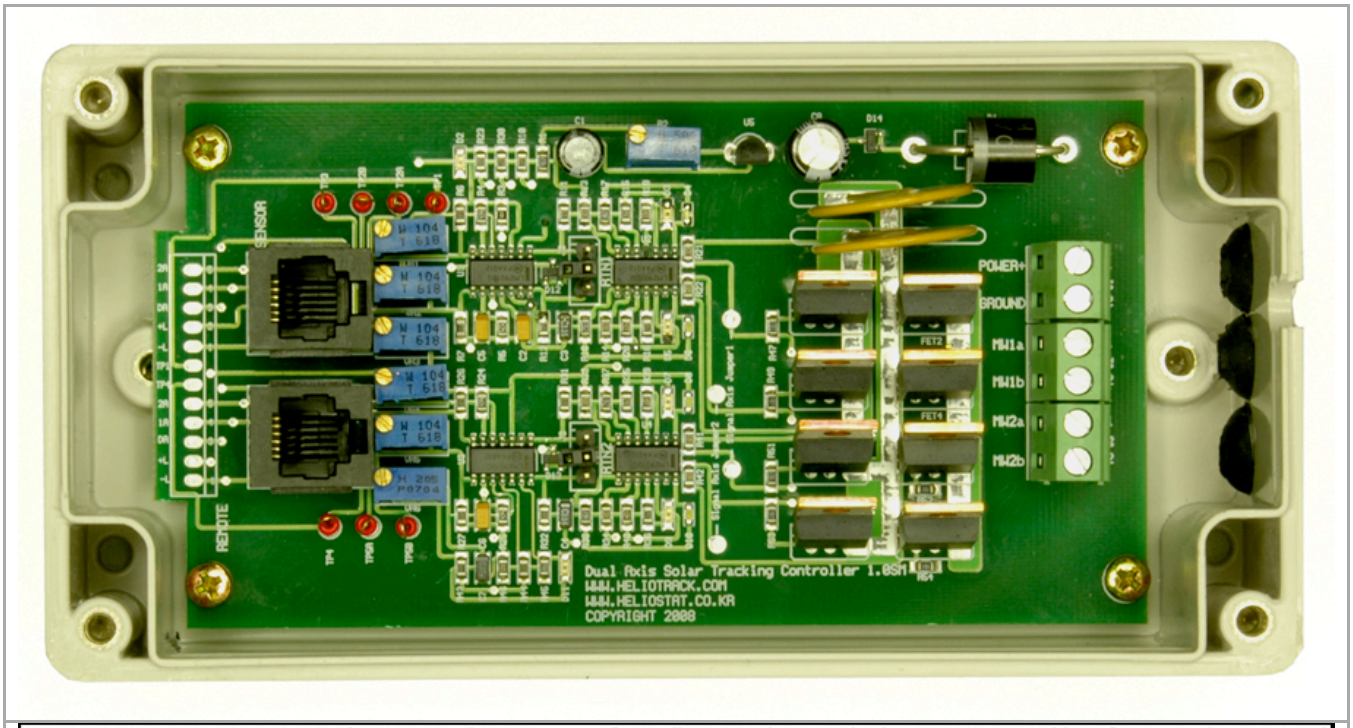
Heliotrack Dual Axis Tracking Controller V1.0SM



Heliotrack Dual Axis Tracking Controller v1.0sm
Operating Voltage: 12-36VDC
Motor Outputs: 3 Amps per channel continuous @ 25ºC
Operating Temperature: -30ºC - +85ºC
Fuse Type: 3 Amp Polyfuse RX300F (Disconnect power for 2 minutes to reset fuses)

Controller may take up to 3 minutes to start tracking after power is connected
Startup Delay is the time it takes for the controller to start tracking
Tracking Delay is the wait time between tracking corrections
See table below for the approximate delays of this controller
Marked row indicates specifications for this controller

