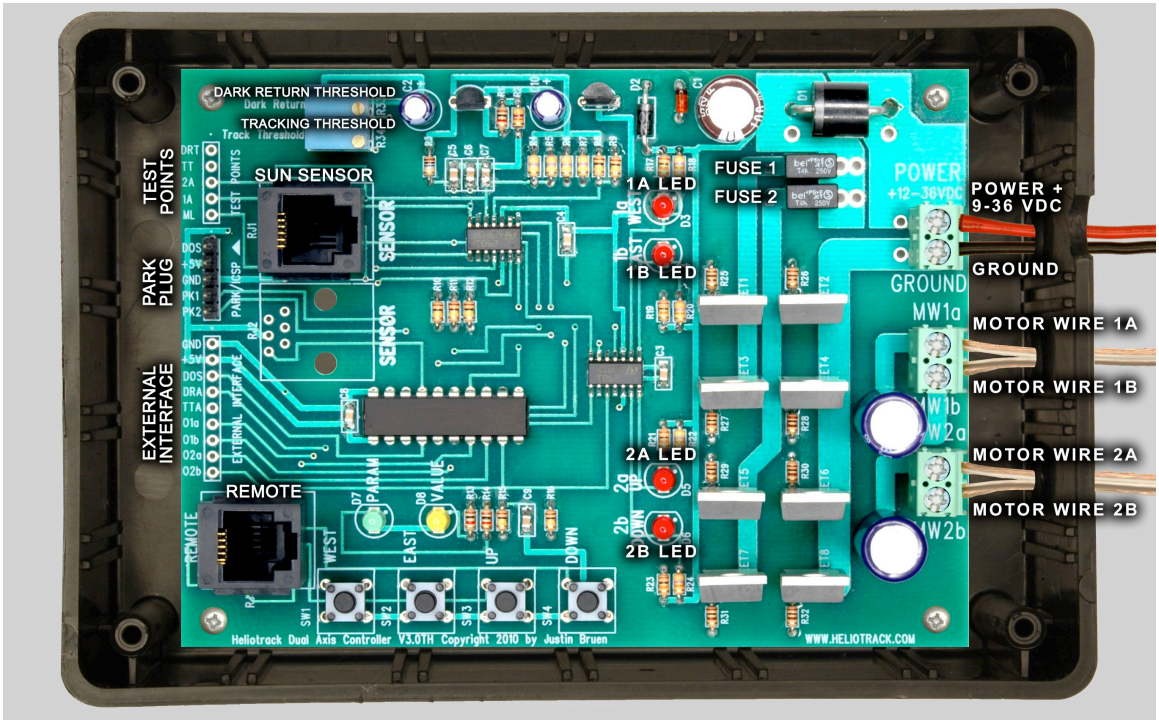
Heliotrack Programmable Dual Axis Solar Tracking Controller V3.0

5/20/11



Features:

- 12-36 VDC power supply
- Solid-State H-bridge driver
- Variable Track-to-Track time delay extends actuator life
- Dead Reckoning Timer advances tracker to follow sun when cloudy
- Programmable load sequencing to reduce power supply amperage requirements
- Programmable duty cycle
- Programmable duty frequency
- Dark return direction selectable for each axis
- Park1 direction selectable for each axis (Includes release timer)
- Park2 direction selectable for each axis (Includes release timer)
- Drive-Off-Sun (DOS) direction selectable for each axis (Includes release timer)
- Programmable Drive-Off-Sun (DOS) timer
- On-Board control buttons for manual control of tracker and programming of controller
- Remote control plug for manual control of tracker and programming of controller
- Screw terminals for easy connection to power supply and motors
- Fuse protection for each axis
- External interface points for expanding capabilities of the controller.

• Output drivers can be bridged for higher current single axis operation
• RJ12 sockets for convenient Sun Sensor and Remote Control connection
• Additional mounting place for RJ12 socket for twin single-axis setups
• On-board LED indicators for Motor Direction, Duty Cycle, and Duty Frequency
• Power Supply reverse connection protection

Applications:

Single-Axis, Twin Single-Axis, and Dual-Axis solar tracking
Pump control
Thermostat control
Servo control
Applications requiring switching outputs based on voltage comparisons

Specifications:

Specification	**Value**
Power supply	12 – 36 Volts DC
Idle current drain	.004 Amps
Sun Sensor and Logic power supply	5.0 Volts DC (.15 amps)
Output voltage	*Power supply minus .5 volts
Continuous output Power	50 Watts per axis
Continuous output current	12VDC = 4 Amps (100% duty cycle)
Continuous output current	24VDC = 2 Amps (100% duty cycle)
Continuous output current	36VDC = 1.5 Amps (100% duty cycle)

* Equal to power supply if reverse connection protection diode is bypassed for increased amperage output.

Controller circuit description:

The dual axis solar tracking controller features three inputs and two solid state H-bridge driver outputs. Inputs 1 & 2 are voltage comparators for bi-directional control of direct current loads, input 3 is a window comparator whose output is linked to the Tracking Threshold control and Dark Return control.

Although this controller was designed primarily for dual axis solar tracking it can also be used for control of other loads requiring DC current up to 4 amps. Possible applications include, but are not limited to, circulation pumps, relays, solenoids, fans, motion control, and system monitoring.

