

Betco/Motion Mechanics **Base Floor Scrubber** **Controller Specification**

Designed by Westshore Design

1. **GENERAL DESCRIPTION** – This product is an electronic controller for a base (lower content) floor scrubber. The user interface consists of a height adjuster selector switch and a solution control potentiometer. The controller will control position of the down pressure linear actuator and the solution dispensing control motor.
2. **DEFINITIONS**
 - 2.1. Controller – An electronic PCB with microcontroller which monitors user interface switches and internal mechanisms and controls motors as appropriate
 - 2.2. Potentiometer (Pot) – A turn knob with variable resistance which allows for smooth variable operation
 - 2.3. Linear Actuator – A motor-controlled device which can extend or retract a mechanism linearly
 - 2.4. I-Drive – Main power control module that controls drive motors and scrubber motors
3. **AGENCY APPROVALS**
 - 3.1. No agency (UL, FCC) approvals are required.
4. **QUALITY GOALS**
 - 4.1. This product is to be produced to a commercial grade per applicable sections of IPC-A-610D *Acceptability of Electronic Assemblies*.
 - 4.2. Product carries a 1 year warranty from date of manufacture.
5. **I/O CONNECTIONS**
 - 5.1. **POWER CONNECTOR** – Input

Pin 1	BATT +
Pin 2	GND

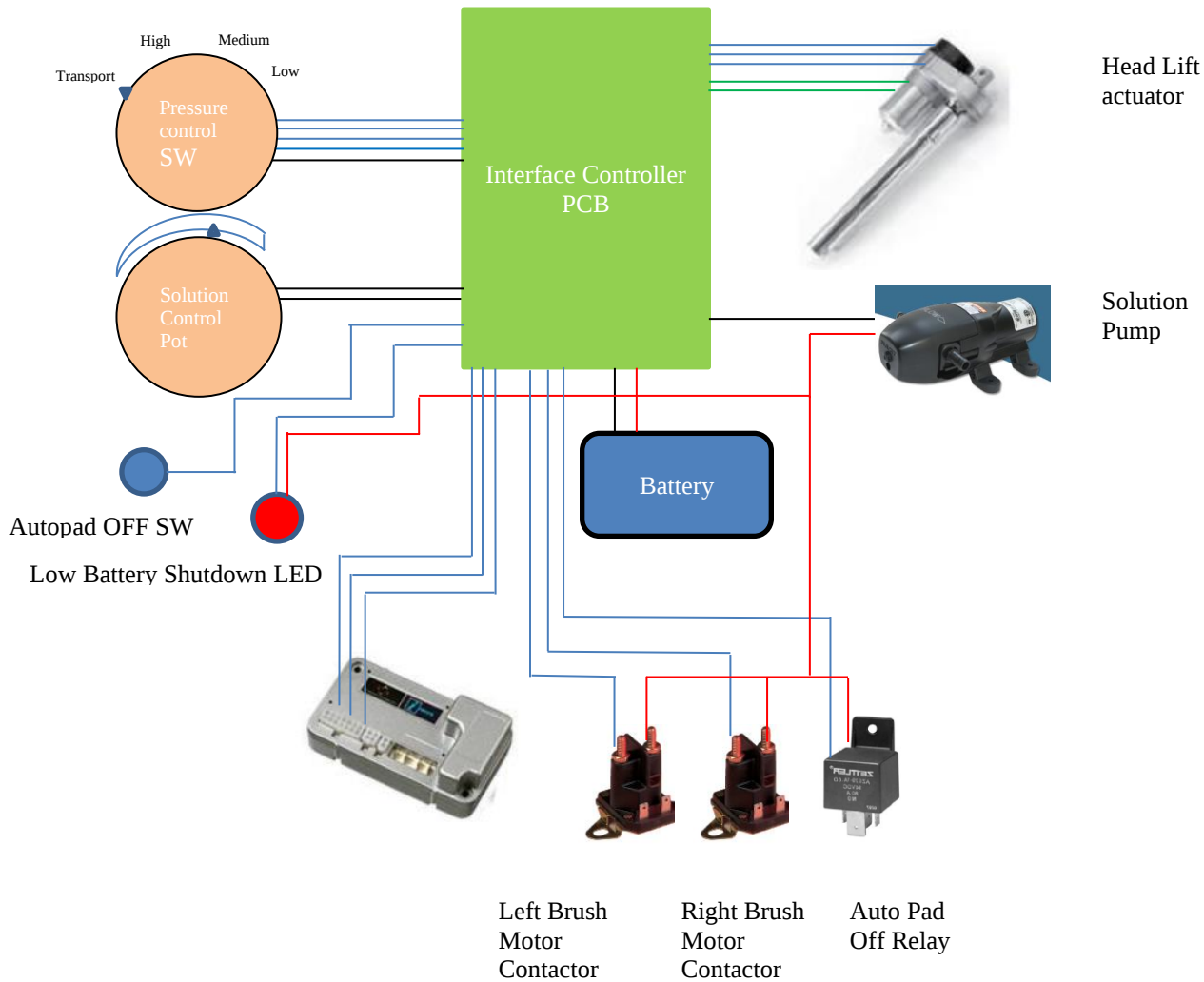
- 5.2. **SWITCH AND SENSOR** – Inputs – Molex Minifit Junior 10 Pin header

