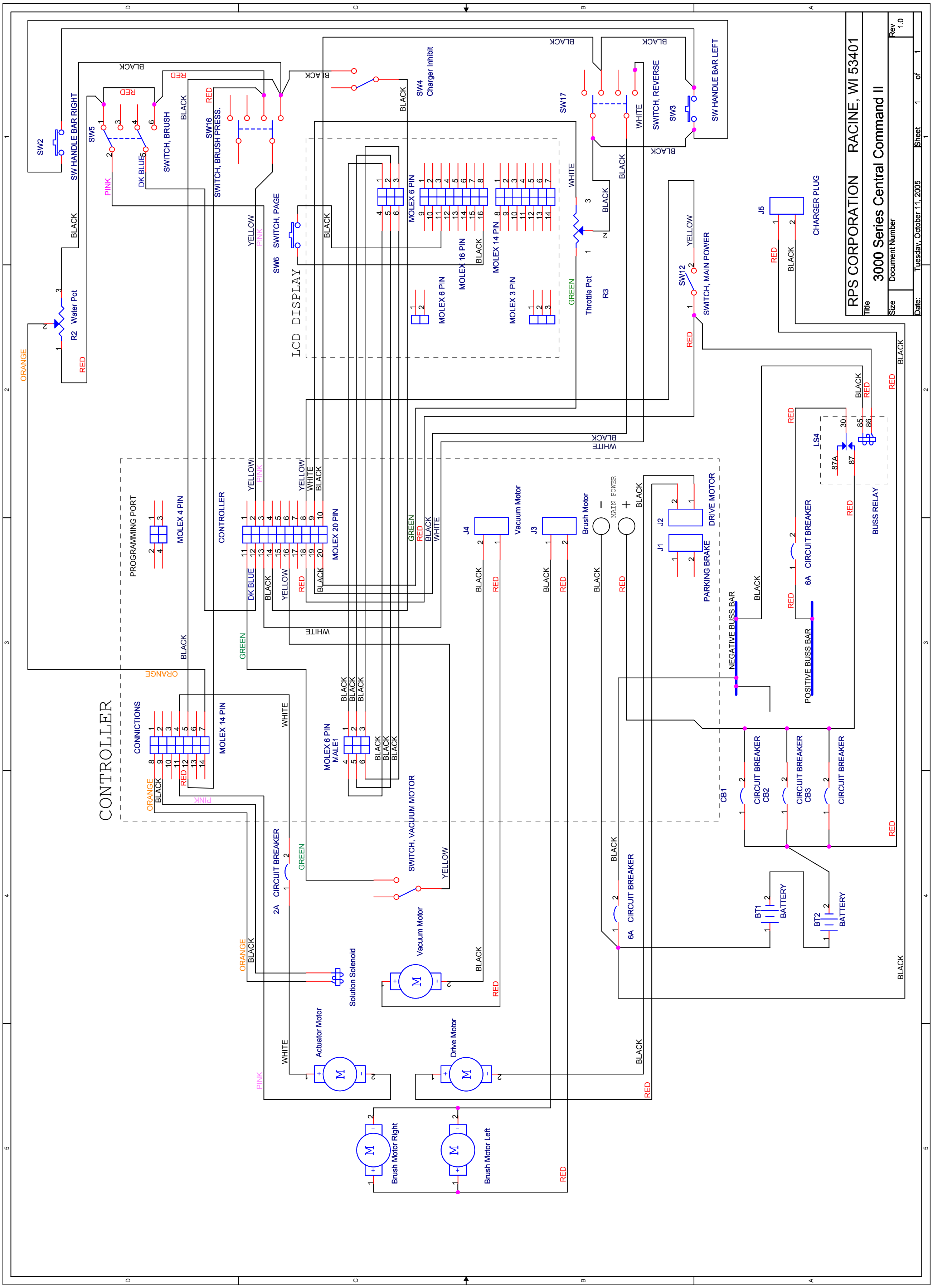
mA~ Miliamps - AC This setting is used to measure AC milliamp flow through a circuit.

mA Miliamps -DC This setting is used to measure DC milliamp flow through a circuit.


Title
2023 Main Schematic
Size
A
Document Number
000-000
Rev
1.0
Date: Wednesday, October 05, 2005
Sheet 1 of 1
CONNECTOR, CHARGER
HANDLEBAR BUTTON
SW DPDT
SW SPST
SW SPST
SW SPST
METER AMP
LAMP
METER, VOLT
METER, HOUR
CIRCUIT BREAKER
CIRCUIT BREAKER
CIRCUIT BREAKER
BATTERY 12 VOLT
BATTERY 12 VOLT
CIRCUIT BREAKER, MAIN
RELAY, BRUSH
RELAY, VACUUM
MOTOR, VACUUM
MOTOR, BRUSH ACCTUATOR
DELTROL VALVE
MOTOR, BRUSH DRIVE
M1
M2
M3
BLACK 10 GAUGE
RED 10 GAUGE
GREEN #110
WHITE #61
PINK #63
PINK #62
BLACK #2
ORANGE #16
ORANGE #18
YELLOW #48
RED #5
RED #3
RED #57
RED #58
RED #26
RED #49
RED #59
BLACK #17
BLACK #27
BLACK #57
RED #26


RPS CORPORATION RACINE, WI 53401
Title
2000 Series Central Command I
Size
Custom
Document Number
000-000
Rev
1.0
Date: Tuesday, November 15, 2005
Sheet 1 of 1
CURTIS 1228 CONTROL
MOLEX 14 PIN
ANDERSON 50A GREY
ANDERSON RED 50A
CHARGER INTERLOCK
MOLEX 4 PIN
ANDERSON 50A BLUE
SHUNT
CIRCUIT BREAKER
RELAY SPST
RELAY, VAC
RELAY, BRUSH
DIODE
LED, STATUS
POT, TOP SPEED
PROGRAM
SWITCH, POWER
SWITCH, REVERSE
HOUR METER
BATTER GAUGE
POT, THROTTLE
SWITCH, BRUSH DECK
SWITCH, SOLUTION
SW SPST
TO DRIVE MOTOR


RPS CORPORATION RACINE, WI 53401
Title
2000 Series Central Command II
Size
Document Number
Rev
1.0
Date: Tuesday, September 27, 2005
Sheet 1 of 1
CONTROLLER
LCD DISPLAY
LED STRIP
PROGRAMMING PORT
MOLEX 4 PIN
CONTROLLER
MOLEX 20 PIN
CONNICTIONS
MOLEX 14 PIN
MOLEX 6 PIN MALE1
MOLEX 6 PIN
MOLEX 16 PIN
MOLEX 14 PIN
MOLEX 3 PIN
SW2
SW HANDLE BAR RIGHT
SW5
SWITCH, BRUSH
SW16
SWITCH, BRUSH PRESS.
SW6
SWITCH, PAGE
SW4
Charger Inhibit
SW17
SWITCH, REVERSE
SW3
SW HANDLE BAR LEFT
R2 Water Pot
Throttle Pot
R3
SW12
SWITCH, MAIN POWER
J5
CHARGER PLUG
J4
Vacuum Motor
J3
Brush Motor
MAIN POWER
J2
J1
DRIVE MOTOR
PARKING BRAKE
6A CIRCUIT BREAKER
LS4
BUSS RELAY
NEGATIVE BUSS BAR
POSITIVE BUSS BAR
CB1
CIRCUIT BREAKER CB2
CIRCUIT BREAKER CB3
CIRCUIT BREAKER
BT1 BATTERY
BT2 BATTERY
2A CIRCUIT BREAKER
SW1 Vaccum Motor Switch
LS3
Solution Solenoid
MG10 Vacuum Motor
Actuator Motor MOTOR SERVO
MG9 Drive Motor
MG6
Brush Motor Right
MG7
Brush Motor Left
D1 LED
D2 LED
D3 LED
D4 LED
D5 LED
D6 LED
D7 LED
D8 LED
D9 LED


RPS CORPORATION RACINE, WI 53401
Title
3000 Series Central Command II
Size
Document Number
Rev
1.0
Date: Tuesday, October 11, 2005
Sheet 1 of 1
CONTROLLER
LCD DISPLAY
PROGRAMMING PORT
MOLEX 4 PIN
MOLEX 20 PIN
MOLEX 14 PIN
MOLEX 6 PIN
MOLEX 16 PIN
MOLEX 3 PIN
CONNECTIONS
SW HANDLE BAR RIGHT
SW HANDLE BAR LEFT
SWITCH, BRUSH
SWITCH, BRUSH PRESS.
SWITCH, PAGE
SWITCH, REVERSE
SWITCH, MAIN POWER
SWITCH, VACUUM MOTOR
Charger Inhibit
Water Pot
Throttle Pot
CHARGER PLUG
BUSS RELAY
NEGATIVE BUSS BAR
POSITIVE BUSS BAR
CIRCUIT BREAKER
BATTERY
PARKING BRAKE
DRIVE MOTOR
Vacuum Motor
Brush Motor
Solution Solenoid
Actuator Motor
Drive Motor
Brush Motor Right
Brush Motor Left