• 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 (Reversed in Southern Hemisphere)
• Motor wire 1B: Usually wired to the East-West actuator - Positive when moving East (Reversed in Southern Hemisphere)
• 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: 4 amp slow-blow fuse for East-West actuator motor
• Fuse 2: 4 amp slow-blow fuse for UP-Down actuator motor
• Tracking Threshold: Turn clockwise to decrease Sun Sensor sensitivity and increase the amount of sunlight required to activate tracking. Turn counterclockwise to increase Sun Sensor sensitivity and activate tracking with less sunlight.
• 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.
• Sun Sensor: There are one or two "Sun Sensor” sockets that are interchangeable. This is where you plug in the Sun Sensor.
-- Pin 1 : Sun Sensor Detect
-- Pin 2 : Ground
-- Pin 3: 5.0 VDC
-- Pin 4: Dark Return Input
-- Pin 5: East-West Tracking Input

-- Pin 6: Up-Down Tracking Input
• Remote: There is one Remote plug for connecting an external Remote Control. Connecting remote control pins will move the tracker as follows assuming the tracker is located in the Northern Hemisphere facing South
-- 1 & 2 West (MW1a Positive / MW1b Negative) (Opposite for southern hemisphere)
-- 1 & 3 East (MW1a Negative / MW1b Positive) (Opposite for southern hemisphere)
-- 1 & 4 Up (MW2a Positive / MW2b Negative)
-- 1 & 5 Down (MW2a Negative / MW2b Positive)

*** 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 $50 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 supply.
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 one week and ship it back to you USPS Priority.

LED indicators:

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 Parameter indicator (Also power, data read, active motor and Park mode indicator)
D8 Parameter Value indicator (Also data write, active motor, and Park mode indicator)

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. Reverse the polarity of the motor wires if an actuator is moving in the wrong.
•In the southern hemisphere the polarity of the EAST-WEST motor wires should be reversed.

3) The sun sensor should be mounted to the tracking plane (solar panels or concentrator) with the cable leading in the Tilt-Down direction, or South when the tracker is at the Noon position in the Northern Hemisphere. The sensor comes with floating spring mounts for convenient calibration. 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, then replace the 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 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 GREEN LED should flash quickly 15 times while the

controller loads the user saved parameters from memory.

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 cable 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 of the box before replacing it to prevent moisture from getting in.

Load Sequencing (Duty Cycle):

Load sequencing allows only one actuator to be on at a time, this reduces the maximum current draw of the controller to the current draw of the highest amperage actuator.

Load sequencing can also reduce the on-time of each actuator to prevent overheating of the driver transistors when using actuators drawing greater than 4 amps. Using Load Sequencing in this way also requires replacing the stock filament fuses with polyfuses that can permit greater amperage spikes without tripping.

Tracking Delay:

The Tracking Delay setting controls the time the controller waits between tracking corrections. Concentrator applications usually require higher accuracy and need to make tracking corrections more frequently so a Time Delay of less than 30 seconds is recommended. PV tracking applications do not require such precise accuracy so we recommend a Time Delay of more than 30 seconds. Time delay can also be used to mitigate "back tracking" or “back-lashing” caused by the tracker traveling past the sun and then tracking in the opposite direction during the next tracking correction. Greater Tracking Delays mean the motors turn on and off fewer times per day generally increasing actuator life.

Relay Controller Option:

If your actuators draw more than 4 amps then relays can be used to supply power to the actuators. The controller can be modified specifically for operation with relays at no extra charge. We can provide a relay harness including 12 Volt 20 amp relays for $150 USD.

Limit Switches:

Limit Switches are required for each direction for every actuator when using Heliotrack solar tracking products! Many actuators on the market include internal limit switches but the user must verify this before connecting actuator motors to the tracking controller. It is also necessary to verify that the limit switches are set to stop the motors before any damage is done to tracking mechanism due to over-traveling.

Disclaimer:

Heliotrack,LLC assumes no responsibility for damages caused by the use or misuse of our products.

STARTUP BUTTON FUNCTIONS

Available while the controller is starting up by pressing indicated buttons while connecting power to the controller.

Pressing Button 1(WEST) & Button2(EAST) while powering up the controller restores the factory presets.

Pressing Button 3(UP) & Button 4(DOWN) while powering up the controller enables hidden Parameters 11 (Time Delay Override) and 12 (Bridge Mode) in the programming mode.

OPERATION BUTTON FUNCTIONS

Available after startup is complete.

Remote Control

Pressing Button 1 will turn on MW1a (West)

Pressing Button 2 will turn on MW1b (East)

Pressing Button 3 will turn on MW2a (Up)

Pressing Button 4 will turn on MW2b (Down)

Pressing Button 1&2 simultaneously will toggle between Tracking Enable and Tracking Disable. Entering or exiting this mode is indicated by three short blinks. When tracking is disabled the green and yellow lights will continue to blink three short blinks.

Pressing Button 3&4 simultaneously enters the programming mode.

PROGRAMMING MODE

1) Entering programming mode:

Pressing Buttons 3&4 (Up & Down) simultaneously for a second will enter the programming mode For Bank 1.
Pressing Buttons 2&3 (East & Up) simultaneously for a second will enter the programming mode For Bank 2.

LED (Green) 1 indicates which parameter is selected.
LED (Yellow) 2 indicates the current value of the parameter.