Pin 1	Head Height SW - Transport Mode
Pin 2	Head Height SW – High Pressure
Pin 3	Head Height SW – Medium Pressure
Pin 4	Head Height SW – Low Pressure
Pin 5	Head Height SW - Ground
Pin 6	Solution control Pot - Ground
Pin 7	Solution control Pot wiper
Pin 8	Auto Pad OFF switch
Pin 9	Propel Sense
Pin 10	Battery water level sense

5.3. LINEAR ACTUATOR CONTROL I/O and ADDITIONAL I/O – Molex Minifit Junior 12 pin header

Pin 1	Actuator Motor - output
Pin 2	Actuator Motor - output
Pin 3	Low pressure switch - input
Pin 4	Medium pressure switch - input
Pin 5	High pressure switch - input
Pin 6	Solution Flow Solenoid - output
Pin 7	Battery water level low LED - output
Pin 8	Battery Level Inhibit - output
Pin 9	Battery Level Inhibit - output
Pin 10	Left Brush Motor Contactor - output
Pin 11	Right Brush Motor Contactor - output
Pin 12	Auto Pad Off Relay - output

5.4. APPLICATION DIAGRAMS



6. ELECTRICAL INTERFACE REQUIREMENTS

6.1. POWER CONNECTION

- 6.1.1. 24VDC +/- 20% from battery.
- 6.1.2. During charge the battery charger may go as high as 32.4V
- 6.1.3. Provide fused circuit (1.1A) for the electronic control circuit, and another fused circuit to the motors (10A)

6.2. INPUTS

6.2.1. SCRUBBER PRESSURE CONTROL SWITCH

- 6.2.1.1. Transport – when selected provides GND input to microcontroller
- 6.2.1.2. High Pressure– when selected provides GND input to microcontroller
- 6.2.1.3. Medium Pressure– when selected provides GND input to microcontroller
- 6.2.1.4. Low Pressure– when selected provides GND input to microcontroller

6.2.2. SOLUTION CONTROL POTENTIOMETER

- 6.2.2.1. Variable resistance based on position: 0 – 5000 ohms
 - 6.2.2.1.1. Provide a pullup on the control board on this input.

6.2.3. DOWN PRESSURE LINEAR ACTUATOR POSITION SWITCHES

- 6.2.3.1. High pressure position – provides GND input to microcontroller when actuator reaches 'high' pressure position. Closes only when high pressure is attained.
- 6.2.3.2. Medium pressure position – provides GND input to microcontroller when actuator reaches 'medium' pressure position. Remains closed from medium pressure through high pressure.
- 6.2.3.3. Low pressure position – provides GND input to microcontroller when actuator reaches 'low' pressure position. Remains closed from low pressure through high pressure.
- 6.2.3.4. Transport mode position – provides GND input to microcontroller when actuator is in transport position.

6.2.4. BATTERY WATER LEVEL SENSOR

- 6.2.4.1. Battery water level sensor is optional. Put a jumper in the HW to jumper to VCC to default to no sensor present. If a scrubber is equipped with the sensor, the customer is to remove the jumper and the sensor will drive the input based on water level:
 - 6.2.4.1.1. Battery water level good = 5.0VDC +/- 5%
 - 6.2.4.1.2. Battery water level too low = 0VDC

6.2.5. AUTO PAD OFF SWITCH

- 6.2.5.1. Provides GND input to microcontroller when pressed

6.2.6. PROPEL SENSE INPUT

- 6.2.6.1. Input from i-Drive when scrubber is moving. Input pulled to GND when moving, input left open (and pulled high to 5V internally) when not moving.