C3 & C4	Tracking Delay	Startup Delay
3.3uf	5 seconds	30 seconds
10uf	15 seconds	1 minute
22uf	25 seconds	2 minutes
47uf	50 seconds	3 minutes

Values are approximate
Replace C3 & C4 to change Tracking Delay
10v Tantalum Capacitor 3216-18 (EIA) 1206

Factory Potentiometer Calibration: Voltage between indicated test points

Logic Level Vreg:	(-L to +L = 5.0V)
Duty Cycle West/East:	(-L to TP1 = 4.6V)
Duty Cycle Up/Down:	(-L to TP4 = 4.6V)
Dark Return Threshold:	(-L to TP3 = 0.7)
Sensitivity West/East:	(TP2A to TP2B = 0.7V)
Sensitivity Up/Down:	(TP5A to TP5B = 0.7V)
Duty Frequency:	(Approximately 0.1 Hz indicated by flashing LED)

Warning: Reverse Protection Diode and Polyfuses may get **HOT** during operation. **USE CAUTION!**

RJ12 Sensor Inputs: PIN1:Ground (-L) | PIN2:Ground (-L) | PIN3:+5.2V (+L) | PIN4:Dark Return (DR) | PIN5:Axis 1 Input (1A) | PIN6:Axis 2 Input (2A)

Controller PCB layout

Sun Sensor or Remote Input RJ12
Duty Cycle West / East
Sensitivity West / East
Dark Return Threshold
Duty Cycle Up / Down
Sensitivity Up / Down
Duty Frequency
Sun Sensor or Remote Input RJ12
Logic Level Vreg
+ C3
+ C4
Return West
Dark Return Jumper
Return East
Return UP
Dark Return Jumper
Return Down
Place Dark Return Jumpers between Center pin and pin labeled with desired direction.
Remove jumpers to disable Dark Return.
Duty Frequency LED (D11)
HOT!
POLYFUSE 2
POLYFUSE 1
Reverse Protection Diode
HOT!
West LED (D3)
East LED (D5)
Up LED (D7)
Down LED (D9)
POWER+ 12 - 36 VDC
GROUND
Motor Wire 1a (West)
Motor Wire 1b (East)
Motor Wire 2a (Up)
Motor Wire 2b (Down)
Remote control movements are subject to Tracking Delay

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Features:

• 12-36 VDC Voltage supply range

• Solid state H-bridge driver with shoot-through protection or Relay control for driving relays, optocouplers, or logic controlled motor drivers.

• Track-to-Track time delay extends actuator life (3 factory presets available: 6 seconds, 20 seconds, or 40 seconds.

• Variable output duty cycle (0 – 100%)

• Variable duty frequency (1 cycle per minute - 4 cycles per second)

• Dark return direction selectable for each axis

• Remote control interface for manual or automated control

• Screw terminals for easy connection of power supply and motors

• Fuse protection on each axis

• External interface points for manual control of Duty Cycle

• Output drivers can be bridged for higher current single axis operation

• RJ12 Socket for convenient Sun Sensor and Remote Control connection

• On Board LED indicators for Motor Direction, and Duty Frequency

• Power Supply reverse connection protection

Specifications:

Specification	Value	Units
Power supply	12 – 36	Volts DC
Idle current drain	.008	Amps
Sun sensor and logic power supply	5.0	Volts DC
Motor Output Voltage	*Power supply minus .5volts	Volts DC
Motor Output Current	3.15 Amps @ 100% duty cycle	Amps
Pulsed output current (.5hz)	5 Amps a@ 20% duty cycle	Amps
Pulsed output current (.5hz)	7 Amps @ 5% duty cycle	Amps
Duty cycle (variable for each axis)	0 – 100	Percent
Duty frequency (variable)	4 cycles per second – 1 cycles per minute	Cycles
Duty cycle control voltage	2.2 – 4.5	Volts DC

*** Equal to power supply if reverse connection protection diode is bypassed.**

Controller circuit description:

The dual axis solar tracking controller features three inputs and two solid state H-bridge driver outputs. Inputs 1 & 2 are window comparators for bi-directional control of direct current loads, input 3 is a single ended comparator whose output can be linked to the output of either direction of either window comparator, or to an input external unit for auxiliary control.