Button 1:
Advance to the next parameter.
If the Parameter is at 13 it will wrap back around to 1 blink Parameter 1)

Button 2:
Display current parameter and increase the value of the current parameter by one.
When the value is at maximum it will wrap back around to 1 blink.

Button 3:
Display the current parameter without changing value.

Button 4:
Exit programming mode and write any changes to memory.
The controller only accepts input from the buttons after the parameter and value have been completely displayed.

Programmable Parameters Bank 1

PARAMETER NAME GREEN LED BLINKS	Parameter Selected	PARAMETER VALUE YELLOW LED BLINKS
1	Tracking Delay Count	1 – 8 Blinks
2	Dark Return Direction	1 – 9 Blinks
3	Park1 Direction	1 – 9 Blinks
4	Park2 Direction	1 – 9 Blinks
5	Drive Off Sun Direction	1 – 9 Blinks
6	Drive Off Sun Count	1 – 8 Blinks
7	Park1 Latch Timer	1 – 2 Blinks
8	Park1 Latch Timer	1 – 8 Blinks
9	Park1 Latch Timer	1 – 8 Blinks
10	Tracking Delay Multiplier	1 – 9 Blinks
*11	Tracking Delay Override	1 – 2 Blinks
*12	Bridge Mode	1 – 2 Blinks

***SPECIAL ACCESS PARAMETERS:** Press Button 3&4 during startup to enable access to these parameters in Programming Mode.

Tracking Delay Override: Disabling the **Tracking Delay** may cause damage to the motor driver transistors. Overriding the Tracking Delay enables high frequency output and should not to be used with the stock H-Bridge driver in this controller.

Bridge Mode: Proper bridge wiring must be observed when Bridge Mode is enabled or the fuses will blow and the driver transistors may be damaged.

Bank 1 Parameter 1: Tracking Delay Count
GREEN LED: 1 Blink
YELLOW LED 2: 1 – 8 Blinks
Default Value = 4

YELLOW LED Blinks	**Tracking Delay count:** Rest time between tracking corrections. Actual time depends on Tracking Delay Multiplier. Tracking Delay is applied to Dark return, Tracking Threshold, and On-Sun signals.	
	Tracking Delay Count	* Tracking Delay Time
1	1	1.8 seconds
2	3	6 seconds
3	7	14 seconds
4	15 (Factory Default)	31 seconds (Factory Default)
5	31	64 seconds
6	63	133 seconds
7	127	266 seconds
8	255	532 seconds

* Tracking Delay Times in this table are only valid when the Tracking Delay Multiplier (Bank 2 Parameter 10) value is set to the factory default of 4.

The Tracking Delay Count sets the amount of time the controller waits between tracking corrections.
The sun traverses the sky at a rate of 1 degree every four minutes; so a Tracking Delay Time of four minutes would limit the tracking accuracy to 1 degree. The default Tracking Delay Time of 31 seconds represents an accuracy of about 1/8 degree. Change the Tracking Delay Multiplier (Parameter 11) to achieve Tracking Delays that are greater or less than the Tracking Delays available in this table.

Bank 1 Parameter 2: Dark Return Direction
GREEN LED: 2 Blinks
YELLOW LED: 1 – 9 Blinks
Default Value = 1

YELLOW LED Blinks	**Dark Return Direction:** Activated when the sun sensor's **Mass Light** output (Pin: **ML**) is less than the Dark Return Threshold (Pin: **DRT**) which is set by the Dark Return Threshold potentiometer (R35)
1	Motor 1 off / Motor 2 off (Factory default)
2	Motor 1 East / Motor 2 off
3	Motor 1 West / Motor 2 off
4	Motor 1 off / Motor 2 Down
5	Motor 1 East / Motor 2 Down
6	Motor 1 West / Motor 2 Down
7	Motor 1 off / Motor 2 Up
8	Motor 1 East / Motor 2 Up
9	Motor 1 West / Motor 2 Up

NOTE: East and West directions are reversed in the Southern Hemisphere when the Tracker is facing North.

The Dark Return Direction is the direction the tracker will move when the Mass Light output voltage of the Sun Sensor (Test Point **ML**) is less than the voltage set by the Dark Return Threshold potentiometer (Test Point **DRT**). The Dark Return output will be on the entire night so limit switches are required on the actuators to stop the tracker in the sunrise position (East Limit).

The most common value for the Dark Return Direction parameter in the Northern Hemisphere is 2; in the Southern Hemisphere it is 3.

Bank 1 Parameter 3: Park 1 Direction

GREEN LED: 3 Blinks

YELLOW LED: 1 – 9 Blinks

Default Value = 1

YELLOW LED Blinks	**Park 1 Direction:** Activated when the Park 1 (Pin: **PK1**) is connected to Ground. Park 1 supersedes Park 2, Drive Off Sun, and Dark Return. Most likely used for stowing the tracker at the horizontal (tilt up) limit for high wind or the vertical (tilt down) limit for Hail.
1	Motor 1a off / Motor 2 off (Factory default)
2	Motor 1a East / Motor 2 off
3	Motor 1b West / Motor 2 off
4	Motor 1a off / Motor 2 Down
5	Motor 1a East / Motor 2 Down
6	Motor 1a West / Motor 2 Down
7	Motor 1a off / Motor 2 Up
8	Motor 1a East / Motor 2 Up
9	Motor 1a West / Motor 2 Up

NOTE: East and West directions are reversed in the Southern Hemisphere (Tracker facing North).