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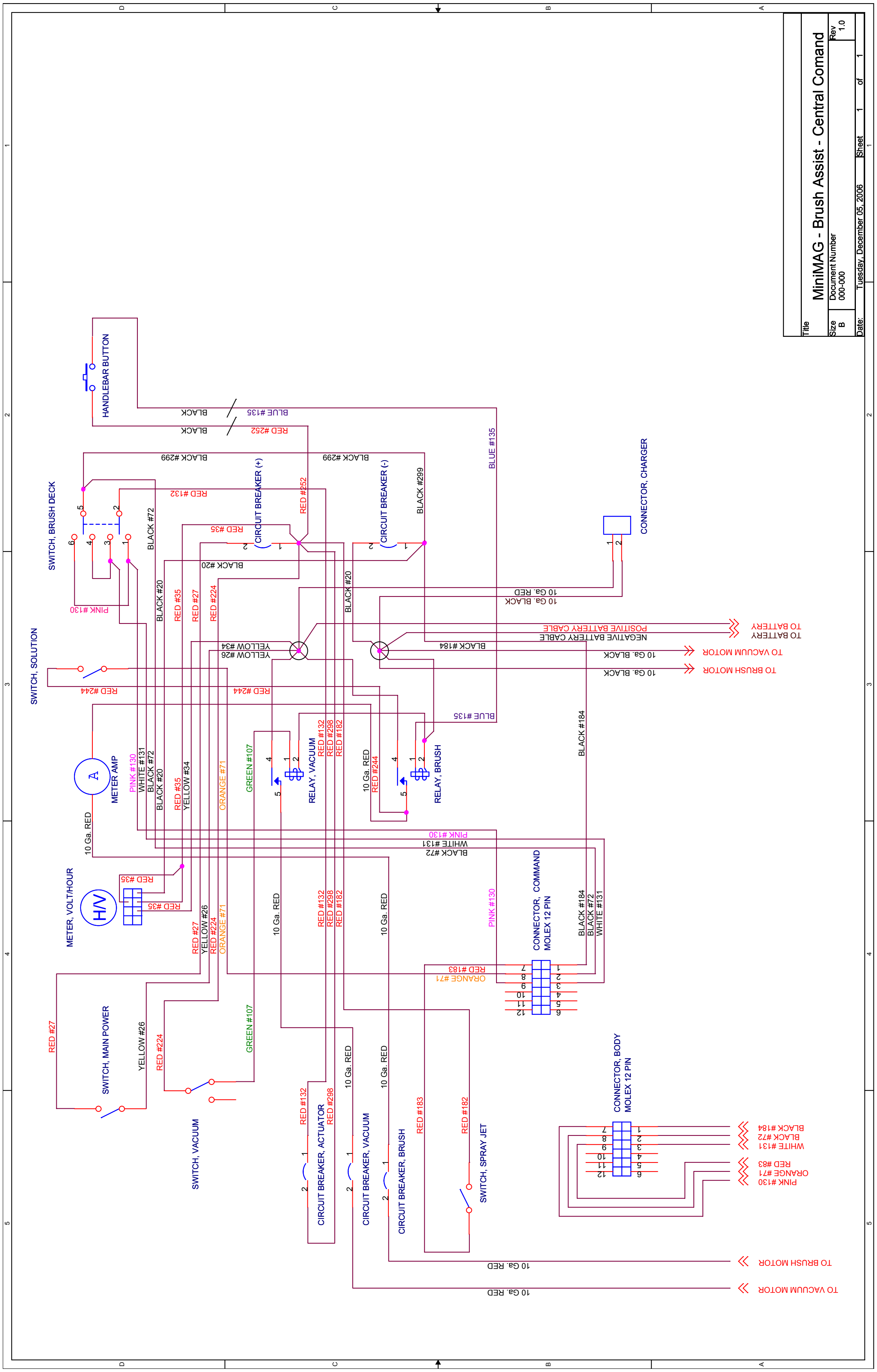
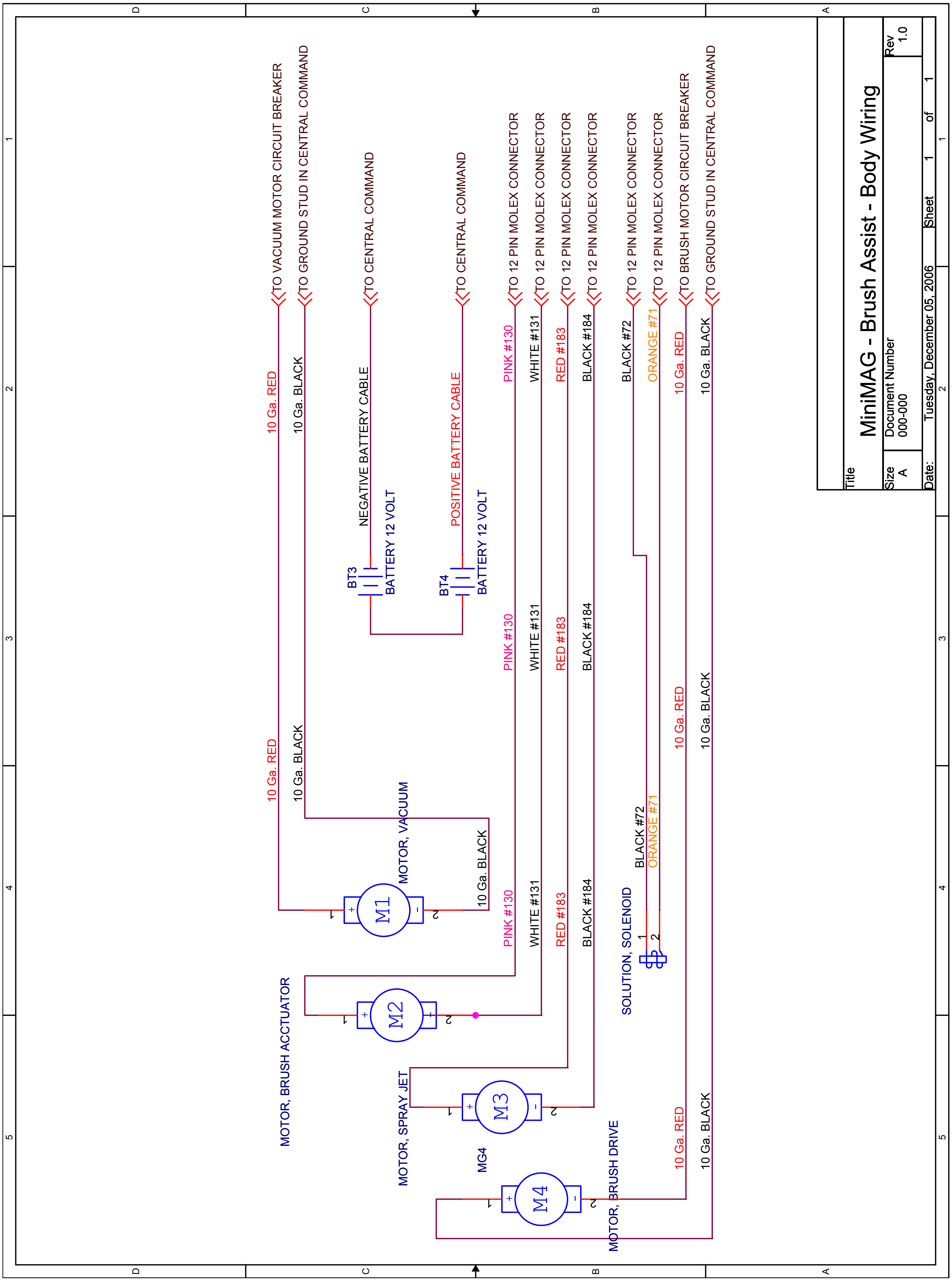
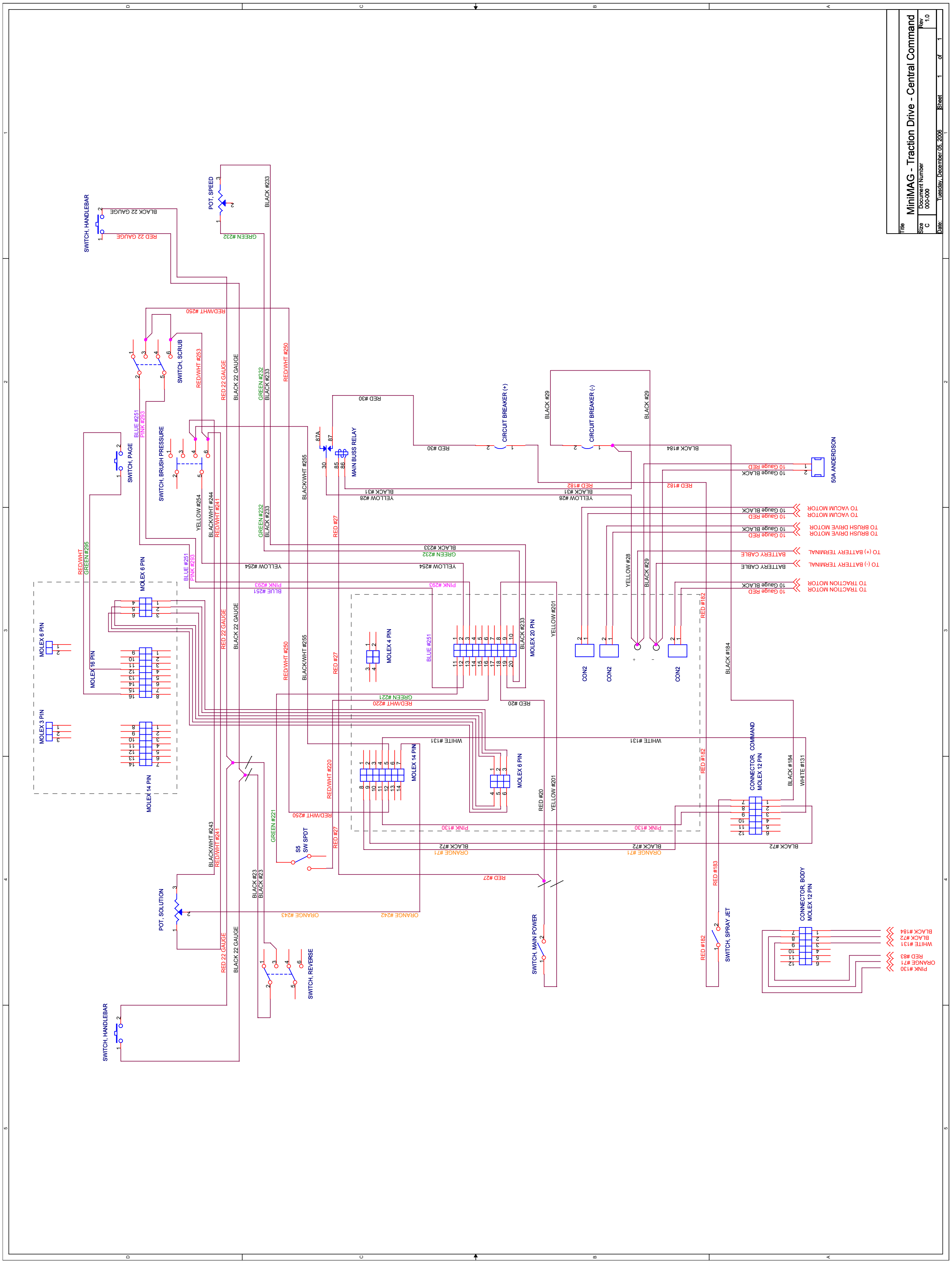
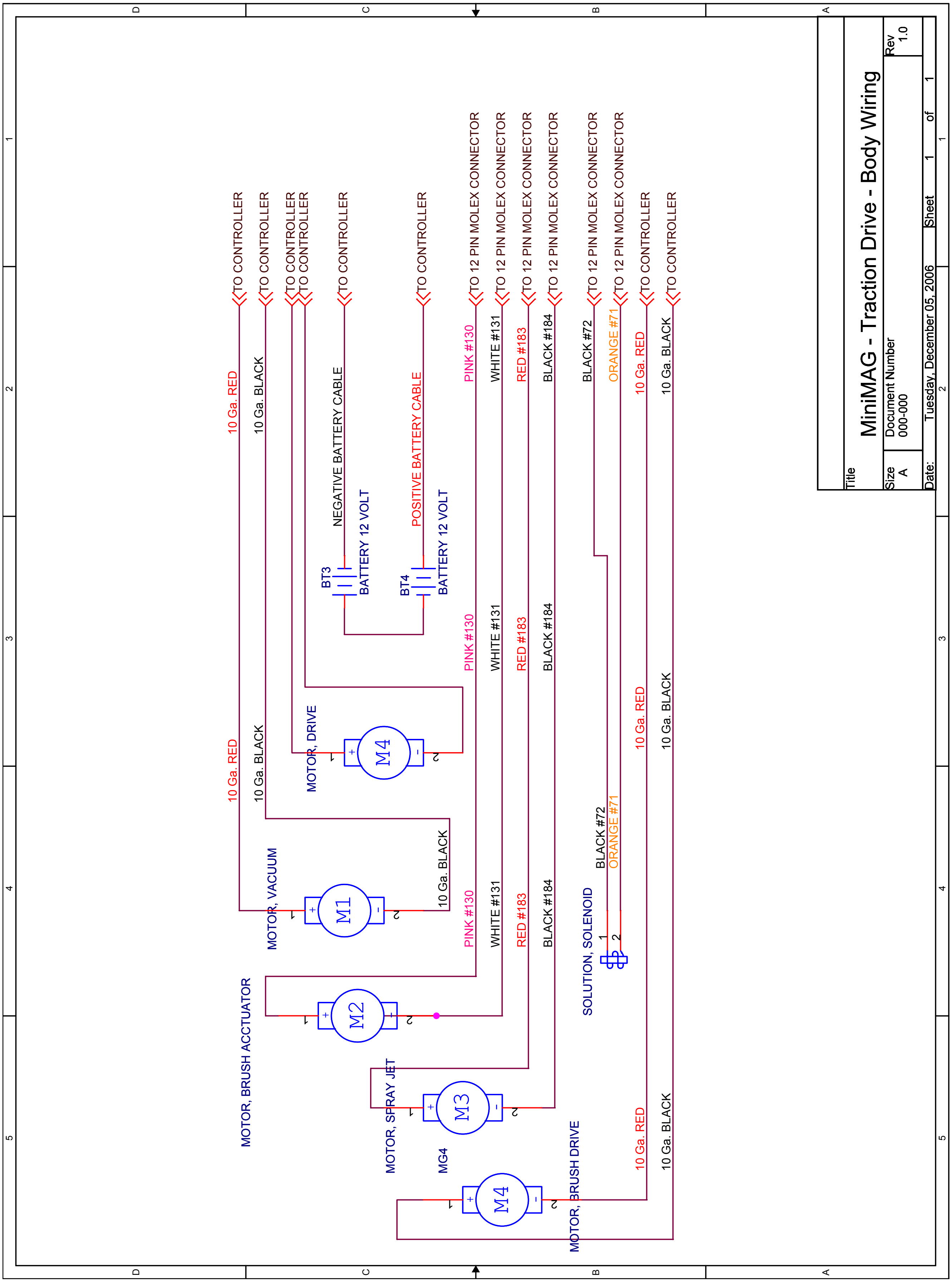