6.2.7. LINEAR ACTUATOR TRANSPORT SWITCH INPUT

- 6.2.7.1. This input goes low when linear actuator has reached transport position (full retract)

6.3. OUTPUTS

6.3.1.1. LINEAR ACTUATOR

- 6.3.1.1.1. Actuator control #1 – 24VDC or GND @ 8A max
- 6.3.1.1.2. Actuator control #2 – 24VDC or GND @ 8A max

6.3.1.2. SOLUTION CONTROL PUMP

6.3.1.2.1. Solution flow solenoid – PWM GND @ 1.5A max

6.3.1.3. SOLUTION CONTROL POTENTIOMETER

6.3.1.3.1. Provide a GND output to the solution control potentiometer

6.3.1.4. HEAD HEIGHT ADJUSTMENT SWITCH

6.3.1.4.1. Provide a GND output to the 4 position switch

6.3.1.5. BATTERY WATER LEVEL LED

6.3.1.5.1. Provide an output low (0V) to drive an external LED at 30mA

6.3.1.6. BATTERY WATER LEVEL INHIBIT TO I-DRIVE

6.3.1.6.1. Provide a switched relay output to two pins of the i-Drive when battery water level is low. Max current through the relay is 10mA.

6.3.1.7. LEFT BRUSH MOTOR CONTACTOR

6.3.1.7.1. Provide an output low (0V) to drive an external solenoid – max 400mA

6.3.1.8. RIGHT BRUSH MOTOR CONTACTOR

6.3.1.8.1. Provide an output low (0V) to drive an external solenoid – max 400mA

6.3.1.9. AUTOPAD RELAY

6.3.1.9.1. Provide an output low (0V) to drive an external relay – max 100mA

7. FUNCTIONAL DESCRIPTION

7.1. Startup

7.1.1. Battery monitor check

7.1.1.1. Perform a check at power up only.

7.1.1.2. Read the battery level sensor input.

7.1.1.2.1. If the sensor reads 4.75V or above, do nothing.

7.1.1.2.2. If the sensor reads 0V and battery voltage is > 23.75V:

7.1.1.2.2.1. Turn on the low battery indicator LED

7.1.1.2.2.2. Switch on the relay to the i-Drive controller.

7.1.1.2.2.3. Ignore head height input and raise head to transport mode

7.1.1.2.2.4. Disable brush contactors, solution motor, and actuator

7.1.1.2.2.5. Do not restore normal functionality until after a key cycle after the water level is corrected.

7.1.2. Check scrubber head height input switches and LINEAR ACTUATOR TRANSPORT SWITCH INPUT compared to head height selector switch setting. If head position does not match the selector switch, move actuator in the appropriate direction until the correct position is reached.

7.1.3. At power up, set bridge output pins low. After they are set low, delay for 50mS, then turn on the 24V power FET to supply voltage to the bridge circuit.

7.2. Normal operation

7.2.1. Operate microcontroller at 1MHz internal bus speed.

7.2.1.1. Ensure microcontroller I/O used to control motor function are forced 'LOW' before making them an output.

7.2.2. Continuously monitor the Propel sense pin.

7.2.2.1. If propel sense is low (active), but low battery fluid sensor is low, do not turn on the left/right brush contactors nor the solution flow control.

7.2.2.2. If propel sense is low (active), and low battery fluid sensor is high, turn on the left/right brush contactors and the solution flow control.

7.2.2.3. If the propel sense is high (inactive), turn off the left/right brush contactors and the solution flow control.

7.2.3. Monitor the Auto Pad Off switch. If the switch is pressed (goes low), perform the following functions:

7.2.3.1. Check if head is in transport mode. If not, do not perform the Autopad off steps called out in the next two items.

7.2.3.2. Turn on the Left and Right brush motor contactors for 2 seconds

7.2.3.3. Turn off brush motor contactors, delay 1 second, then turn on the Auto Pad OFF relay for 1 second and turn it back off.

7.2.3.4. Allow Auto Pad function at any time except when it is already active or within 5 seconds of last activation end.

7.2.4. Monitor Down Pressure Control switch

7.2.4.1. Based on position of the selector switch as monitored at the microcontroller, move the down pressure actuator to appropriate distance based on feedback from the pressure switches.

7.2.4.1.1. Never allow both directions (extend and retract) to be active at the same time. If switching between extend and retract, delay 100mS between switching direction.

7.2.4.1.2. Monitor selector switch inputs for position change

7.2.4.1.3. If the position changes, move the motor in the appropriate direction by driving the H-Bridge to extend or retract the linear actuator.

7.2.4.1.4. Monitor the Linear actuator switch inputs and turn off the motor drive when the selected position is reached. If no switch inputs change for 10 seconds, turn off the Linear Actuator motor.