The tracker will turn on the motor(s) in the Park 1 direction whenever the Park 1 pin (PK1) is connected to ground. This function can be used to park the tracker during adverse weather conditions like high wind or hail. The motor wires will be the entire time the Park 1 pin is connected to ground requiring limit switches to keep the actuators from over-traveling.

Park 1 has priority over Park 2, Drive Off Sun, and Dark Return.

Bank 1 Parameter 4: Park 2 Direction
GREEN LED: 4 Blinks
YELLOW LED: 1 – 9 Blinks
Default Value = 1

YELLOW LED Blinks	**Park 2 Direction:** Activated when the Park 2 (Pin: **PK2**) is switched to Ground. Park 2 supersedes Drive Off Sun, and Dark Return. Parking for weather or a system fault.
1	Motor 1a off / Motor 2 off (Factory default)
2	Motor 1a East / Motor 2 off
3	Motor 1b West / Motor 2 off
4	Motor 1a off / Motor 2 Down
5	Motor 1a East / Motor 2 Down
6	Motor 1a West / Motor 2 Down
7	Motor 1a off / Motor 2 Up
8	Motor 1a East / Motor 2 Up
9	Motor 1a West / Motor 2 Up

NOTE: East and West directions are reversed in the Southern Hemisphere (Tracker facing North)

The tracker will turn on the motor(s) in the Park 2 direction whenever the Park 2 pin (PK2) is connected to ground. This function can be used to park the tracker during adverse weather conditions like high wind or hail. The motor wires will be the entire time the Park 2 pin is connected to ground requiring limit switches to keep the actuators from over-traveling.

Park 2 has priority over Drive Off Sun, and Dark Return.

Bank 1 Parameter 5: Drive Off Sun Direction

GREEN LED: 5 Blinks

YELLOW LED: 1 – 9 Blinks

Default Value = 1

YELLOW LED Blinks	**Drive Off Sun Direction:** Activated when the Drive Off Sun (Pin: **DOS**) is grounded (**GROUND** or Pin: **GND**)
1	Motor 1 off / Motor 2 off (Factory default)
2	Motor 1 East / Motor 2 off
3	Motor 1 West / Motor 2 off
4	Motor 1 off / Motor 2 Down
5	Motor 1 East / Motor 2 Down
6	Motor 1 West / Motor 2 Down
7	Motor 1 off / Motor 2 Up
8	Motor 1 East / Motor 2 Up
9	Motor 1 West / Motor 2 Up

NOTE: East and West directions are reversed in the Southern Hemisphere (Tracker facing North)

When the Drive Off Sun pin (DOS) is connected to ground the tracker will move in the Drive Off Sun Direction for the time specified by the Drive Off Sun Count and then stop. When the DOS pin is released from ground the DOS counter will reset.

This function is designed to move the tracker off sun when the solar collector is overheating. This is important in Concentrated Solar Power (CSP) applications where the collector may be damaged if recirculation of the working fluid is interrupted, or when overheating can cause the working fluid to boil causing critical buildup of system pressure.

Bank 1 Parameter 6: Drive Off Sun Count

GREEN LED: 6 Blinks

YELLOW LED: 1 – 8 Blinks

Default Value = 4

YELLOW LED Blinks	**Drive Off Sun Count:** Time that the tracker moves in the Drive Off Sun direction while the DOS pin is grounded. When the count expires the tracker will rest until The DOS pin is released from ground. Park 1 and Park 2 will override the DOS function. Actual time depends on Tracking Delay Multiplier.
1	0.5 Seconds
2	1.7 Seconds
3	3.5 Seconds
4	8 Seconds (Factory default)
5	16 Seconds
6	32 Seconds
7	64 Seconds
8	128 Seconds

Drive Off Sun Count is the amount of time that the tracker will move in the Drive Off Sun Direction when the DOS pin is connected to ground. The Drive Off Sun Count is reset whenever the DOS pin is released from ground.

Bank 1 Parameter 7: Park 1 Latch Timer
GREEN LED: 7 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 1

YELLOW LED Blinks	**Park 1 Latch Timer:** This is the time that the controller will wait to resume Tracking, Dead Reckoning, or Dark Returning after Park 1 has been released.
1	OFF (Factory default)
2	30 Seconds
3	60 Seconds
4	120 Seconds
5	240 Seconds
6	480 Seconds
7	960 Seconds
8	1920 Seconds

Park Latch Timers are used to delay the resumption of tracking operations after the respective park pin has been released. For example, if Park 1 is being triggered by a high wind alarm then the Park 1 Latch Timer will allow the user to set how long the wind needs to be below a certain speed before tracking will resume. The Park 1 Latch Timer will be cleared if either Park 2 or DOS are activated.

Bank 1 Parameter 8: Park 2 Latch Timer
GREEN LED: 8 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 1

YELLOW LED Blinks	**Park 2 Latch Timer:** This is the time that the controller will wait to resume Tracking, dead reckoning, or Dark Returning after Park 2 has been released.
1	OFF (Factory default)
2	30 Seconds
3	60 Seconds
4	120 Seconds
5	240 Seconds
6	480 Seconds
7	960 Seconds
8	1920 Seconds

Park Latch Timers are used to delay the resumption of tracking operations after the respective park pin has been released. For example, if Park 2 is being triggered by a hail alarm then the Park 2 Latch Timer will allow the user to set how long the hail storm needs to have passed before tracking will resume. The Park 2 Latch Timer will be cleared if either Park 1 or DOS are activated.