MiniMAG - Brush Assist - Central Comand
Title
Size B
Document Number 000-000
Rev 1.0
Date: Tuesday, December 05, 2006
Sheet 1 of 1
HANDLEBAR BUTTON
SWITCH, BRUSH DECK
SWITCH, SOLUTION
METER, AMP
METER, VOLT/HOUR
SWITCH, MAIN POWER
SWITCH, VACUUM
CIRCUIT BREAKER (+)
CIRCUIT BREAKER (-)
RELAY, VACUUM
RELAY, BRUSH
CONNECTOR, CHARGER
CONNECTOR, COMMAND MOLEX 12 PIN
CONNECTOR, BODY MOLEX 12 PIN
CIRCUIT BREAKER, ACTUATOR
CIRCUIT BREAKER, VACUUM
CIRCUIT BREAKER, BRUSH
SWITCH, SPRAY JET
TO BATTERY
POSITIVE BATTERY CABLE
NEGATIVE BATTERY CABLE
TO VACUUM MOTOR
TO BRUSH MOTOR


MiniMAG - Brush Assist - Body Wiring
Title
Size
A
Document Number
000-000
Rev
1.0
Date:
Tuesday, December 05, 2006
Sheet
1
of
1
TO VACUUM MOTOR CIRCUIT BREAKER
TO GROUND STUD IN CENTRAL COMMAND
TO CENTRAL COMMAND
TO CENTRAL COMMAND
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO BRUSH MOTOR CIRCUIT BREAKER
TO GROUND STUD IN CENTRAL COMMAND
10 Ga. RED
10 Ga. BLACK
NEGATIVE BATTERY CABLE
POSITIVE BATTERY CABLE
PINK #130
WHITE #131
RED #183
BLACK #184
BLACK #72
ORANGE #71
BT3
BATTERY 12 VOLT
BT4
BATTERY 12 VOLT
M1
MOTOR, VACUUM
M2
MOTOR, BRUSH ACCTUATOR
M3
MOTOR, SPRAY JET
M4
MG4
MOTOR, BRUSH DRIVE
SOLUTION, SOLENOID


MiniMAG - Traction Drive - Central Command
Title
Size C
Document Number 000-000
Rev 1.0
Date: Tuesday, December 05, 2006
Sheet 1 of 1


TO CONTROLLER
TO CONTROLLER
TO CONTROLLER
TO CONTROLLER
TO CONTROLLER
TO CONTROLLER
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO 12 PIN MOLEX CONNECTOR
TO CONTROLLER
TO CONTROLLER
10 Ga. RED
10 Ga. BLACK
NEGATIVE BATTERY CABLE
POSITIVE BATTERY CABLE
PINK #130
WHITE #131
RED #183
BLACK #184
BLACK #72
ORANGE #71
10 Ga. RED
10 Ga. BLACK
BT3
BATTERY 12 VOLT
BT4
BATTERY 12 VOLT
MOTOR, DRIVE
M4
MOTOR, VACUUM
M1
10 Ga. BLACK
MOTOR, BRUSH ACCTUATOR
M2
MOTOR, SPRAY JET
M3
MG4
MOTOR, BRUSH DRIVE
M4
SOLUTION, SOLENOID
Title
MiniMAG - Traction Drive - Body Wiring
Size
A
Document Number
000-000
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Date: Tuesday, December 05, 2006
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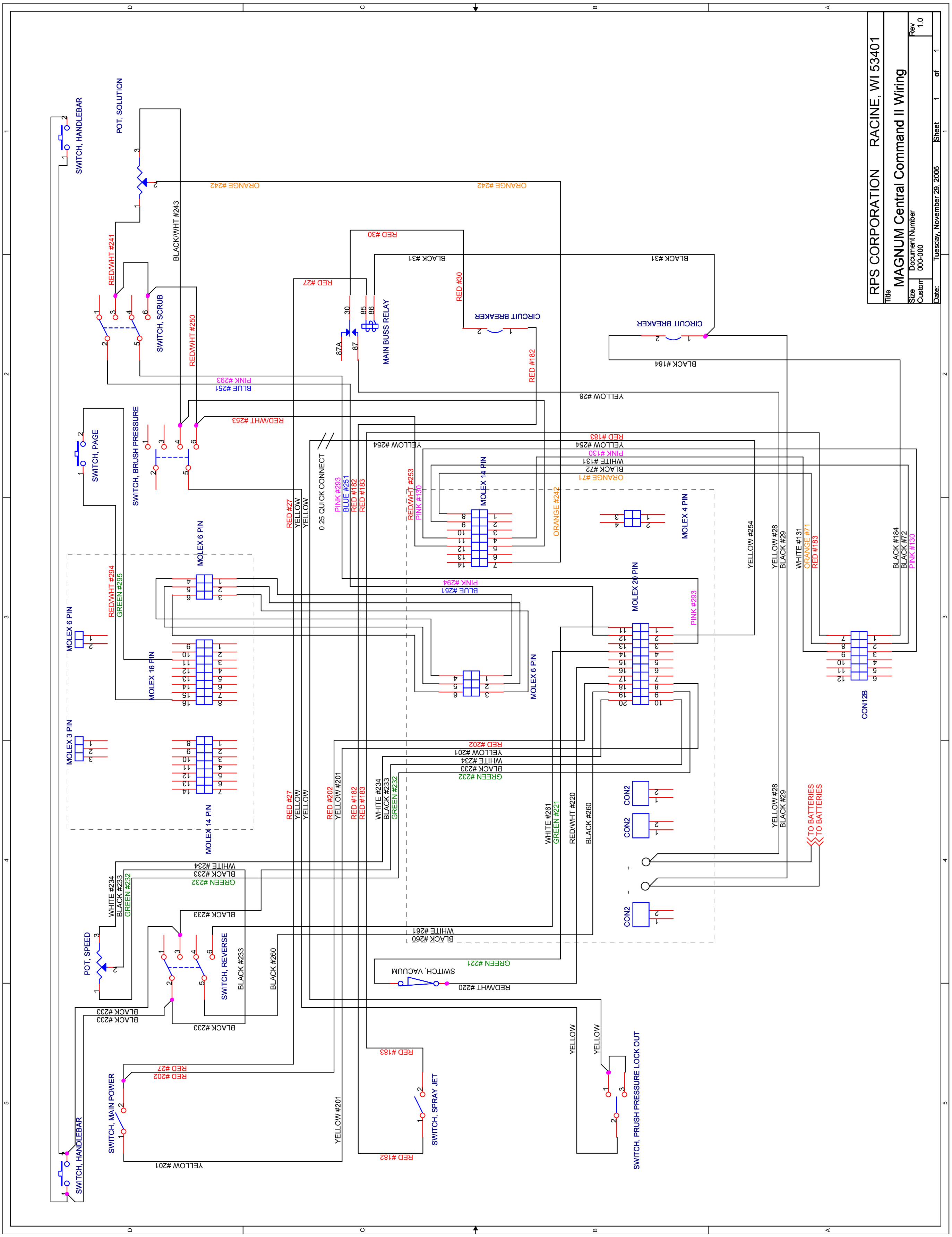
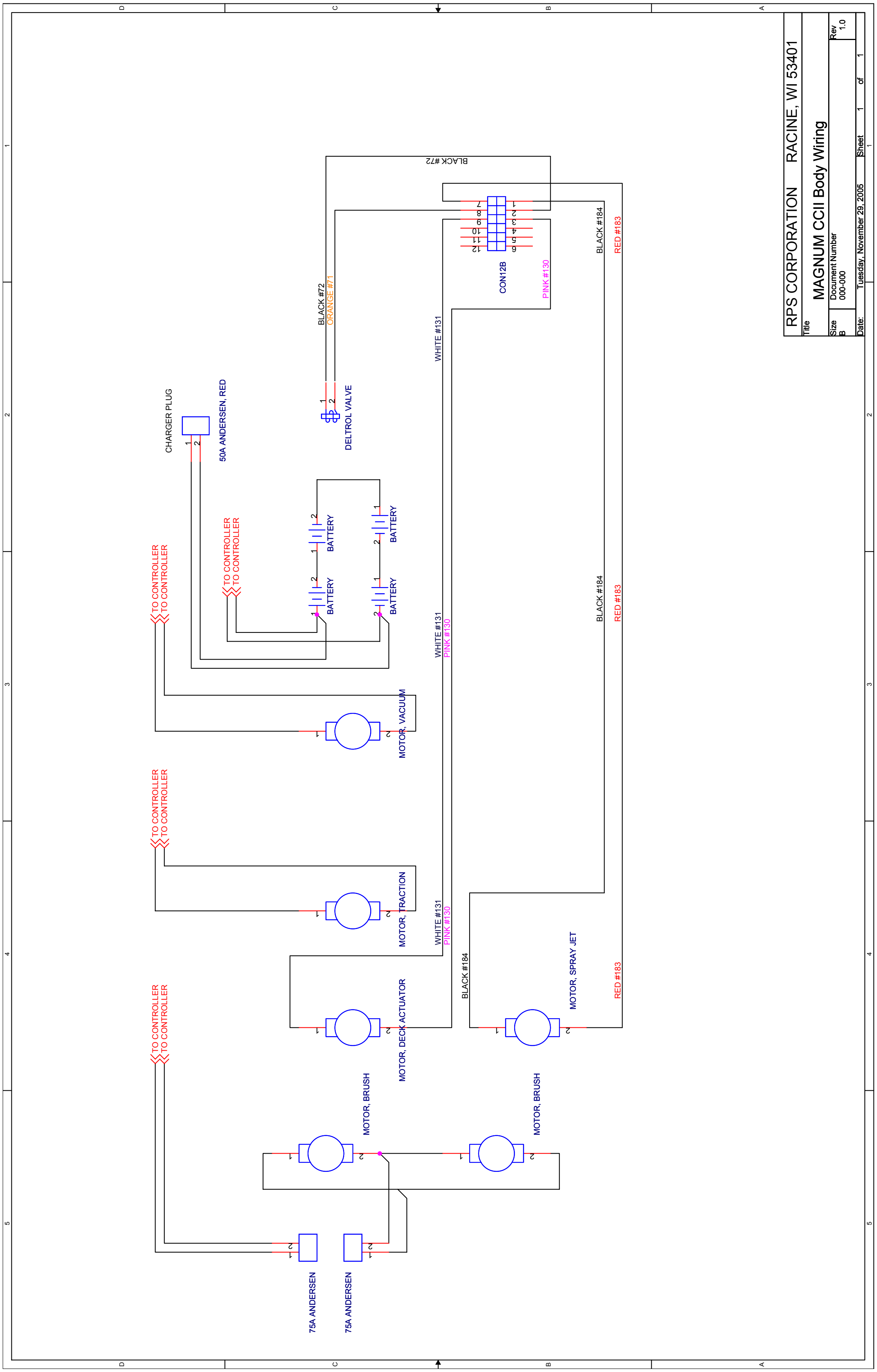
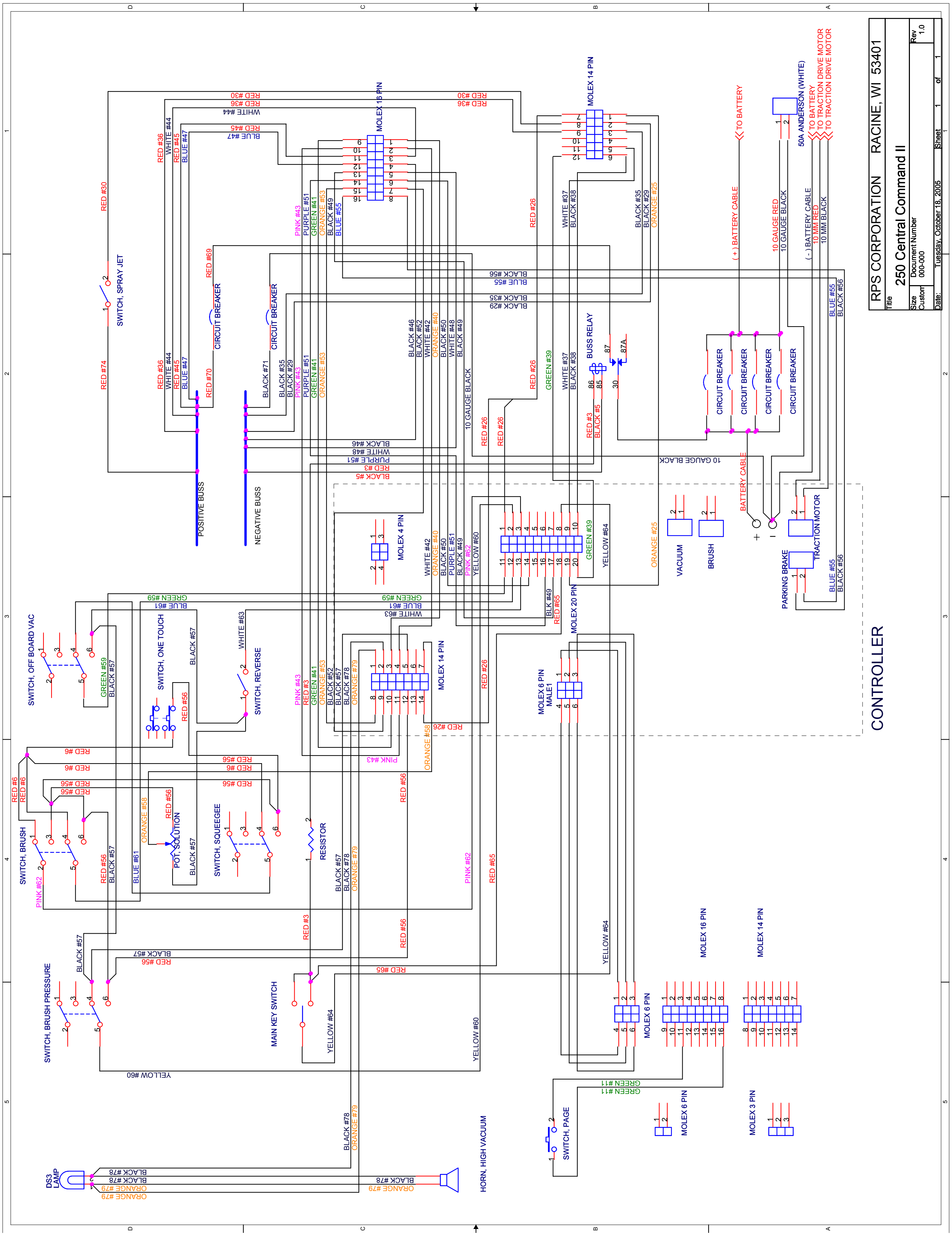
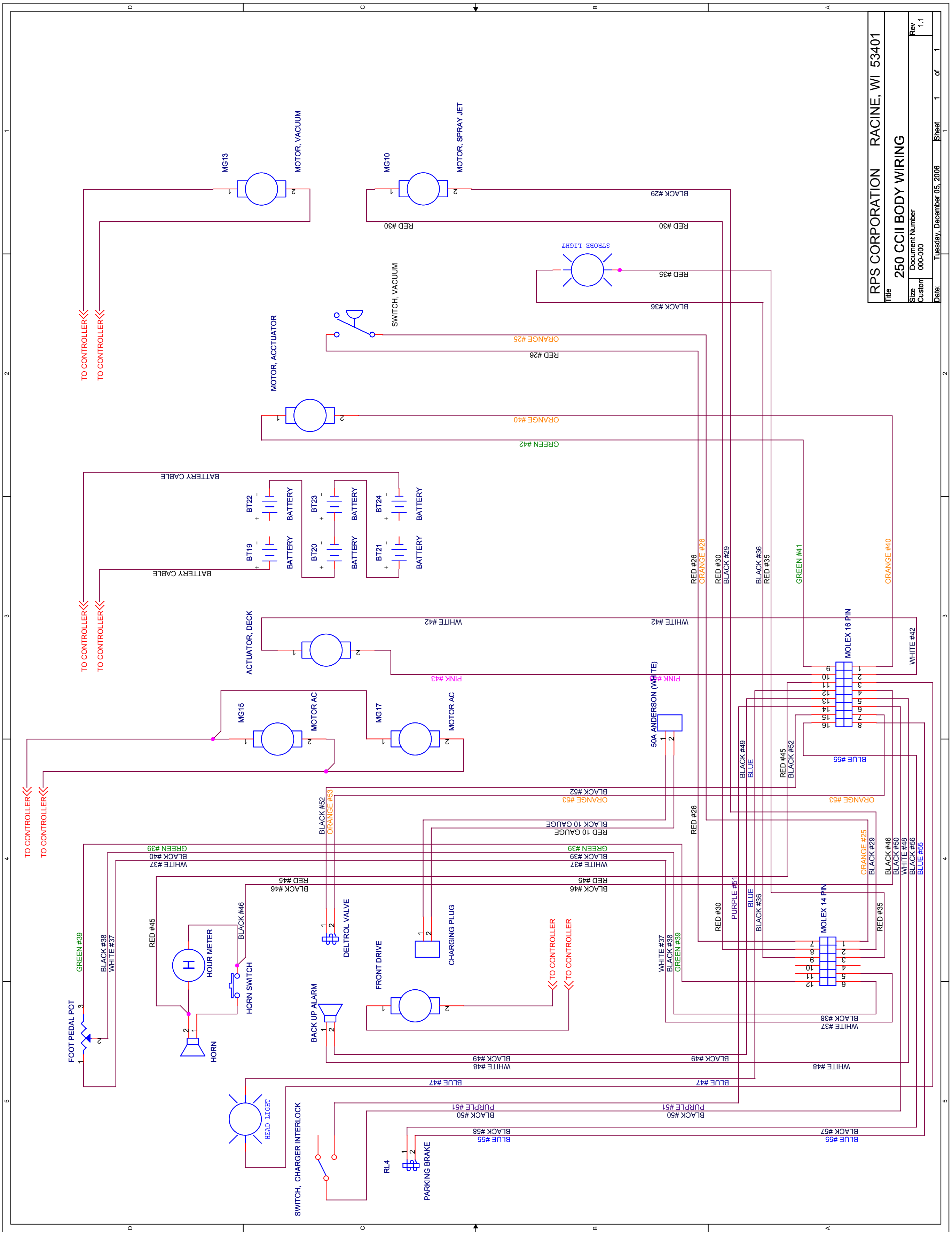
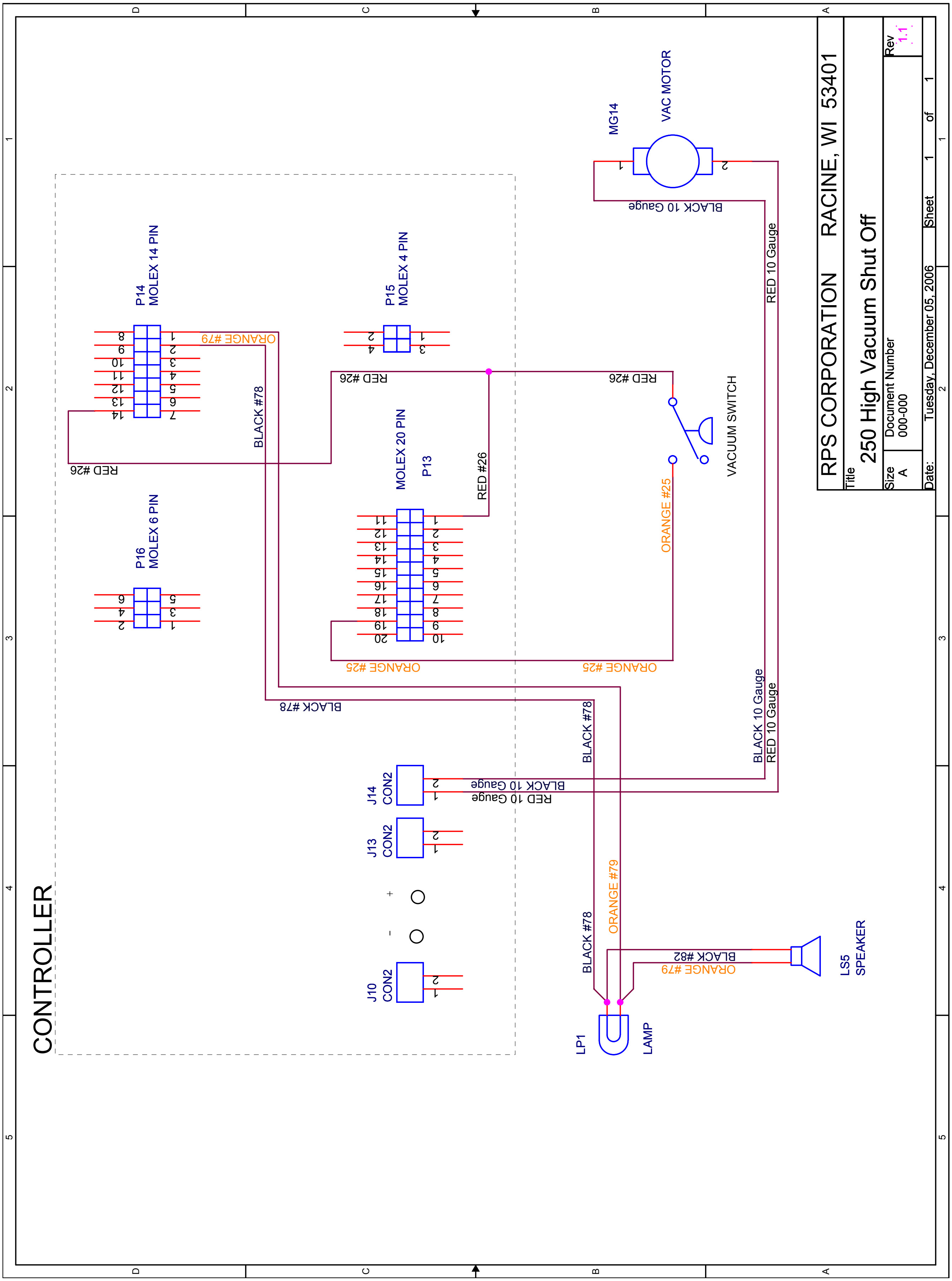