Although this controller is ideal for dual axis solar tracking it is also well suited for other control loads requiring DC current up to 3 amps. Possible applications include, but are not limited to, re circulation pumps, relays, solenoids, fans, motion control, and system monitoring.

***** Caution*****
Duty Frequency of greater than 1 cycle per second can potentially damage the driver transistors when larger motors are being used The fuse may not protect against this. High frequency duty cycles should only be used with loads of less than .5 amps.

• Power: 12-36 VDC (volts direct current)

• Ground: Negative terminal of power supply

• Motor wire 1A: Usually wired to the East-West actuator - Positive when moving West

• Motor wire 1B: Usually wired to the East-West actuator - Positive when moving East

• Motor wire 2A: Usually wired to the Up-Down actuator - Positive when moving Up
• Motor wire 2B: Usually wired to the Up-Down actuator - Positive when moving Down

• Fuse 1: 3.15 amp poly fuse for East-West actuator motor

• Fuse 2: 3.15 amp poly fuse for UP-Down actuator motor

• Duty cycle 1: Turn clockwise to increase duty cycle of East-West axis

• Duty cycle 2: Turn clockwise to increase duty cycle of Up-Down axis

• Duty Frequency: Turn Clockwise to INCREASE cycle time (DECREASE the frequency)

• Sensitivity 1: Turn counterclockwise to increase immunity of East-West axis if wandering is a problem

• Sensitivity 2: Turn counterclockwise to increase immunity of Up-Down axis if wandering is a problem.

*****Note: When the sun is obscured, optical solar trackers can be susceptible to wandering toward the brightest source of light; this could be a reflection from a window or the silver lining of a cloud. This circuit features a sensitivity adjustment that can compensate if wandering becomes a problem. The sensitivity can also be increased for applications requiring low-light tracking or greater degrees of accuracy. Turning the adjustment screw clockwise will increase tracking sensitivity.**

• Dark return threshold: Turn clockwise if ambient light is keeping the tracker from returning at night. Turn counterclockwise if the tracker is returning in heavy cloud conditions when it is not yet night.

• Dark Return 1 Jumper:

-- Place shorting jumper across Center and East pins to return EAST if the tracker is facing South (Northern Hemisphere)

-- Place shorting jumper across Center and West pins to return EAST if the tracker facing North (Southern Hemisphere)

-- Remove jumper to disable Dark Return function.

• Dark Return 2 Jumper:

-- Place shorting jumper across Center and UP pins to tilt UP at night

-- Place shorting jumper across Center and DOWN pins to tilt UP at night

-- Remove jumper to disable return function.

• Sun Sensor / Remote:

There are two "Sun Sensor / Remote" sockets, they are interchangeable. This is where you plug in the Sun Sensor or the Remote Control.

-- Pin 1: No Connection
-- Pin 2 (-L): Ground
-- Pin 3 (+L): 4.75 - 5 VDC
-- Pin 4 (DR): Dark Return Input
-- Pin 5 (1A): East-West Tracking Input
-- Pin 6 (2A): Up-Down Tracking Input

• Connecting remote control plug pins will move the tracker as follows assuming the tracker is in the northern hemisphere facing South. The remote control pins are also available on the edge of the controller PCB they are noted in the parenthesis.

– Pin 2(-L) & Pin 5(1A) East (MW1a Negative / MW1b Positive) (Opposite for southern hemisphere)

-- Pin 3(+L) & Pin 5(1A) West (MW1a Positive / MW1b Negative) (Opposite for southern hemisphere)

-- Pin 2(-L) & Pin 6(2A) Down (MW2a Negative / MW2b Positive)

-- Pin 3(+L) & Pin 6(2A) Up (MW2a Positive / MW2b Negative)

We suggest using a 1K resistor when bridging pins for remote control; this prevents accidental shorting of the power pins (Pin 2 and Pin 3)

***** Never apply power directly to the motor leads when they are connected to the controller circuit. This will destroy the driver transistors and incur a $40 fix it fee. YOU MUST disconnect the motor wires from the tracking controller if you want to test your motors by connecting them directly to the power source.**

If you do damage the boards from mishandling then remove the controller board from the plastic enclosure and send it back to us in a padded mailer. We will fix the board within two days and ship it back to you USPS Priority. We will request a $25 + shipping payment via PayPal for the repair.

LED indicators:

LED designator	Indicates	Comments
D2	Power Available	This LED will change intensity with controller current draw
D3	Motor Wire 1a Positive	This LED turns on when MW1a is positive
D4	Motor Wire 1b Positive	This LED turns on when MW1b is positive
D5	Motor Wire 2a Positive	This LED turns on when MW2a is positive
D6	Motor Wire 2b Positive	This LED turns on when MW2b is positive
D7	Duty Frequency	Flashes at same rate as Duty Frequency Oscillator

Installation instructions:

1) Mount the tracking controller box in an accessible location. Be sure to mount the box with the wire holes leading down, this will prevent water from running into the box. If you wish to drill mounting holes in the controller box – remove the 4 screws from cover, there is space above and below the circuit board for mounting hardware to penetrate the plastic enclosure.

2) Connect the motor wires from your actuators to the motor terminals on the circuit board.

•Motor terminals 1a and 1b should control the EAST-WEST or AZIMUTH actuator.

•Motor terminals 2a and 2b should control the UP-DOWN or ALTITUDE actuator.

•In the Northern Hemisphere Motor wire 1a will be positive when the tracker needs to move West.

•Motor wire 2a will be positive when the tracker needs to tilt UP. If an actuator is moving in the wrong direction try reversing the polarity of the motor wires.

•In the southern hemisphere the polarity of the EAST-WEST motor terminals / wires are reversed.

3) The sun sensor should be mounted to the tracking plane with the cable leading in the Tilt down direction, this would be South if the tracker is at the Noon position. The sensor comes with floating spring mounts for convenient aiming. Remove the wing nuts and one washer from each mounting

bolt (this leaves one washer and the spring on each bolt). Pass the three bolts through pre-drilled holes on your sensor bracket. Replace washer and then the wing nut on each bolt. This provides a spring-loaded tripod mount for your sensor. Fine-tune the alignment of the sensor by simply turning the wing nuts in the appropriate direction.

4) WITHOUT THE POWER ON... connect your 12 - 36 VDC power supply wires to the power terminals on the tracking circuit. Be sure to verify polarity, especially when bypassing the reverse protection diode for high amperage operation. Verify connections and turn on the power. The controller takes a while to charge up but should start tracking the sun in less than two minutes. The time it takes the controller to start tracking is roughly equal to the Track-to-Track time delay.

5) If an actuator is tracking in the wrong direction, disconnect the power, reverse the polarity of the motor wires for that actuator, and reconnect the power.

6) Replace the cover on the control box when you are satisfied that everything is working properly. Make sure that the stress grommet on the sun sensor wire is seated in the notch on the controller box. For permanent outdoor installations it is a good idea to put a bead of caulking around the lid before replacing it to prevent moisture from getting in.

*****Maintenance note: Once a year place a coat of clear fingernail polish on the surface of the sun sensor and around the base of the six photocells if it looks like UV is causing excessive deterioration.**

Duty Cycle: **Duty Cycle is how long the motor is on compared to how long it is off during the Duty Period. If the duty period is 2 seconds (.5 Hertz) and the motor is on for one second and off for one second then the Duty Cycle is 50%. The controller features a Duty Cycle control for each axis. The Duty Frequency will be the same for both axis but the duty cycle can be adjusted for each axis individually by adjusting the Duty Cycle 1 or Duty Cycle 2 potentiometers. Duty cycle is useful in two situations...**

1) Compensating for tracker overshoot: If a solar tracker has actuators that move too fast the inertia of the tracking plane will move it past alignment with the sun even after the controller turns off the motor. This overshoot may cause the tracker to move back and forth (back tracking) and cause focal point misalignment in concentrator applications. Using a duty cycle of about 25% and a duty period of about 2 seconds will send short .5-second pulses to the motor reducing momentum of the tracker and mitigating overshoot problems.

2) Operating at higher amperages: You can also use duty cycle to power motors that draw more current than the controller rating. Decrease the duty cycle to send short .5 to .25 second pulses to the actuator motors. It is necessary to monitor the temperature of the transistors when operating at higher amperages to make sure that they are not overheating. Controllers equipped with polyfuses can run intermittent loads up to 7 amps, higher amperages than that will require installation higher amperage fuses.

Time Delay: **The Time Delay is preset at the factory, it is the amount of time the controller waits between tracking corrections. Some concentrator applications require higher accuracy and need to make tracking corrections more frequently so a Time Delay of 30 seconds or less may be required. Many concentrator and most PV tracking applications do not require better than 1/4 degree accuracy so a Time Delay greater than 50 seconds is preferred because it reduced actuator wear and mitigates "back tracking". Backtracking is caused when an actuator stops but backlash in the tracker mechanics causes it overshoot the sun requiring the tracker move in the opposite direction to get back on target. The greater the time delay the less often the actuators start and stop reducing wear.**

A time delay of 50 seconds will allow 1/4 degree tracking accuracy.

A time delay of 25 seconds will allow 1/8 degree tracking accuracy.

A time delay of 6 seconds will allow better than 1/20 degree tracking accuracy.

Customizations: **There are some customizations available upon request when you place your order.**

• Relay Controller Outputs: **1) (No charge) Controller output terminals wired specifically for relays _2) ($175 USD) Controller output terminals wired specifically for relays and includes relays with wiring harness**

• Single Axis Bridging:
***** INCORRECT BRIDGING WILL BLOW FUSES AND POSSIBLY RUIN THE DRIVER TRANSISTORS!**

Please contact us if you want to use the controller setup in this mode, as it requires some additional instructions.

A pair of jumper wires connects the bridging terminals together to make a Single Axis Controller with twice the amperage output.

Calibration and On Board Adjustments:

Test points are used to calibrate the Controller as well. Each calibration measures the voltage between two test points, set your multimeter to measure voltage and place the leads between the test points referenced.

Calibration	Test Points	Voltage	Component Label	POT Designator
Logic/Sun Sensor Voltage **	-L &+L	4.7 - 5.5	Logic Level Vreg	R2
Axis 1 Duty Cycle	GND & DC1	4.7	Duty Cycle 1	R57
Axis 2 Duty Cycle	GND - DC2	4.7	Duty Cycle 2	R58
Axis 1 Sensitivity	S1a - S1b	0.8	Sensitivity 1	R55
Axis 2 Sensitivity	S2a - S2b	0.8	Sensitivity 2	R56
Dark Return Threshold	GND - DRT	0.8	Dark Return Threshold	R61
Duty Frequency*	N/A	N/A	Duty Frequency	R62

*** Duty Frequency is set at the factory to approximately .25 cycles per second by observing the frequency LED. This represents a duty period of about 4 seconds.**

**** This is a factory set temperature compensation voltage. Adjust this voltage only if the motor outputs are pulsing even when 100% duty cycle is selected or if the motor outputs turn on and don't turn off even when the sun sensor is disconnected. Turning the potentiometer clockwise will stop motors that are latched on. Turning the potentiometer counterclockwise will prevent the actuators from pulsing when they are on.**