Bank 1 Parameter 9: DOS Latch Timer
GREEN LED: 6 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 4

YELLOW LED Blinks	**DOS 1 Latch Timer:** This is the time that the controller will wait to resume Tracking, dead reckoning, or Dark Returning after DOS has been released.
1	OFF (Factory default)
2	30 Seconds
3	60 Seconds
4	120 Seconds
5	240 Seconds
6	480 Seconds
7	960 Seconds
8	1920 Seconds

Park Latch Timers are used to delay the resumption of tracking operations after the respective park pin has been released. For example, if DOS is being triggered by a collector overheat alarm then the DOS Latch Timer will allow the user to set how long the overheat condition needs to be corrected before tracking will resume. The DOS Latch Timer will be cleared if either Park 1 or Park 2 are activated.

Bank 1 Parameter 10: Tracking Delay Multiplier
GREEN LED: 10 Blinks
YELLOW LED: 1 – 9 Blinks
Default Value = 4

YELLOW LED Blinks	Drive Off Sun Direction
1	X 1
2	X 2
3	X 3
4	X 4 (Factory default)
5	X 5
6	X 6
7	X 7
8	X 8
9	X 9

Tracking Delay Multiplier is used to extend or reduce the factory default Tracking Delay Times. The minimum Tracking Delay Time is approximately .25 seconds when using a multiplier of 1. This setting is used for extremely precise tracking.

The maximum Tracking Delay Time is about 20 minutes when using a multiplier of 9. This setting is good for PV tracking where having fewer tracking movements per day may be preferable to high accuracy.

See the Tracking Delay Time Table to determine possible Tracking Delay Time possibilities.

Bank 1 Parameter 11: Tracking Delay Override
(*Hidden Parameter)
GREEN LED: 11 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 1

YELLOW LED Blinks	**Time Delay Override:** Disables Time Delay between tracking corrections. **Caution!!** this may cause high frequency oscillations that can destroy the transistors if the controller has the stock H-Bridge output.
1	Tracking Delay Enabled (Factory default)
2	Tracking Delay Disabled

Tracking Delay Override disables the Tracking Delay Timer causing the controller motor outputs to react instantaneously to signals from the sun sensor. This parameter should be never be enabled when using the stock controller driver transistors because the high speed switching frequencies can damage the transistors.

This parameter enables high speed control of an external driver circuit and requires that the controller PCB be modified as a logic controller; this is done by removing the four N-MOSFET driver transistors or all of the driver transistors depending on the application.

Please contact us for more information if you plan on enabling this parameter or the warranty may be void.

Bank 1 Parameter 12: Motor Bridging Mode
(*Hidden Parameter)
GREEN LED: 12 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 1

YELLOW LED Blinks	**Motor Bridging Mode:** Both motor outputs are driven by the selected axis. **Caution!!** Proper wiring must be observed or the output transistors may be damaged.
1	Bridging off (Factory default)
2	Bridge Axis 1 (East / West) to all motor terminals
3	Bridge Axis2 (Up / Down) to all motor terminals

Motor Bridging Mode is used to bridge the motor output terminals for higher amperage single-axis operation. Pulsed currents of up to 8 amps are possible in Motor Bridging Mode. Continuous currents of up to 8 amps are possible if the reverse connection protection diode is bypassed. The controller may be severely damaged if the power supply is connected in reverse while the reverse connection protection diode is bypassed.

Motor Wire 1a and Motor Wire 2a should be connected together and Motor Wire 1b and Motor Wire 2b should be connected together Motor Bridging Mode is enabled. The fuses will blow or the controller may be severely damaged If the motor terminals are wired for Motor Bridging Mode and the Motor Bridging Mode parameter is not enabled; for this reason the Motor Bridging Mode is hidden. Please contact us if you have any doubts about the correct implementation of this parameter..

Tracking Delay Time Table

		Tracking Delay (Parameter 1)							
		1	2	3	4	5	6	7	8
Tracking Delay Multiplier (Parameter 11)	1	.1 - .5	1.5	3.5	7	15	32	66	133
	2	.8	3	7	15	32	66	133	266
	3	1.3	4.5	10	22	47	98	200	400
	4	1.8	6	14	31	64	133	266	532
	5	2.4	7.5	18	38	81	166	332	665
	6	3	9	22	46	98	200	400	800
	7	3.5	10.5	25	53	114	233	464	933
	8	4	12	29	61	133	266	533	1066
	9	4.5	13.5	33	68	145	300	600	1200

Tracking Delay table results are in seconds.

The default value of the Tracking Delay and Tracking Delay Multiplier parameter is 4 making the tracking delay time 31 seconds. The minimum Tracking Delay Time possible is about .25 seconds, the maximum Tracking Delay Time is about 20 minutes.