RPS CORPORATION RACINE, WI 53401
Title
MAGNUM Central Command II Wiring
Size Custom
Document Number 000-000
Rev 1.0
Date: Tuesday, November 29, 2005
Sheet 1 of 1
SWITCH, HANDLEBAR
POT, SOLUTION
SWITCH, SCRUB
SWITCH, PAGE
SWITCH, BRUSH PRESSURE
MAIN BUSS RELAY
CIRCUIT BREAKER
MOLEX 6 PIN
MOLEX 16 PIN
MOLEX 3 PIN
MOLEX 14 PIN
MOLEX 4 PIN
MOLEX 20 PIN
CON12B
CON2
TO BATTERIES
POT, SPEED
SWITCH, REVERSE
SWITCH, VACUUM
SWITCH, MAIN POWER
SWITCH, SPRAY JET
SWITCH, PRUSH PRESSURE LOCK OUT
0.25 QUICK CONNECT


RPS CORPORATION RACINE, WI 53401
Title
MAGNUM CCII Body Wiring
Size
B
Document Number
000-000
Rev
1.0
Date: Tuesday, November 29, 2005
Sheet 1 of 1
CON12B
DELTROL VALVE
CHARGER PLUG
50A ANDERSEN, RED
BATTERY
BATTERY
BATTERY
BATTERY
TO CONTROLLER
TO CONTROLLER
MOTOR, VACUUM
MOTOR, TRACTION
MOTOR, DECK ACTUATOR
MOTOR, SPRAY JET
MOTOR, BRUSH
MOTOR, BRUSH
75A ANDERSEN
75A ANDERSEN
BLACK #72
ORANGE #71
WHITE #131
PINK #130
BLACK #184
RED #183


RPS CORPORATION RACINE, WI 53401
Title
250 Central Command II
Size Custom
Document Number 000-000
Rev 1.0
Date: Tuesday, October 18, 2005
Sheet 1 of 1
CONTROLLER
MOLEX 16 PIN
MOLEX 14 PIN
MOLEX 4 PIN
MOLEX 20 PIN
MOLEX 6 PIN MALE1
MOLEX 6 PIN
MOLEX 3 PIN
POSITIVE BUSS
NEGATIVE BUSS
CIRCUIT BREAKER
BUSS RELAY
SWITCH, SPRAY JET
SWITCH, OFF BOARD VAC
SWITCH, ONE TOUCH
SWITCH, REVERSE
SWITCH, BRUSH
POT, SOLUTION
SWITCH, SQUEEGEE
RESISTOR
SWITCH, BRUSH PRESSURE
MAIN KEY SWITCH
HORN, HIGH VACUUM
SWITCH, PAGE
DS3 LAMP
VACUUM
BRUSH
PARKING BRAKE
TRACTION MOTOR
(+) BATTERY CABLE
(-) BATTERY CABLE
BATTERY CABLE
TO BATTERY
50A ANDERSON (WHITE)
TO TRACTION DRIVE MOTOR
10 GAUGE RED
10 GAUGE BLACK
10 MM RED
10 MM BLACK