7.2.4.1.5. If the 'Transport' position is selected, drive the motor to retract the linear actuator until the LINEAR ACTUATOR TRANSPORT SWITCH INPUT goes LOW. Turn off the brush motor contactors and the solution control.

7.2.5. Solution Flow Control

7.2.5.1. Based on input from the solution control potentiometer, drive the solution motor control at the appropriate speed.

7.2.5.1.1. If in transport mode, do not allow solution flow.

7.2.5.1.2. Drive the solution control pump to the following table:

Voltage level	AtoD counts	Setting	Flowrate	Duty Cycle	Time On	Time Off
1.71	350	15	0.760	1.000	1	0
1.63	334	14	0.688	0.940	1	0
1.55	317	13	0.616	0.900	1	0
1.46	299	12	0.544	0.860	1	0
1.37	281	11	0.472	0.830	1	0
1.27	260	10	0.400	0.810	1	0.18
1.17	240	9	0.356	0.810	1	0.36
1.06	217	8	0.311	0.810	1	0.55
0.95	195	7	0.267	0.810	1	0.83
0.83	170	6	0.222	0.810	1	1.20
0.7	143	5	0.178	0.810	1	1.80
0.56	115	4	0.133	0.810	1	2.87
0.42	86	3	0.089	0.810	1	4.50
0.29	59	2	0.044	0.810	1	9.00
0.1	20	1	0.000	0.810	0	1

- 7.2.5.1.3. At setting 15 turn the pump ON
- 7.2.5.1.4. Set the PWM frequency to 4Hz.
- 7.2.5.1.5. From setting 14 down to 9 adjust the duty cycle to the appropriate value while running at 4Hz with no OFF time.
- 7.2.5.1.6. From setting 8 down to 2, leave duty cycle at 81%, and introduce OFF time per the appropriate value. For instance, at a setting of 5, set the ON time running at 4 Hz to a duty cycle of 81% for 1S, then turn the unit off for .95S.
- 7.2.5.1.7. At a setting of 1, turn the pump OFF.
- 7.2.5.1.8. Provide hysteresis to ensure motor control does not bounce between two settings.

8. PHYSICAL AND MECHANICAL REQUIREMENTS

- 8.1. The PCB should be no larger than 4" x 6"
- 8.2. Place 4 mounting holes – 1 in each corner of the PCB.
- 8.3. The PC Boards are .062 double sided FR-4
- 8.4. Conformal coating. Floor scrubber will be subjected to cleaning via pressure washer. Metal enclosure housing the PCB will not be IP67 compliant.
- 8.5. Product will be shipped to customer in bulk using non-returnable packaging.

9. ELECTROMAGNETIC COMPATIBILITY TEST REQUIREMENTS

- 9.1. Radiated Emissions CISPR 25 – Not required as this is covered under exception per FCC Part 15.

10. ENVIRONMENTAL & DUTY CYCLE REQUIREMENTS –

- 10.1. Operating temperature range: 0°C (33°F) to 50°C (122°F)
- 10.2. Storage temperature range: -25°C (-10°F) to 55°C (130°F)
- 10.3. Relative humidity: 30 to 95%
- 10.4. Drop: Must also survive standard shipping and handling requirements in intended packaging.
- 10.5. Shock: Must survive a floor scrubber going full speed into a wall.

11. SERVICABILITY REQUIREMENTS

- 11.1. The product is not field serviceable except for replaceable fuses, it is intended for repair only by the factory. Provide clips for fuses.

12. MARKING

- 12.1. Markings on the product shall include:

- 12.1.1. Customer Name and Trademarks as applicable.
12.1.2. Part number

13. Revisions

- Version .1 - .5: various updates and refinement
- Version .6: updated sections 6.2.3 to add the word "pressure" in each section, rewrote sections 7.1.2 and 7.2.2
- Version .7: Significantly changed Section 7.2.5. Various other minor updates
- Version .8: updated section 7.2.3.3 to add delay between turning off contactors and turning on autopad relay
- Version .9: Added section 7.1.3.
Updated 7.2.3.4 to include a delay for a period of time after autopad executed.
- Version .A: Updated section 6.2.4.1 to include a jumper option for scrubbers with and without battery water sensor
- Version .B: Added section 6.2.3.4.
Modified 6.2.6.1 and 7.2.2 for changed propel sense polarity.
Added section 7.2.5.1.8
Updated section 7.2.4.1.5 to turn off contactors and solution motor in transport mode.
Added section 6.2.7
Updated section 7.1.2 to also check linear actuator transport switch input
- Version .C: Updated section 7.1.1.2.2
- Version .D: Updated section 7.2.5.1.2 table
- Version 1.0: No updates, just up-revved spec for production release