Programmable Parameters Bank 2

PARAMETER NAME GREEN LED BLINKS	Parameter Selected	PARAMETER VALUES YELLOW LED BLINKS
1	Dead Reckoning Enable	1 – 4 Blinks
2	Dead Reckoning Lock	1 – 2 Blinks
3	Load Sequencing Mode	1 – 2 Blinks
4	Load Sequencing 1 Count	1 – 8 Blinks
5	Load Sequencing 2 Count	1 – 8 Blinks
6	Load Sequencing Rest Count	1 – 8 Blinks
7	Load Sequencing Speedup	1 – 2 Blinks
8	Remote Follows Load Sequencing	1 – 2 Blinks

Bank 2 Parameter 1: Dead Reckoning
GREEN LED: 1 Blink
YELLOW LED: 1 – 4 Blinks
Default Value = 1

YELLOW LED Blinks	**Dead Reckoning:** Operates motors at timed intervals during the day when cloudy to approximate path of sun.
1	Dead Reckoning Disabled (Factory default)
2	Dead Reckoning Enabled Axis 1 (East – West)
3	Dead Reckoning Enabled Axis 2 (Up – Down)
4	Dead Reckoning Enabled Axis 1 & Axis 2

The Dead Reckoning feature times how long the motors run while tracking. When it is cloudy the tracker will run the motors at the same frequency to approximate the path of the sun. This keeps the tracker aligned approximately with the sun when it is cloudy.

Dead Reckoning will not work with trackers that backtrack due to backlash in the mechanics. After power is connected to the controller the Dead Reckoning timer requires three subsequent corrections in the same direction before it will begin working.

Bank 2 Parameter 2: Dead Reckoning Lock
GREEN LED: 2 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 1

YELLOW LED Blinks	**Dead Reckoning Lock:** Locks the current Dead Reckoning times in memory and prevents future updates.
1	Dead Reckoning Lock Disabled (Factory default)
2	Dead Reckoning Lock Enabled

If The Dead Reckoning Timer has values that are satisfactory then these values can be locked into memory by enabling the Dead Reckoning Lock. The values will be saved even when power is disconnected and restored at next startup.

When the Dead Reckoning Lock is disabled then the Dead Reckoning times are reset to Zero and will be constantly updated during tracking.

Bank 1 Parameter 3: Load Sequencing
GREEN LED: 3 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 2

YELLOW LED Blinks	Load Sequencing Mode
1	Load Sequencing Off
2	Load Sequencing On (Factory default)

Load Sequencing is used to alternate power to the actuators, this limits the maximum current that the controller draws at any time to the current drawn by the largest actuator. The controller's reverse connection protection diode is limited to 5 amps, so it is necessary to enable Load Sequencing if the current draw of both actuators running simultaneously is greater than 5 amps.

The Load Sequencing cycle follows this order…
1) Load Sequencing 1 Count (Motor 1 – East/West)
2) Load Sequencing 2 Count (Motor 2 – Up/Down)
3) Load Sequencing Rest Count (Motors disabled)

If the *Remote Respects Load Sequencing* parameter is disabled then the load sequencing order will automatically advance when the position of the operating actuator is On-Sun.

If the *Remote Respects Load Sequencing* parameter is enabled then the load sequencing order will not automatically advance when the position of the operating actuator is On-Sun.

Bank 1 Parameter 4: Load Sequencing 1 Count
GREEN LED: 4 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 3

YELLOW LED Blinks	**Load Sequencing 1 Count:** Time that Motor 1 will be on during the Load Sequencing routine.
1	0.5 Seconds
2	1.7 Seconds
3	3.5 Seconds (Factory default)
4	8 Seconds
5	16 Seconds
6	32 Seconds
7	64 Seconds
8	128 Seconds

Load Sequencing 1 Count is the maximum time that Motor 1 (East/West) will be on during each Load Sequencing cycle.

Bank 1 Parameter 5: Load Sequencing 2 Count
GREEN LED: 2 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 3

YELLOW LED Blinks	**Load Sequencing 2 Count:** Time that Motor 2 will be on during the Load Sequencing routine.
1	0.5 Seconds
2	1.7 Seconds
3	3.5 Seconds (Factory default)
4	8 Seconds
5	16 Seconds
6	32 Seconds
7	64 Seconds
8	128 Seconds

Load Sequencing 2 Count is the time that Motor 2 (Up/Down) will be enabled during each Load Sequencing cycle.

Bank 1 Parameter 6: Load Sequencing Rest Count
GREEN LED: 6 Blinks
YELLOW LED: 1 – 8 Blinks
Default Value = 1

YELLOW LED Blinks	**Load Sequencing Rest Count:** Time that both motors are off during the Load Sequencing routine. Only enabled when Remote Respects Load Sequencing is enabled as well.
1	0.5 Seconds (Factory default)
2	1.7 Seconds
3	3.5 Seconds
4	8 Seconds
5	16 Seconds
6	32 Seconds
7	64 Seconds
8	128 Seconds

Load Sequencing Rest Count is the amount of time that both motors will be disabled during each Load Sequencing cycle.