RPS CORPORATION RACINE, WI 53401
Title
250 CCII BODY WIRING
Size Custom
Document Number 000-000
Rev 1.1
Date: Tuesday, December 05, 2006
Sheet 1 of 1
MOTOR, VACUUM
MOTOR, SPRAY JET
SWITCH, VACUUM
MOTOR, ACCTUATOR
STROBE LIGHT
BATTERY CABLE
BATTERY
ACTUATOR, DECK
MOTOR AC
MOLEX 16 PIN
50A ANDERSON (WHITE)
MOLEX 14 PIN
TO CONTROLLER
HOUR METER
HORN SWITCH
HORN
FOOT PEDAL POT
DELTROL VALVE
CHARGING PLUG
FRONT DRIVE
BACK UP ALARM
HEAD LIGHT
SWITCH, CHARGER INTERLOCK
PARKING BRAKE



RPS CORPORATION RACINE, WI 53401
Title
250 High Vacuum Shut Off
Size
A
Document Number
000-000
Rev
1.1
Date: Tuesday, December 05, 2006
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CONTROLLER
P14
MOLEX 14 PIN
P15
MOLEX 4 PIN
P16
MOLEX 6 PIN
MOLEX 20 PIN
P13
J14
CON2
J13
CON2
J10
CON2
MG14
VAC MOTOR
VACUUM SWITCH
LP1
LAMP
LS5
SPEAKER
ORANGE #79
BLACK #78
RED #26
ORANGE #25
RED 10 Gauge
BLACK 10 Gauge
BLACK #82

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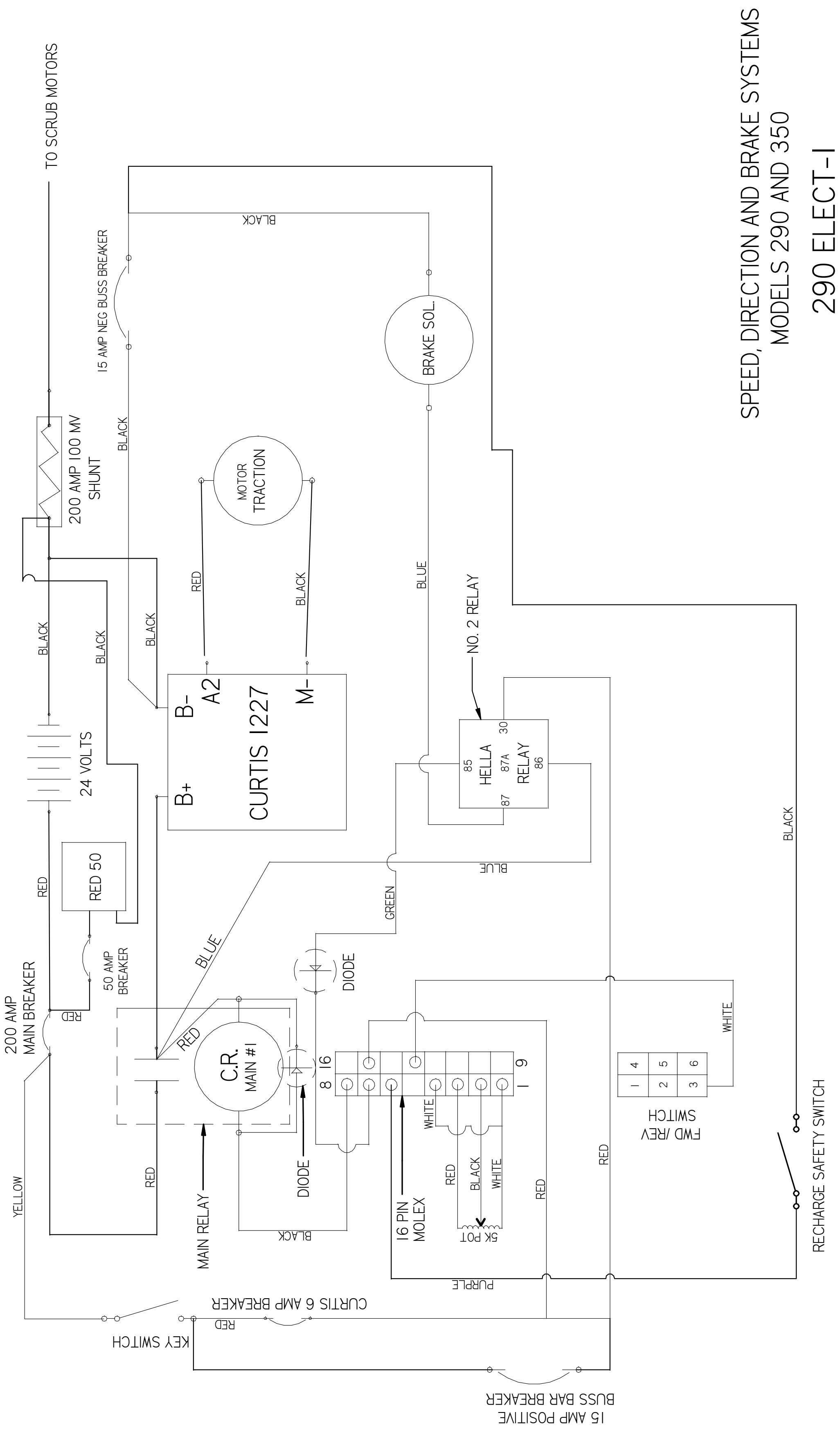
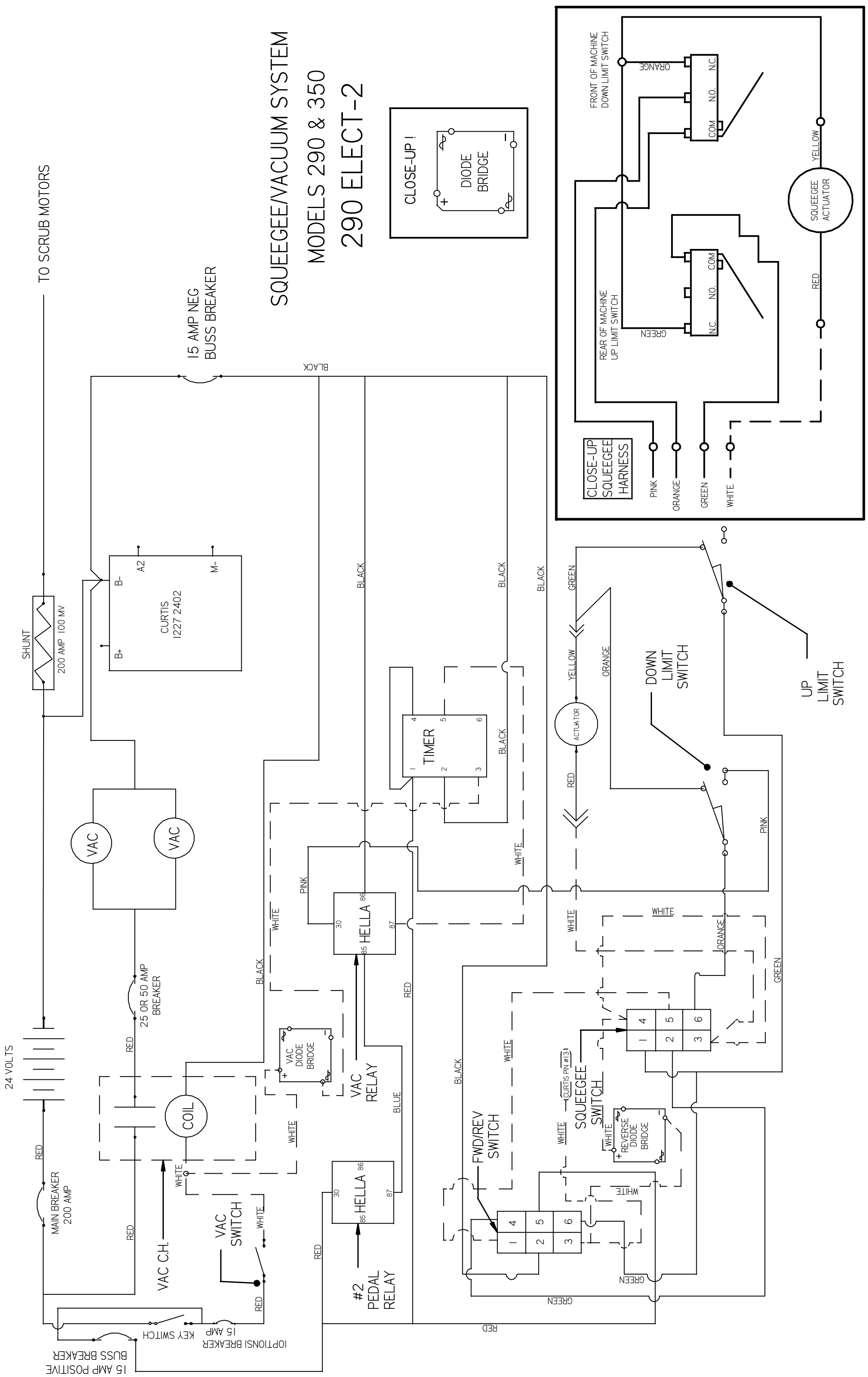
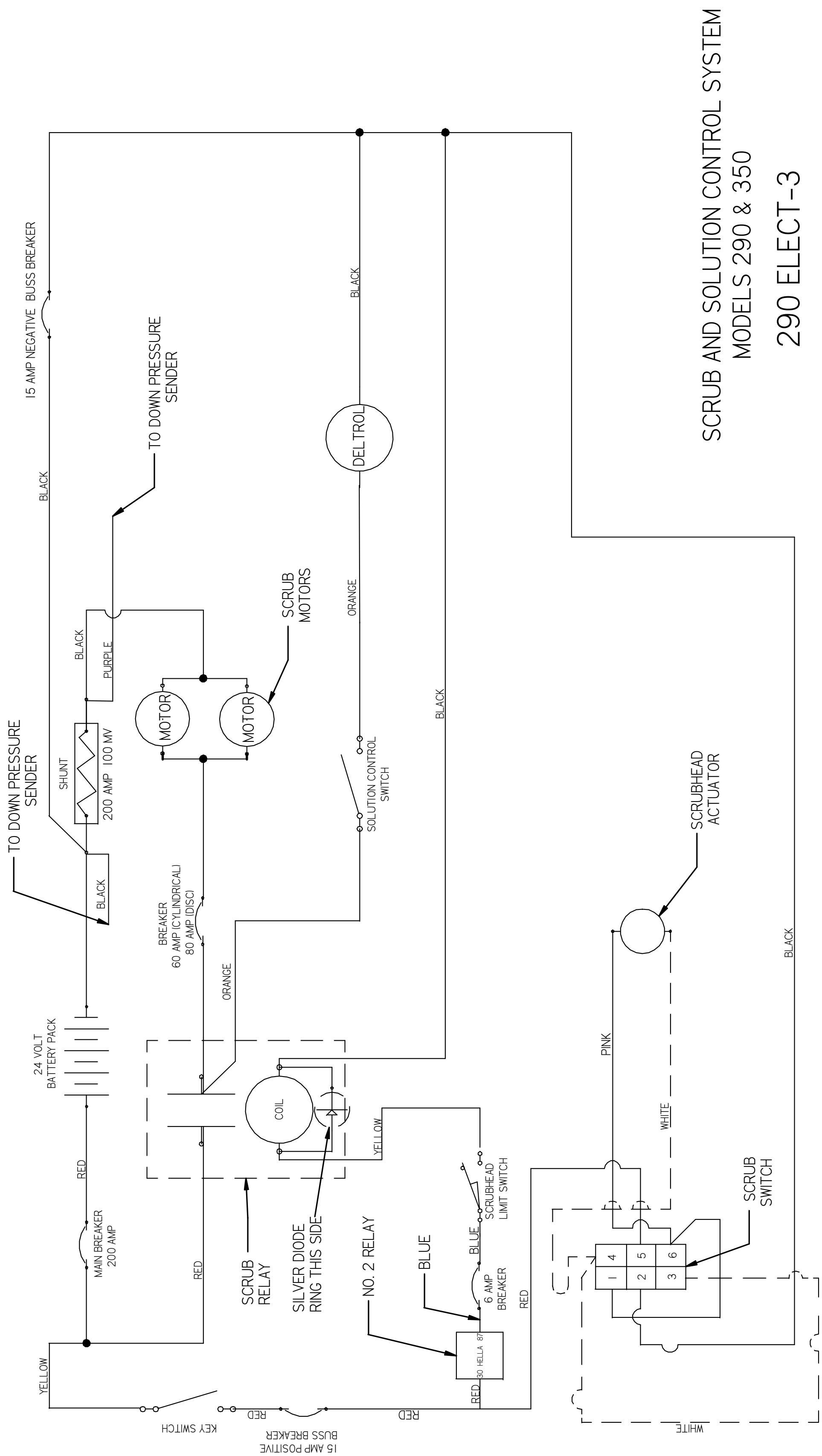
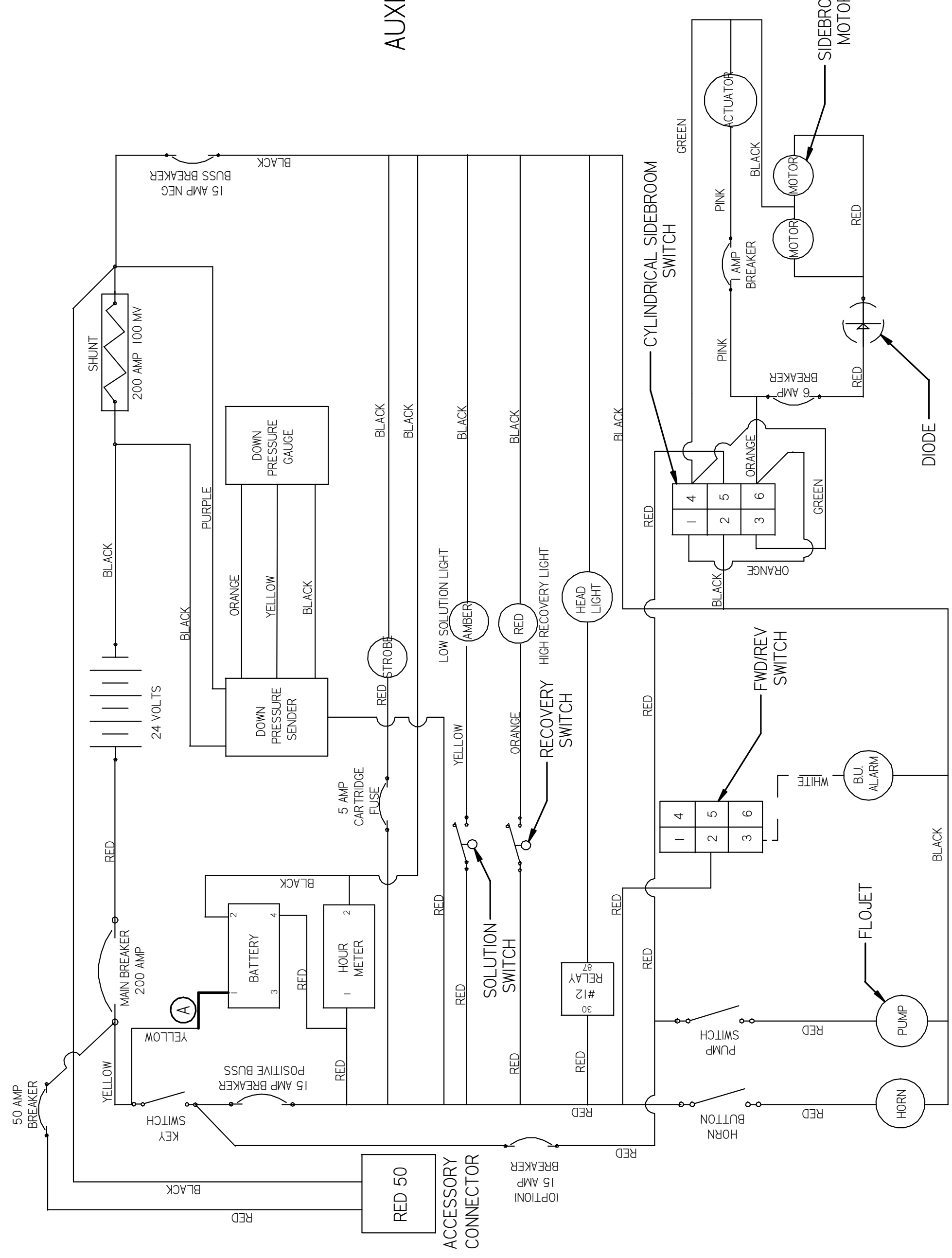