Bank 1 Parameter 7: Load Sequencing Speedup
GREEN LED: 7 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 1

YELLOW LED Blinks	Load Sequencing Speedup
1	Load Sequencing Normal Speed (Factory default)
2	Load Sequencing 2X normal speed
3	Load Sequencing 4X normal speed
4	Load Sequencing 8X normal speed
5	Load Sequencing 16X normal speed
6	Load Sequencing 32X normal speed
7	Load Sequencing 64X normal speed
8	Load Sequencing 128X normal speed

Load Sequencing Speedup divides the Load Sequencing Timer. This can be used when smaller increments of load sequencing time are needed for shorter pulses to the motors.
Use high speed sequencing with caution as faster switching of the driver transistors can cause them to heat up. Longer Load Sequencing Rest Counts are recommended when enabling this parameter.

The warranty does not cover transistors that are damaged resulting from load sequencing speedup. It is a good idea to monitor the temperature of the driver transistors to make sure they are not heating up when using the Load Sequencing Speedup parameter value is greater than 3.

Bank 1 Parameter 8: Remote Respects Load Sequencing
GREEN LED: 8 Blinks
YELLOW LED: 1 – 2 Blinks
Default Value = 1

YELLOW LED Blinks	**Remote Respects Load Sequencing:** Whenever the remote control buttons are used to move the tracker the motors will start and stop according to the load sequencing order. Used to limit the duty cycle when driving motors that exceed 4 amps continuous current draw.
1	Remote Ignores Load Sequencing (Factory default)
2	Remote Respects Load Sequencing

Remote Respects Load Sequencing should be enabled when Load Sequencing is being used to limit the time that the motors are on to prevent the driver transistors from heating up. This insures that the load sequencing order is followed when using the remote buttons to operate the motors. This is used when powering motors that exceed 4 amps continuous current draw.

User Interface Pin Descriptions:

***Caution must be used to insure that no static discharge is introduced any of the interface pins or the controller may be damaged and require factory repair.

CALIBRATION TEST POINTS:
Set multimeter on volts. Negative lead goes to ground. Positive lead goes to test point.

DRT - Dark Return Threshold: Sets Dark Return activation voltage threshold.
Default = .7 volts
Increase voltage to set the threshold lighter.
Increase voltage by turning adjustment screw clockwise.

TT - Tracking Threshold: Sets Tracking Threshold activation voltage threshold.
Default =2.9 volts
Increase voltage to increase sun intensity needed to track.
Increase voltage by turning adjustment screw clockwise.

SUN SENSOR TEST POINTS
1A - Axis 1 Sun Sensor Output
2A - Axis 2 Sun Sensor Output
ML - Mass Light Sun Sensor Output: Voltage represents sun intensity
(Dark = .1V – 1.5V | Cloudy = 1.5V – 2.5V | Sunny = 2.5V – 4.5V)

PARK & DRIVE OFF SUN ACTIVATE:
DOS - Drive Off Sun: Pull pin to Ground to activate DOS function.
+5v - +5 Volts DC (100ma)
GND - Ground
PK1 - Park 1 Activate: Connect to Ground to activate Park 1 Function.
PK2 - Park 2 Activate: Connect to Ground to activate Park 2 Function.

EXTERNAL INTERFACE:
GND - Ground
+5v - +5 Volts DC (100ma)
DOS - Drive Off Sun: Pull pin to Ground to activate DOS function.
DRA - Dark Return Activated (Goes from 5V to ground when Dark Returning)
TTA - Tracking Threshold Activated (Goes from 5V to ground when Tracking)
O1a - Logic Output Axis 1a (Goes from 5V to ground when MW1a is on)
O1b - Logic Output Axis 1b (Goes from 5V to ground when MW1b is on)
O2a - Logic Output Axis 2a (Goes from 5V to ground when MW2a is on)
O2b - Logic Output Axis 2b (Goes from 5V to ground when MW2b is on)

Note: External interface pins can be used in conjunction with another microcontroller that uses the actuator “reed switch pulse encoders” for memory positioning functions.

REMOTE SOCKET:
Pin1: GND - Ground
Pin2: WE - Move West: Connect to GND (Ground) to move tracker West
Pin3: EA - Move East: Connect to GND (Ground)to move tracker East
Pin4: UP - Move Up: Connect to GND (Ground) to move tracker Up
Pin5: DN - Move Down: Connect to GND (Ground) to move tracker Down
Pin6: AUX - Open pin/conductor - User access is the AUX test point on the PCB.

Additional LED Signals:

• When power is first connected to the controller the Green LED will blink three times to indicate that this is V3 firmware.

• While the controller is starting up the Green LED will flash very quickly 22 times as the user parameters are recalled from memory.

• The Green and Yellow LED will alternate quickly if the sun sensor is not plugged in.

• When Load Sequencing is enabled the Green LED indicates that the sequence is in the Motor 1 Cycle. The Yellow LED indicates that the sequence is in the Motor 2 Cycle. They will both be off during the Rest Cycle.

• When Load Sequencing is disabled the Green LED will flash periodically to indicate that the controller is on.

• When Park 1 is enabled the Green LED will blink quickly continuously.

• When Park 2 is enabled the Yellow LED will blink quickly continuously.

• When DOS is enabled the Green & Yellow LED will blink twice quickly then repeat.

• When Tracking has been disabled by Remote Control the Green and Yellow LED will flash 3 times followed by a short pause and then repeat.