SPEED, DIRECTION AND BRAKE SYSTEMS
MODELS 290 AND 350
290 ELECT-I
TO SCRUB MOTORS
BLACK
I5 AMP NEG BUSS BREAKER
BRAKE SOL.
200 AMP 100 MV
SHUNT
MOTOR
TRACTION
RED
BLUE
NO. 2 RELAY
B-
A2
M-
CURTIS I227
B+
24 VOLTS
HELLA
RELAY
85
87A
86
87
30
RED 50
50 AMP
BREAKER
200 AMP
MAIN BREAKER
GREEN
DIODE
C.R.
MAIN #1
8
16
9
I
4
5
6
1
2
3
WHITE
FWD /REV
SWITCH
YELLOW
MAIN RELAY
16 PIN
MOLEX
5K POT
PURPLE
RECHARGE SAFETY SWITCH
CURTIS 6 AMP BREAKER
KEY SWITCH
I5 AMP POSITIVE
BUSS BAR BREAKER

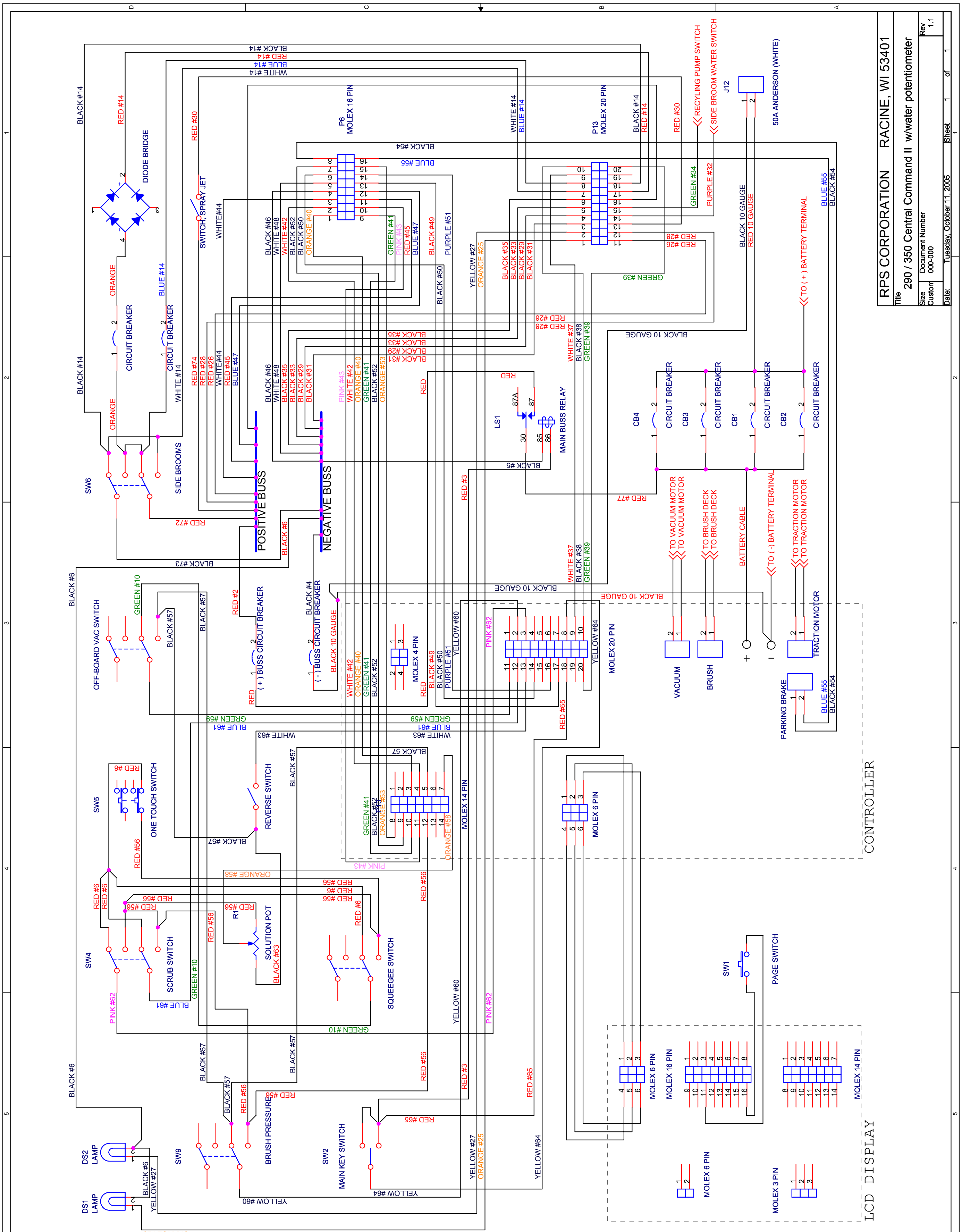

SQUEEGEE/VACUUM SYSTEM
MODELS 290 & 350
290 ELECT-2
CLOSE-UP !
DIODE BRIDGE
TO SCRUB MOTORS
15 AMP NEG BUSS BREAKER
BLACK
SHUNT
200 AMP 100 MV
CURTIS 1227 2402
B- A2 M- B+
24 VOLTS
25 OR 50 AMP BREAKER
RED
VAC
VAC
COIL
VAC DIODE BRIDGE
VAC RELAY
HELLA
TIMER
PINK
WHITE
BLUE
MAIN BREAKER 200 AMP
VAC C.H.
VAC SWITCH
#2 PEDAL RELAY
15 AMP POSITIVE BUSS BREAKER
KEY SWITCH
15 AMP (OPTIONS) BREAKER
FWD/REV SWITCH
SQUEEGEE SWITCH
CURTIS PIN #13
REVERSE DIODE BRIDGE
GREEN
YELLOW
ORANGE
ACTUATOR
DOWN LIMIT SWITCH
UP LIMIT SWITCH
CLOSE-UP SQUEEGEE HARNESS
FRONT OF MACHINE DOWN LIMIT SWITCH
REAR OF MACHINE UP LIMIT SWITCH
COM N.O. N.C.
SQUEEGEE ACTUATOR

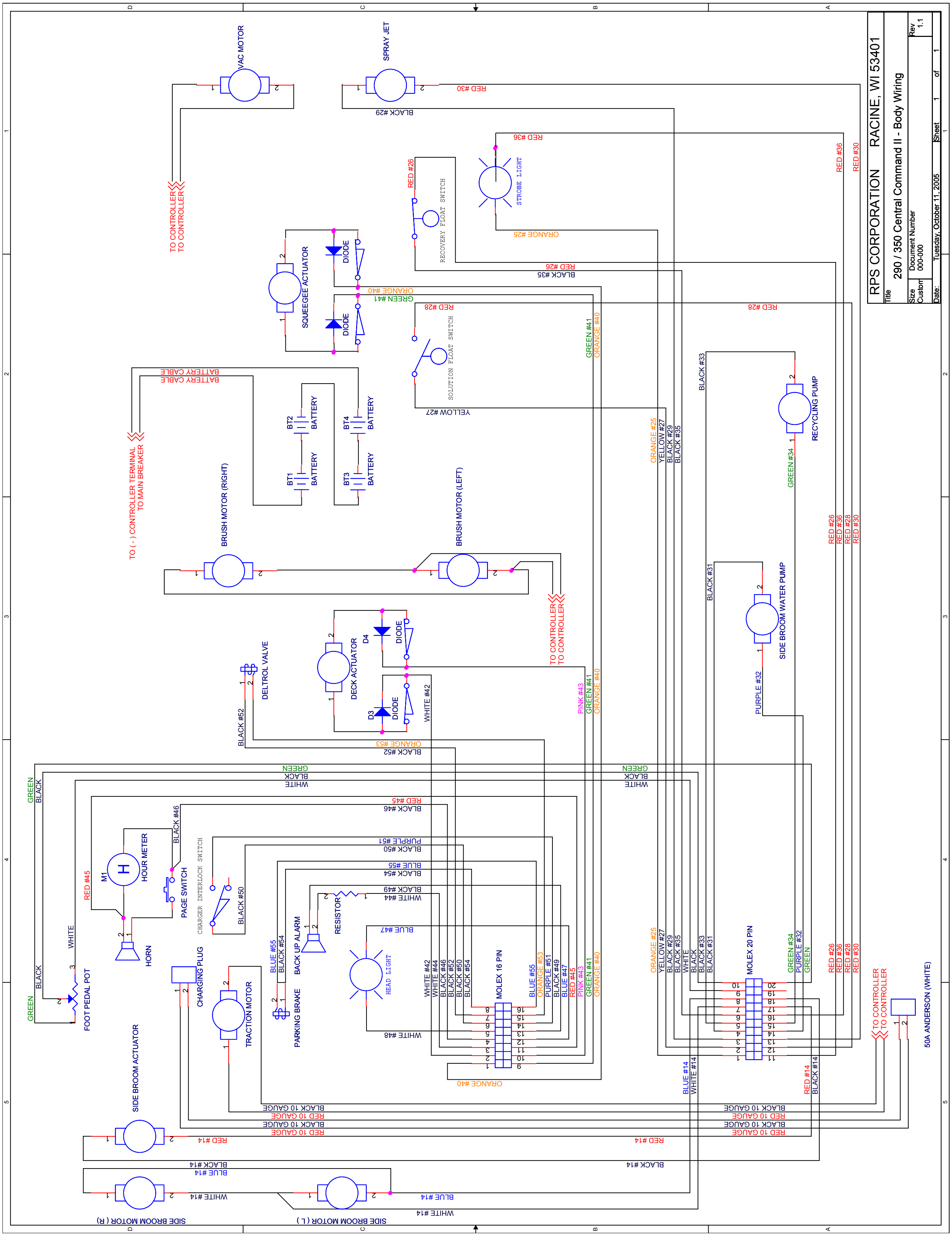


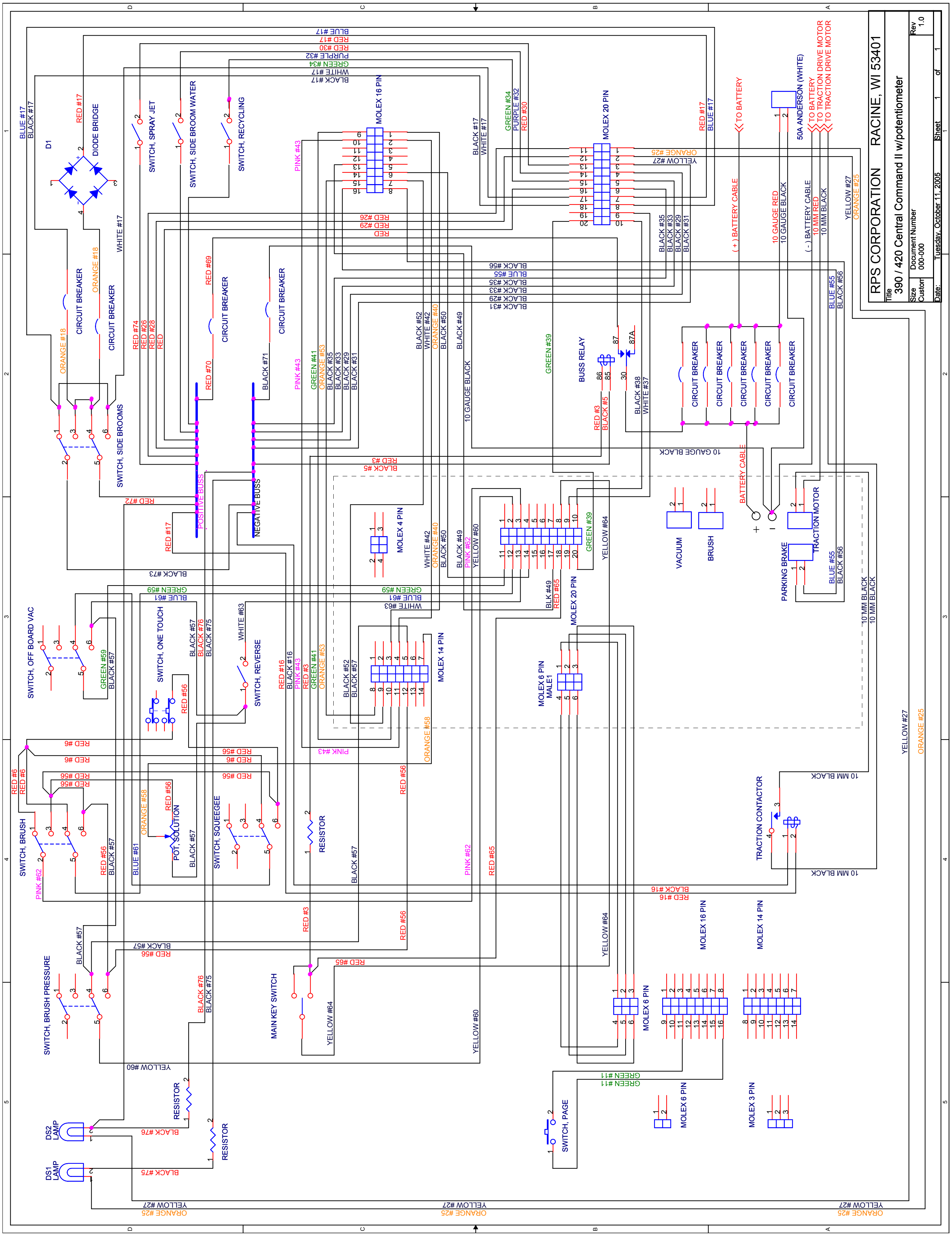
SCRUB AND SOLUTION CONTROL SYSTEM
MODELS 290 & 350
290 ELECT-3
15 AMP NEGATIVE BUSS BREAKER
BLACK
TO DOWN PRESSURE SENDER
DELTROL
ORANGE
SCRUB MOTORS
MOTOR
MOTOR
PURPLE
SHUNT
200 AMP 100 MV
SOLUTION CONTROL SWITCH
BREAKER 60 AMP (CYLINDRICAL) 80 AMP (DISC)
24 VOLT BATTERY PACK
COIL
YELLOW
SCRUBHEAD LIMIT SWITCH
SCRUBHEAD ACTUATOR
PINK
WHITE
SCRUB SWITCH
MAIN BREAKER 200 AMP
RED
SCRUB RELAY
SILVER DIODE RING THIS SIDE
NO. 2 RELAY
BLUE
6 AMP BREAKER
30 HELLA 87
KEY SWITCH
15 AMP POSITIVE BUSS BREAKER

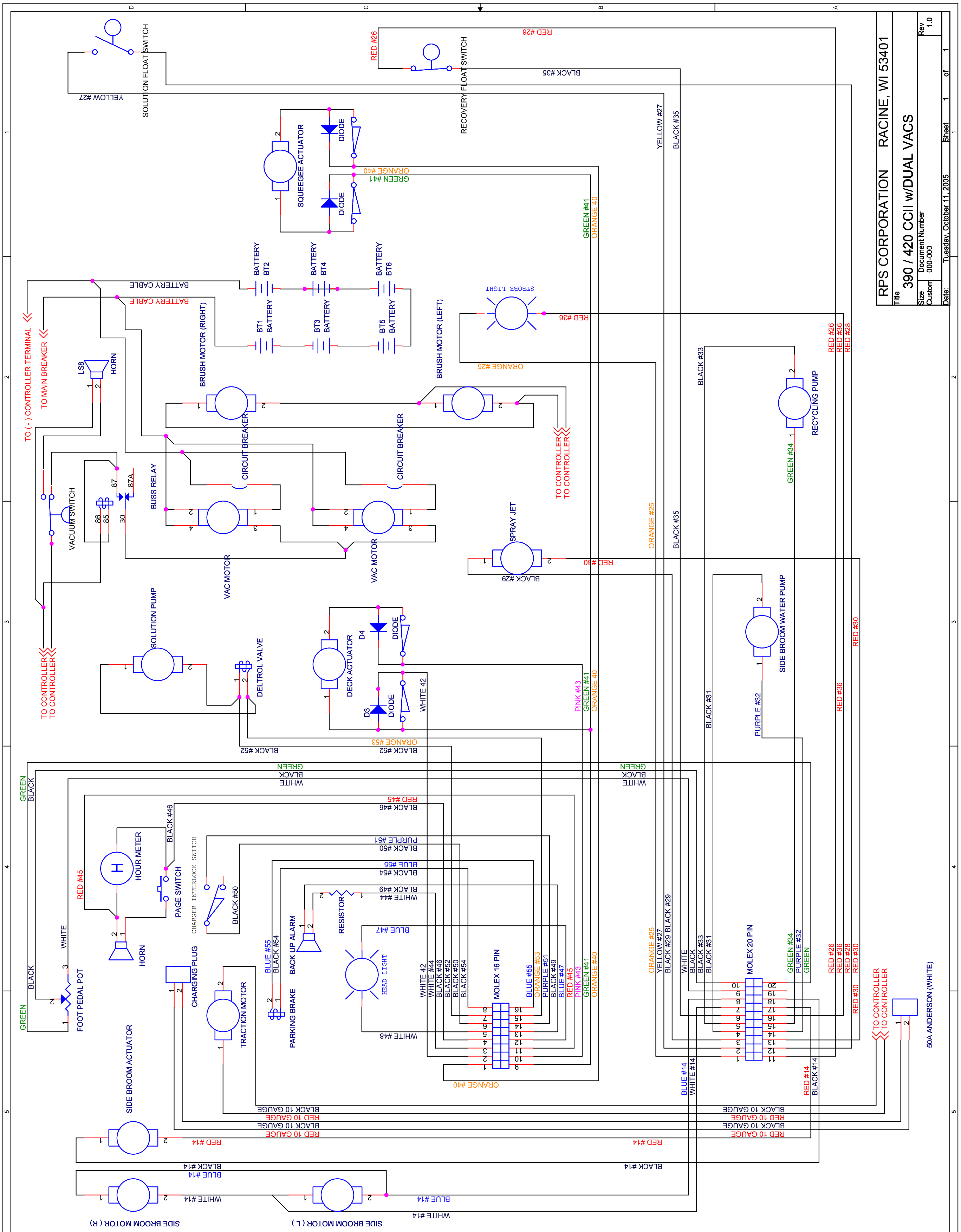
AUXILIARY, INSTRUMENT & INDICATORS
MODELS 290 & 350
290 ELECT-4




RPS CORPORATION RACINE, WI 53401
290 / 350 Central Command II w/water potentiometer
Document Number
000-000
Tuesday, October 11, 2005
POSITIVE BUSS
NEGATIVE BUSS
CONTROLLER
LCD DISPLAY


RPS CORPORATION RACINE, WI 53401
Title
290 / 350 Central Command II - Body Wiring
Size Custom
Document Number 000-000
Rev 1.1
Date: Tuesday, October 11, 2005
Sheet 1 of 1
VAC MOTOR
SPRAY JET
STROBE LIGHT
RECOVERY FLOAT SWITCH
SQUEEGEE ACTUATOR
DIODE
SOLUTION FLOAT SWITCH
RECYCLING PUMP
BATTERY
BATTERY CABLE
TO (-) CONTROLLER TERMINAL
TO MAIN BREAKER
TO CONTROLLER
BRUSH MOTOR (RIGHT)
BRUSH MOTOR (LEFT)
SIDE BROOM WATER PUMP
DECK ACTUATOR
DELTROL VALVE
HOUR METER
PAGE SWITCH
CHARGER INTERLOCK SWITCH
HORN
FOOT PEDAL POT
CHARGING PLUG
TRACTION MOTOR
PARKING BRAKE
BACK UP ALARM
RESISTOR
HEAD LIGHT
MOLEX 16 PIN
MOLEX 20 PIN
50A ANDERSON (WHITE)
SIDE BROOM ACTUATOR
SIDE BROOM MOTOR (R)
SIDE BROOM MOTOR (L)


RPS CORPORATION RACINE, WI 53401
Title
390 / 420 Central Command II w/potentiometer
Size Custom
Document Number 000-000
Rev 1.0
Date: Tuesday, October 11, 2005
Sheet 1 of 1
MOLEX 16 PIN
MOLEX 20 PIN
MOLEX 14 PIN
MOLEX 6 PIN
MOLEX 4 PIN
MOLEX 3 PIN
CIRCUIT BREAKER
DIODE BRIDGE
POSITIVE BUSS
NEGATIVE BUSS
BUSS RELAY
TRACTION CONTACTOR
TRACTION MOTOR
PARKING BRAKE
VACUUM
BRUSH
MAIN KEY SWITCH
SWITCH, SIDE BROOMS
SWITCH, BRUSH
SWITCH, BRUSH PRESSURE
SWITCH, SQUEEGEE
SWITCH, REVERSE
SWITCH, ONE TOUCH
SWITCH, OFF BOARD VAC
SWITCH, SPRAY JET
SWITCH, SIDE BROOM WATER
SWITCH, RECYCLING
SWITCH, PAGE
POT, SOLUTION
RESISTOR
DS1 LAMP
DS2 LAMP
50A ANDERSON (WHITE)
TO BATTERY
TO TRACTION DRIVE MOTOR


RPS CORPORATION RACINE, WI 53401
Title
390 / 420 CCII w/DUAL VACS
Size Custom
Document Number 000-000
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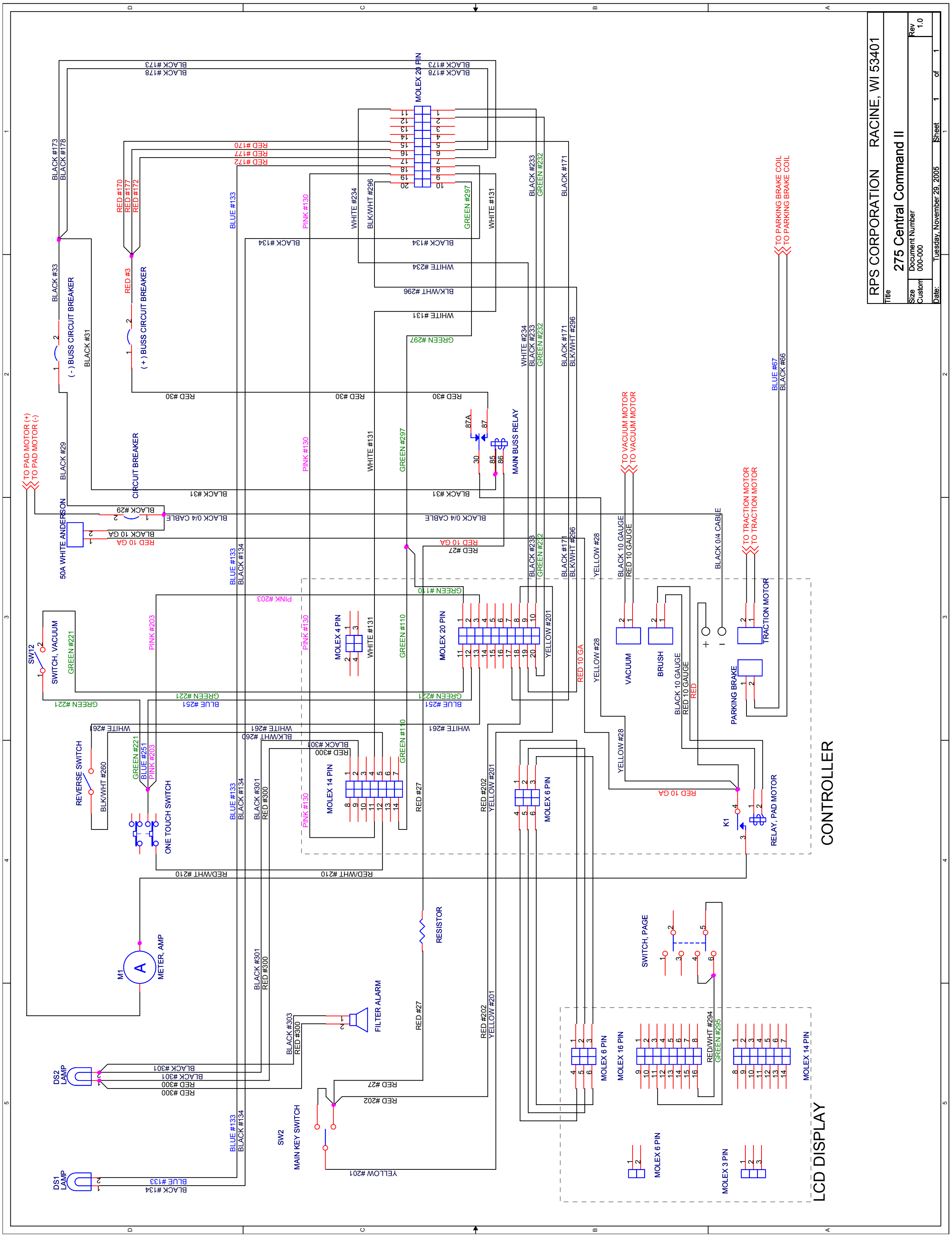
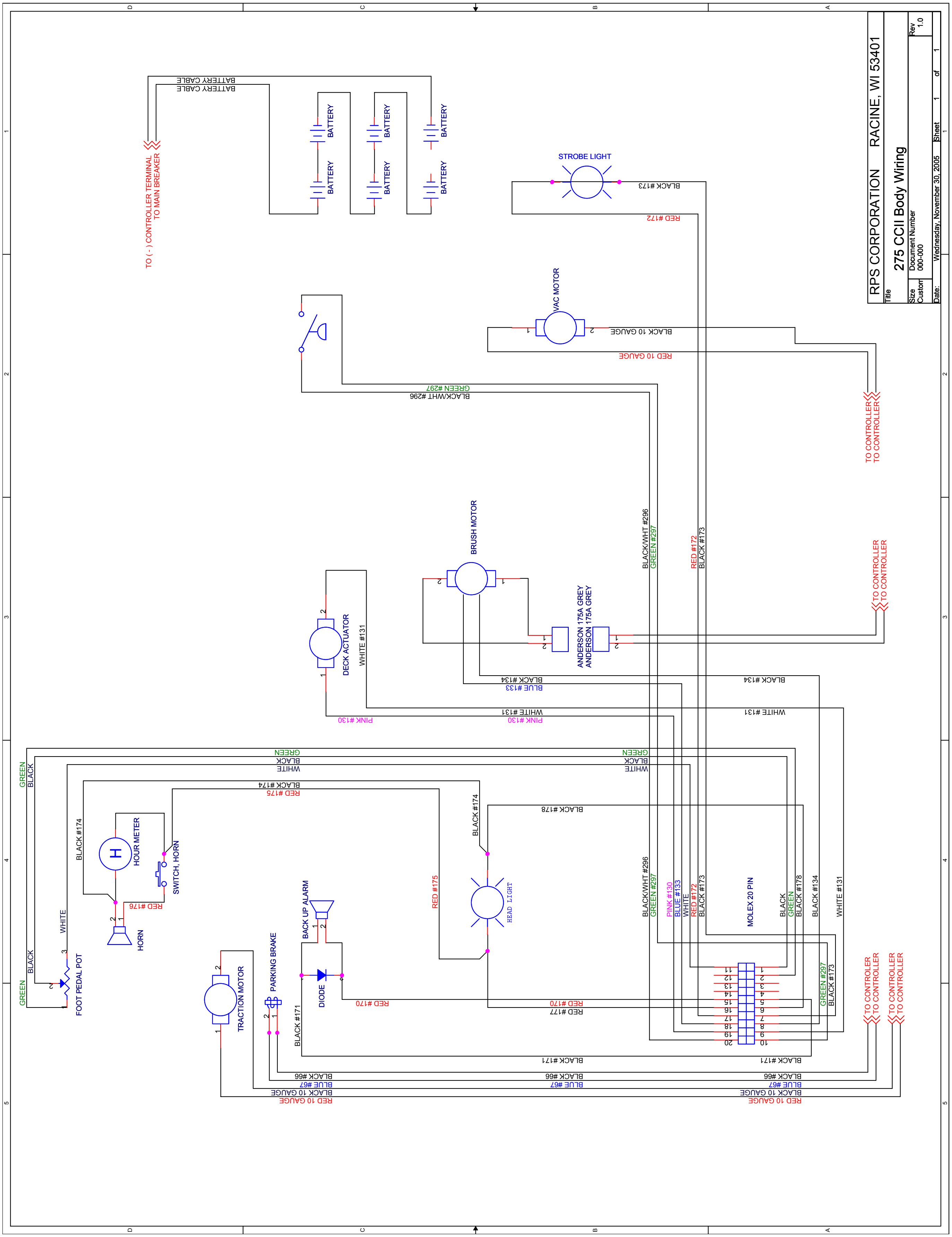
Sheet 1 of 1
SOLUTION FLOAT SWITCH
RECOVERY FLOAT SWITCH
SQUEEGEE ACTUATOR
DIODE
BATTERY BT1
BATTERY BT2
BATTERY BT3
BATTERY BT4
BATTERY BT5
BATTERY BT6
STROBE LIGHT
BRUSH MOTOR (RIGHT)
BRUSH MOTOR (LEFT)
RECYCLING PUMP
TO (-) CONTROLLER TERMINAL
TO MAIN BREAKER
HORN
VACUUM SWITCH
BUSS RELAY
CIRCUIT BREAKER
VAC MOTOR
SPRAY JET
SOLUTION PUMP
DELTROL VALVE
DECK ACTUATOR
SIDE BROOM WATER PUMP
HOUR METER
PAGE SWITCH
CHARGER INTERLOCK SWITCH
FOOT PEDAL POT
CHARGING PLUG
TRACTION MOTOR
PARKING BRAKE
BACK UP ALARM
RESISTOR
HEAD LIGHT
MOLEX 16 PIN
MOLEX 20 PIN
50A ANDERSON (WHITE)
TO CONTROLLER
SIDE BROOM ACTUATOR
SIDE BROOM MOTOR (R)
SIDE BROOM MOTOR (L)


RPS CORPORATION RACINE, WI 53401
Title
275 Central Command II
Size
Custom
Document Number
000-000
Rev
1.0
Date: Tuesday, November 29, 2005
Sheet 1 of 1
CONTROLLER
LCD DISPLAY
MOLEX 20 PIN
MOLEX 4 PIN
MOLEX 14 PIN
MOLEX 6 PIN
MOLEX 16 PIN
MOLEX 3 PIN
MAIN BUSS RELAY
(-) BUSS CIRCUIT BREAKER
(+) BUSS CIRCUIT BREAKER
CIRCUIT BREAKER
50A WHITE ANDERSON
TO PAD MOTOR (+)
TO PAD MOTOR (-)
TO VACUUM MOTOR
TO TRACTION MOTOR
TO PARKING BRAKE COIL
SWITCH, VACUUM
REVERSE SWITCH
ONE TOUCH SWITCH
VACUUM
BRUSH
PARKING BRAKE
TRACTION MOTOR
RELAY, PAD MOTOR
METER, AMP
RESISTOR
SWITCH, PAGE
FILTER ALARM
MAIN KEY SWITCH
DS1 LAMP
DS2 LAMP


RPS CORPORATION RACINE, WI 53401
Title
275 CCII Body Wiring
Size
Custom
Document Number
000-000
Rev
1.0
Date: Wednesday, November 30, 2005
Sheet 1 of 1
BATTERY CABLE
BATTERY CABLE
TO (-) CONTROLLER TERMINAL
TO MAIN BREAKER
BATTERY
STROBE LIGHT
BLACK #173
RED #172
VAC MOTOR
BLACK 10 GAUGE
RED 10 GAUGE
TO CONTROLLER
TO CONTROLLER
GREEN #297
BLACK/WHT #296
BRUSH MOTOR
ANDERSON 175A GREY
ANDERSON 175A GREY
DECK ACTUATOR
WHITE #131
BLACK #134
BLUE #133
PINK #130
GREEN
BLACK
WHITE
BLACK #174
RED #175
BLACK #178
HOUR METER
SWITCH, HORN
HORN
RED #176
HEAD LIGHT
BACK UP ALARM
FOOT PEDAL POT
TRACTION MOTOR
PARKING BRAKE
DIODE
MOLEX 20 PIN
RED #170
RED #177
BLACK #171
BLACK #66
BLUE #67
BLACK 10 GAUGE
RED 10 GAUGE

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