HINTS:
Disabling tracking to facilitate control of actuators with an external circuit:
1 - Program Park1 to have no direction. *Parameter 3(Green LED = 3 blinks) Value = 1 (Yellow LED = 1 blink).*

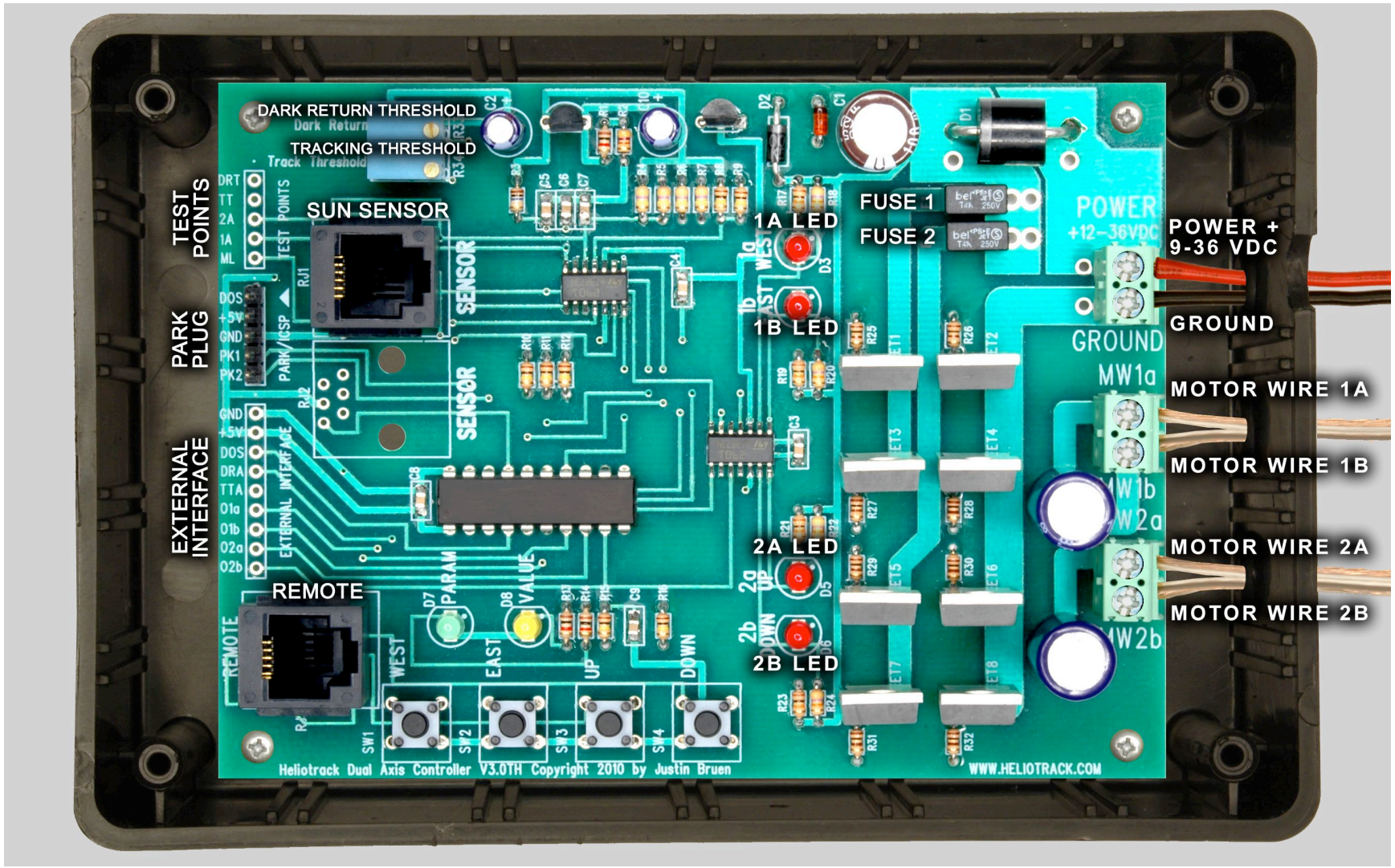
2 - Connect Park1 pin is to ground to disable Dark Return, Park2 and DOS and Tracking functions.

3 - Now use the Remote Control inputs to control tracker motion.

Copyright 2005-2011 By Justin Bruen
Heliotrack,LLC
32990 Poudre Canyon
Bellvue, Co 80512

Troubleshooting tips:

• **Symptom :** The parameter LED flashes quick 15 times, then holds for a moment, then repeats but controller never properly powers up.
• **Cause :** One or both motor terminals may be shorted. When the motor terminals are energized the power supply will fold at which point the controller will power down and shut off current to the motor terminals, the power will come back up and the controller will begin the initialization sequence again only to repeat the process.


DARK RETURN THRESHOLD
TRACKING THRESHOLD
SUN SENSOR
REMOTE
TEST POINTS
PARK PLUG
EXTERNAL INTERFACE
1A LED
1B LED
2A LED
2B LED
FUSE 1
FUSE 2
POWER +12-36VDC
GROUND
MW1a
MW1b
MW2a
MW2b
POWER + 9-36 VDC
GROUND
MOTOR WIRE 1A
MOTOR WIRE 1B
MOTOR WIRE 2A
MOTOR WIRE 2B
WEST
EAST
UP
DOWN
PARAM
VALUE
Heliotrack Dual Axis Controller V3.0TH Copyright 2010 by Justin Bruen
WWW.HELIOTRACK.COM

Notes: