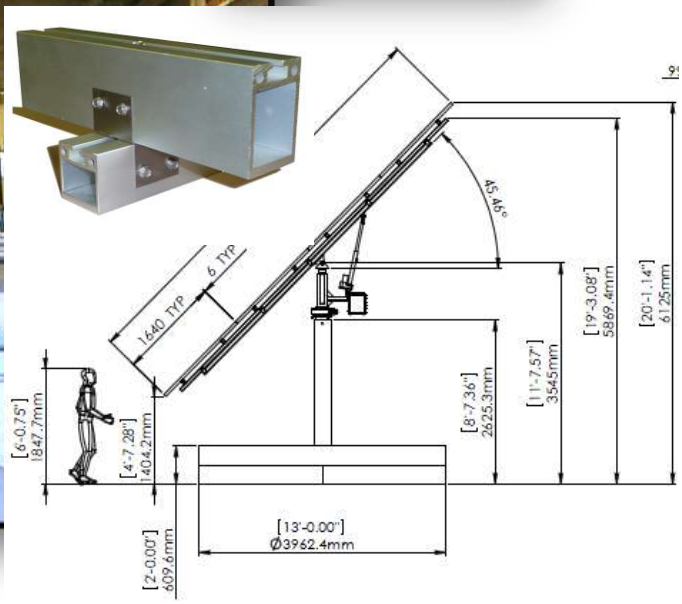
SP5000 and SP3600 with Sunpoint3GPS with DropNGo



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Throughout this manual, the terms WARNING, CAUTION, and NOTE are used to highlight hazards or unsafe practices or significant points worthy of emphasis, defined as:

WARNING
Hazards or unsafe practices that could cause damage, serious injury or death.

CAUTION
Hazards or unsafe actions or conditions that could cause personal injury or damage to the equipment and or PV components.

NOTE
Notes that will make assembly or operation easier and less prone to error or may avoid poor performance due to improper installation or adjustment.

Channellox extrusions and universal mounting PowerSeries Strongbacks
are the highest quality and strength needed to ensure years of safe and worry free use.

READ THIS ENTIRE DOCUMENT CAREFULLY BEFORE INSTALLING

PV PANEL MANUFACTURER'S MOUNTING INSTRUCTIONS
SUPERCEDE THOSE OF THE MOUNT ITSELF

ALL REFERENCES TO PV PANELS, ELECTRICAL AND GROUNDING
INSTRUCTIONS CONTAINED IN THIS MANUAL
ARE FOR INFORMATION ONLY
CONSULT THE MANUFACTURER FOR INSTALLATION INSTRUCTIONS

THIRD PARTY DESIGN, ANCHORING AND INSTALLATION OF THE POLE IT MOUNTS ON IS ALSO
FOR INFORMATION ONLY CONSULT A PROFESSIONAL ENGINEER

DISCLAIMERS - GENERAL SOLAR PV PEDESTAL AND PANEL MOUNTING INFORMATION

1. Introduction

This document provides recommendations for the installation of a mounting system for virtually any photovoltaic panel and identifies the hazards associated with the handling and installation of these products. *Please read this document in its entirety before installing.*

1.1. Disclaimer of Liability

All True North Power NG products are designed and manufactured to comply with relevant international standards (refer to the product label for details). However, as the conditions or methods of installation, operation and maintenance are beyond True North's control, True North Power NG Inc. does not assume responsibility and expressly disclaims liability for loss, damage or expense arising out of, or in any way connected with, such installation, operation, use or maintenance. PowerSeries mounts are designed for easy installation and long life. However, the warranty can be invalidated, in the event of a claim, if there is evidence that the Strongback, rails or connectors have been improperly installed or damaged prior to or during installation. Refer to the Warranty Certificate, provided separately, for full details regarding the Limited Warranty. PowerSeries Pedestals with Channellox rails are intended to operate under normal climate conditions between -40 and +50degC.

2 Electrical Hazard

Photovoltaic (PV) modules generate electricity whenever they are exposed to light. Potentially lethal voltages can be present. PV modules produce DC current, special regulations may apply. Follow local building codes and panel manufacturer's instructions when working with or connecting PV panels.

2.1. Prior to Installation of the PowerSeries Mount

Ensure that the pedestal installation and wiring of solar modules is performed by a qualified installer in accordance with ALL local standards or engineering codes. The pedestal that the PowerSeries Strongback and rails attach to is NOT part of this installation guide and must be designed and installed by a qualified engineer/installer. Ensure that a structural integrity of the pedestal is sufficient to carry the weight and wind/snow loads of the entire structure including panels under all conditions anticipated in your area. Consult a qualified structural engineer. Before performing any operation involving the pedestal foundations or system electrical connections, perform a risk assessment paying particular attention to the soil and environmental conditions as well as personal protection equipment required. *ALWAYS* obtain approval from a certified professional engineer to verify the suitability of the pedestal itself to meet anticipated operating conditions such as wind gusts, snow collection and thermal expansion requirements. When connecting solar modules to other equipment (batteries, charge controllers, inverters, etc.) refer to the equipment manufacturer's instructions.

2.2. Handling Safety

Use appropriate protective safety equipment as recommended by local safety codes and practices (e.g. Hard hat, scaffolding, steel toed shoes, gloves and restraining harness) and exercise caution particularly when installing heavy steel components or when working at height. Strongbacks and rails are heavy and should always be handled by 2 or more people using appropriate lifting equipment to do the work.

2.3. Installation precautions

DO NOT attempt any installation in adverse weather conditions (when high winds, rain, ice or snow is present). Remove any jewellery or other metallic adornments to avoid accidental electrical contact and use insulated tools. If installation must be done in bright sunlight, cover the front surface of all modules with an opaque material to prevent the modules from generating electricity until they are connected to open breakers and grounded. Ensure that both the front and back surfaces of the module and the sheaths of the connecting cables are undamaged, before installing them on the rails. NEVER install solar modules where the protective back covering has been damaged. Ensure that appropriate barriers are installed to prevent accidental contact between rails or other active circuit elements. Ensure that all electrical connections are properly connected, secured to the frame and protected from unauthorized personnel or animals.

3. Mechanical Installation

PV Panels normally have 4 mounting holes on the back of the panel as well as grounding points. PowerSeries mounts are designed to ensure a strong mechanical connection but avoid the stress or damage caused by top down "gripper" type clamps that may void your panel warranty. To comply with the requirements of UL1703 the modules must be fixed using hex-head bolts. For greater longevity, all PowerSeries hardware is made of 316 grade (A4) stainless steel. Prevention of corrosive effect of dissimilar metals must be considered when mounting the solar module frame (Aluminum) against other materials. Always refer to your specific panel's mounting instructions for accurate advice on mechanical connections.

4. Wiring Considerations

Always use cables and connections consistent with the anticipated environmental conditions of the installation. Cables should be selected for sunlight (UV) stability and rated for at least 90°C. Cables should be fixed & supported with adequate strain relief. A local grounding device must be electrically connected (grounded) to the pedestal.

4.1. Special Considerations

To reduce the risk of an electrical shock, always connect the frame of the module to ground by fixing an appropriate grounding cable to one of the grounding points of the module. Refer to your panel installation guide for correct grounding methods. You may use a self tapping rail penetrating screw for connecting (grounding) to any point on the rails. This helps in electrically connecting (grounding) panel's frame and rails.

If the system is to be installed in USA, then grounding methods must comply with articles 690 and 250 of the NEC. Perform initial ground fault detection (Riso) before system start-up and immediately contact your installer in the event that a ground fault is detected. Ensure that appropriate measures are taken to prevent unauthorized access and employ appropriate over-current/over-voltage protection.

5. Care and Maintenance

True North Power recommends that system inspections are carried out on a regular basis. This inspection should include verification of the integrity of electrical and mechanical connections, confirmation of the system isolation (Riso tests), and checking that system alarms are operating correctly. The array should be set at an angle of at least 10 degrees from the horizontal to aid self cleaning.

5.1. Cleaning

Channellox rail and PowerSeries galvanized Strongbacks require minimal maintenance. Clean the rails or Strongback with a soft cloth or sponge using clean and neutral water based cleaning solution (no ammonia)

6. Useful References

- A5/ANZ 5033:2005 Installation of photovoltaic (PV) arrays
- 1EC61140 Protection against electric shock - Common aspects for installation and equipment
- IEC 60364-4-41: 1992, Electrical installations of buildings. Part 4: Protection for safety.
- IEC61 730-1 Photovoltaic (PV) module safety qualification-
-CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1
- NFPA 70 US National Electrical Code (NEC)

PS5000 Tools Required

1) Heavy lift device will be needed for Drop*N*Go ballast capable up to 10,000lb. Some concrete suppliers may include this service with the delivery of Drop*N*Go ballast, If not you may need to hire one locally.
2) For all other components, Backhoe or small lifting device capable of approximately 1450kg 3200lbs
3) Two 25ft ropes
4) Extension ladder, step ladder or scaffolding
5) A set of standard Metric Hex Keys (Allen Wrenches)
6) A set of standard Metric Open End or Adjustable Wrenches
7) T-Square or framing square
8) Torque Wrench and a set of standard Metric sockets
9) Removable Strongback lifting kit (1 supplied)

Third Party Concrete Pedestals and Site Preparation

CAUTION
IMPORTANT: If you decide to construct your own pedestal base on site, to hold the tower, consult a qualified civil engineer for proper and sufficient weight, depth and strength to support the entire PS5000 mount with panels installed.

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Pedestal or Ballast Design Parameters

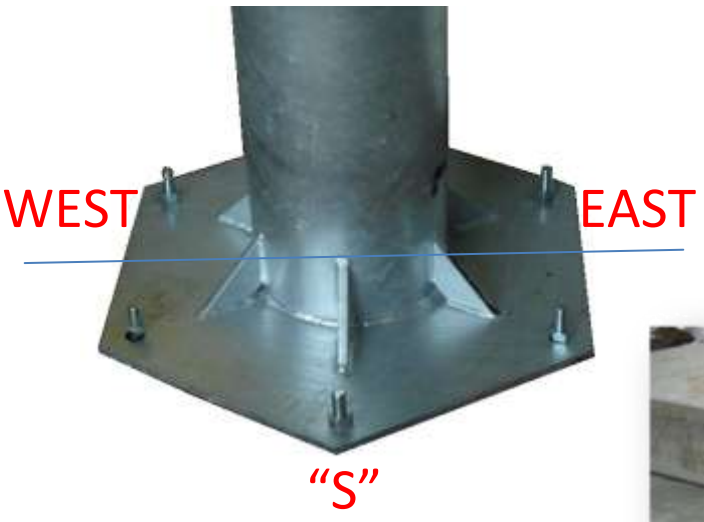
Max array surface area: 40.63SqM (437sq ft) 24 panels approx. 1675x1001mm (e.g. SolarWorld 230-240w)
Max designed wind speed: 90mph (145km/hr) at max tilt of 90 degrees
Max snow loading: 50lb/sq ft at winter minimum 38deg tilt and 90mph winds
Height of max pressure above grade: 10ft – Calculated tower bending moment ~63,000nm at the base with 90mph wind and 50lb/sq ft snow at 38deg tilt,
Total dead weight to be supported by pedestal base or ballast ~1,300kg
Panels (variable): 528kg
Upper Strongback: 390kg
Lower Strongback: 190kg
Tower 190kg
Ballast 4x9,000lbs = ~36,000lbs minimum per tower

Drop*N*Go Site Preparation and Placement

1) Drop*N*Go is a ballast system for PowerSeries 5000 mounts consisting of a system of 4 “D” shaped pre-cast steel reinforced concrete pads, placed on a prepared surface with a Basepost bolted to the concrete and Strongback and slew drive bolted on top.
2) There are two pairs of slightly different ballast forms used for the PS5000, an upper ballast pair with no protrusions and a lower ballast pair with 6 x ¾ “ galvanized threaded bolts on the center of the upper surface. Both sets have a radius of >6.5ft and are 1ft thick. Each weighs approximately 9,000lbs. When the two lower halves are joined the line or space between them should be oriented TRUE EAST WEST. See below.

3) Scrape off topsoil from the surface of about 15ft (4.5m) square and spread approximately. 4-6" of coarse gravel or crushed stone to assure good drainage. Consult a local soil engineer to determine if your location can support the entire weight without sinking or causing frost heaves in cold weather.
4) Dig a 1.5-2ft deep trench up to about 7.5 ft (2.3m) from center of the area. Drop*N*Go upper ballast halves should be oriented so the mating surface is oriented TRUE NORTH SOUTH. To locate TRUE SOUTH hold a pole or stick vertical at noon. The shadow will point TRUE NORTH. Using a compass you can find Magnetic South but you will need to look up magnetic deviation tables for your location to find the "Magnetic Deviation", the offset between Magnetic South and TRUE SOUTH. Magnetic poles "drift" slightly each year.
5) Place the 2 lower haves so that two flat edges are aligned GRID EAST WEST with one bolt directly SOUTH. (Look for "S" printed on the base)
6) Remove the top nut and split lock washer from each of the 6 threaded rods on the lower ballast and you are ready to lift the post onto the threaded rods. Place the post and level the base using the lower nuts, then install and torque the upper nuts to 200ft-lbs (275nm).

Figure 1 – PS3600-5000 Basemount and Ballast



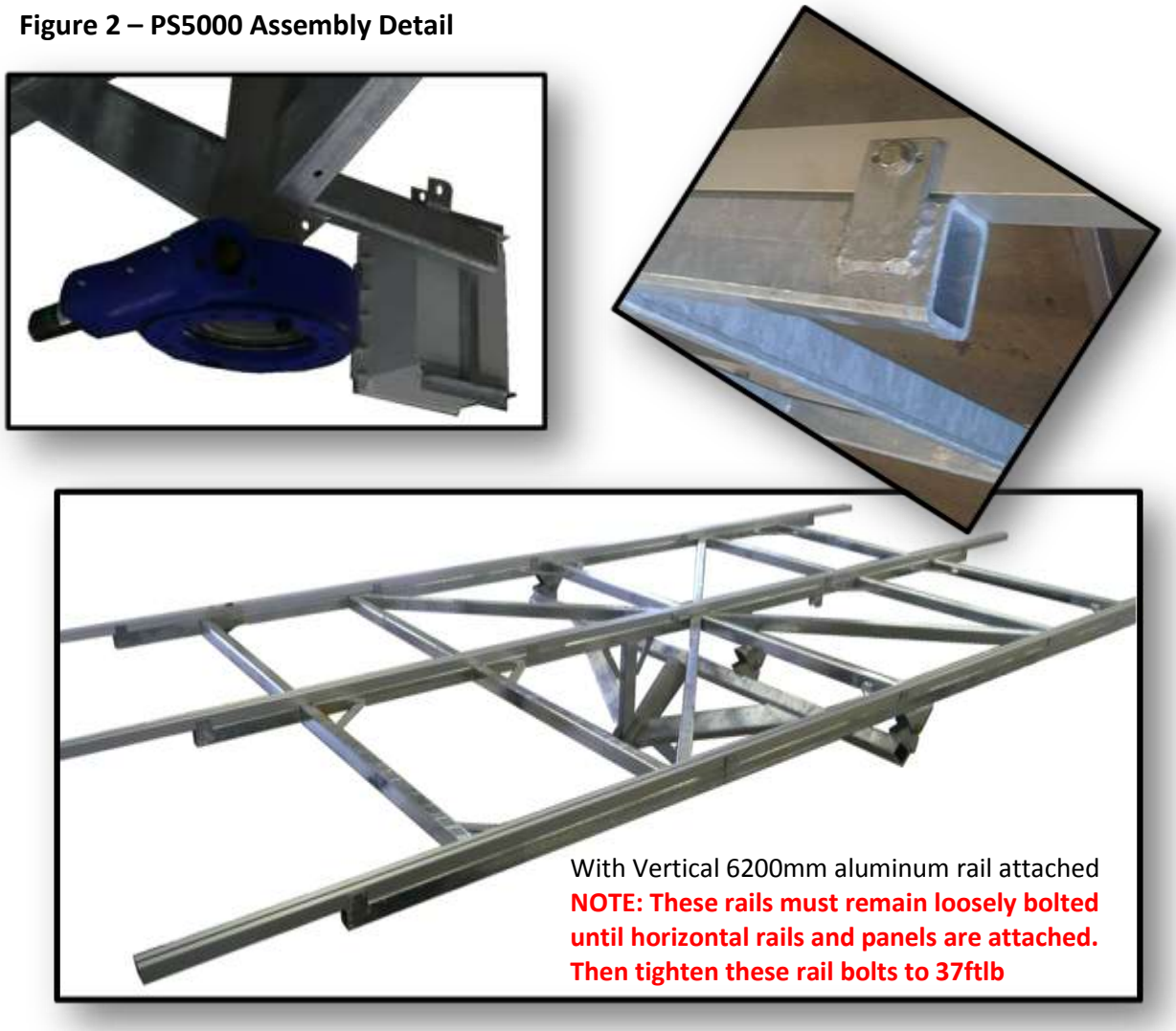
6 Bolt pattern attaches to the LOWER Ballast pair on 6x ¾" threaded rod with flat washer, split lock washer and nut. Torque to 200 Ft-lbs

Upper Ballast placed at 90 degrees.

Seal the upper joints with concrete parge or weather proof silicone sealant to prevent water from seeping in between the ballast layers

PS5000 DropNGo Ballast as installed

Figure 2 – PS5000 Assembly Detail



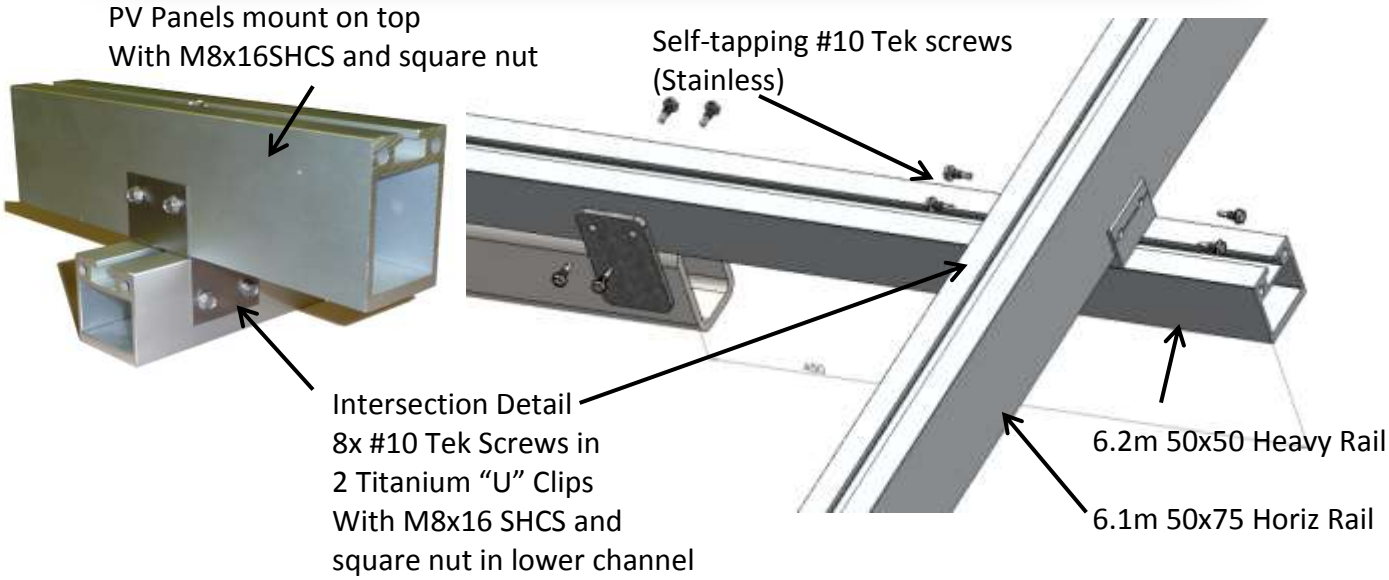
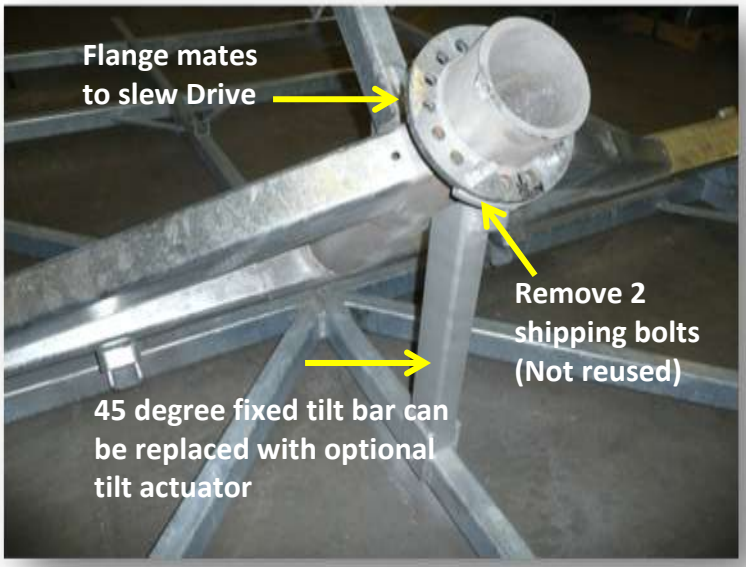


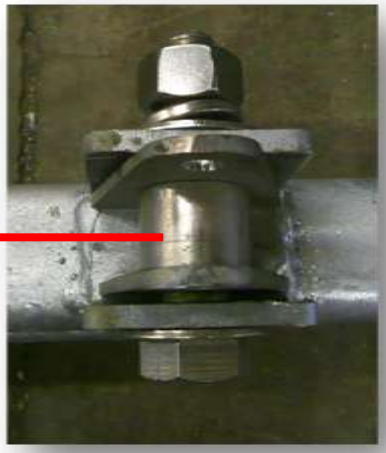
Figure 3 – PS5000 Lower Assembly



NOTE
For Azimuth Drive trackers, changes in Tilt Elevation provide very little actual value in terms of increased production. Unlike a fixed roof setting where changing the tilt twice a year can add about 5% additional energy, AZ Drive mounting systems only achieve about 1% additional energy by changing the tilt angle. Monthly tilt changes all year has virtually no significant impact on production. Detailed production analysis done in conjunction with the University of Guelph shows that the difference in annual collected energy between dual axis trackers and azimuth tracking with seasonal adjustment is barely 3-4%. SunpointGPS accomplishes this without the wear and tear of all the motor drive motion demanded by always accurately pointing at the brightest spot in the sky. In diffuse light regions like Ontario Canada, and most of the world, the dual axis tracker concept does not add significant value, uses more energy, is less reliable and is unnecessarily complicated. Dual Axis trackers require more maintenance compared to Azimuth Drive systems using a fixed tilt.

Linear Actuator (Optional with fixed mount)
FIXED tilt bar provides >95% energy when used with AZ Tracking systems in Ontario

A fixed mount (no actuator) can be fixed 45-60 degrees from horizontal and bolted on the south side of the tower, just above the slew drive.



Installation of SP3600-5000

Align Post

Prepare upper & lower Strongback

Prepare 8 Horizontals With Titanium brackets

Space and secure Horizontals

Enphase Kit?

Install panels

Install Lift trapeze

Attach Probe and Limit Switches and connect to controller

Install Controller

1. Check the post is vertical, adjust and torque base bolts to 200ft-lbs (275nm).
2. Suspend the Upper Strongback (face UP with the Lower Strongback below) on a scaffold or several saw horses. Identify the 50x75x~2000mm Rail with lifting tabs for later. SeeFig.4.
3. Prepare all eight 50x75x6100mm horizontal rails (Fig 2 detail) with an M8 x 24mm T-Bolt with ribbed lock washer, flat washer and hex nut each through the 2 interlocking titanium brackets (see detail bottom of Fig 2). Slide 8 T-bolts into each horizontal rail first add 2 interlocking titanium brackets. Then add 5x75 rails onto the 3 T-bolts. *This is more easily done if you first hold the rail upside down and push the bolt up from underneath through the 2 titanium interlocking tabs with a 6 mm hex key.*
4. Align the horizontal rails to the spacing required to fit your panels (Be sure to account for 6mm spacing between panels on all sides. You may have to spread the lower titanium brackets slightly to slide each rail past the lower rail mounting brackets. Torque the socket head bolts to 22 ft-lb or 30 nm for M8 bolts. Double check panel bolt spacing is correct and parallel and secure the titanium brackets with 8 stainless self-tapping #10 Tek screws.
5. Preinstall M6 or M8 square nuts and bolts on each PV panel and slide the panels onto each pair of rails in turn, connect electrically and secure. If Enphase micro-inverters are to be installed, be sure to place extra square nuts between panel bolts as needed. Tighten panel mounting bolts to 22 ft-lb or 30 nm for M8, and 12nm for M6 bolts. (Maintain 6mm Spacing). Follow panel supplier's specifications for grounding the panels.
6. When everything is checked and secure, install the two LIFT TABS and trapeze on either side of the center 2 panels and around the upper strongback (See Fig 4). Secure additional 25ft ropes temporarily to the lower corners. (2 workers will hold these to control sway)
7. DO NOT DO THIS STEP IN WINDY CONDITIONS. Lift the Upper Strongback and panels to mate the upper assembly to the slew drive. Install the 16x M16x70mm upper slew attachment stainless bolts and torque to 150ft-lbs with BLUE Medium strength locktite.
8. Install the Titanium Probe under the NORTH most (open bolt hole) of the slew drive. Use Zip ties and "peel and stick" mounts provided to secure the wires

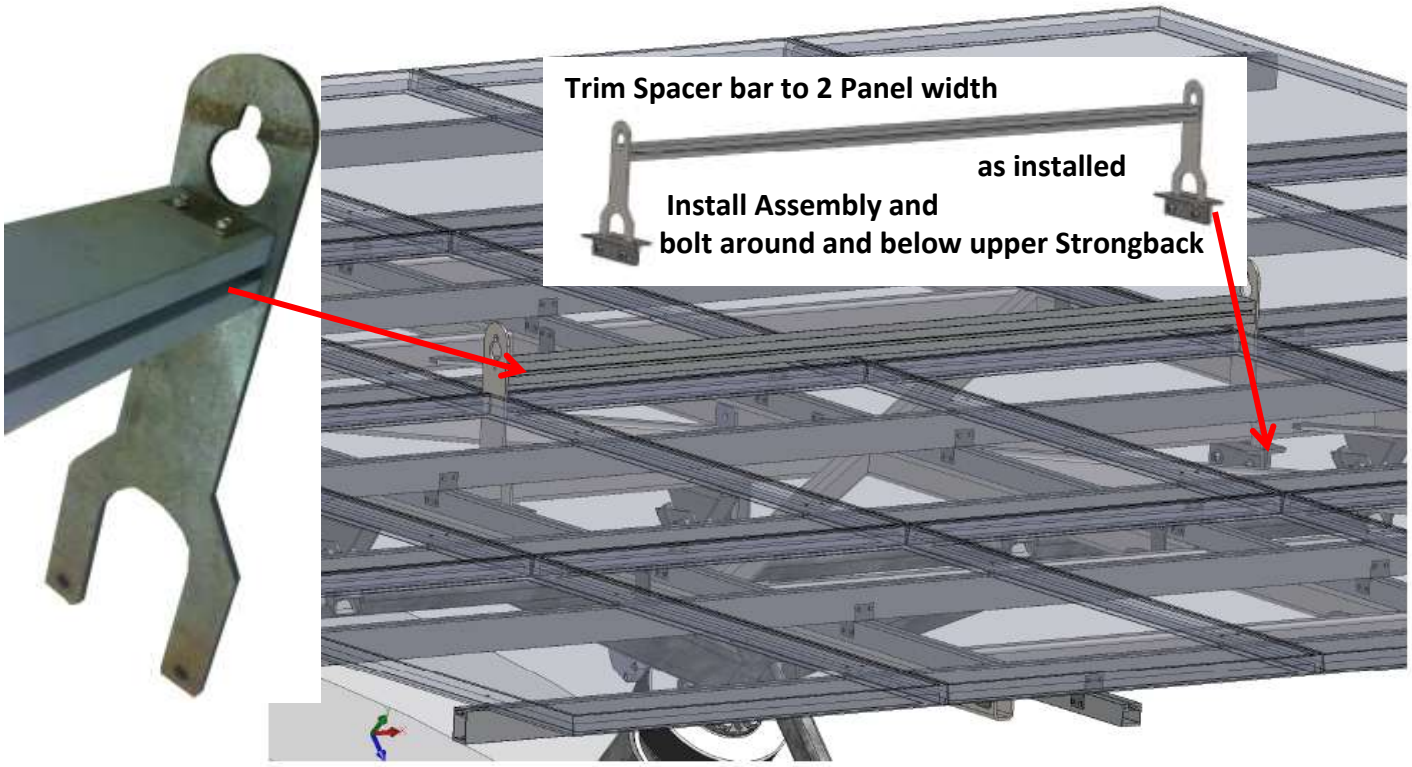
9. Proceed to Electrical Assembly in the SunpointGPS Controller Installation and Wiring section. **VERY IMPORTANT** Refer to SunpointGPS Power connection before connecting Power.

WARNING
The DC voltage of Solar PV strings of 10-15 panels can exceed 450 to 600v. Special care must be taken when hooking up the SunpointGPS controller to the power available at the combiner box

Figure 4 Lifting Trapeze – (OPTIONAL LIFTING DEVICE – NOT INCLUDED)

Measure the length between just outside the outer edges of the two center panels as installed and cut the 50x75mm ~2m Channellox rail to size. Attach each of the two Lifting Hooks to a titanium clip with a single M8x20 Hex bolt and nylock nut. Attach the rail horizontally between the two Lifting Hooks with 4x #10Tek screws in each titanium clip. Place the lifting hooks between the adjacent panels, on either side of the main upper Strongback 3x2" Galvanized Steel horizontal support tube and close the opening with 2 "L" angle iron rails with ½" bolts and nuts. Use locking chain links or suitable crane hooks to lift the array in to place.

CAUTION
IMPORTANT: Always secure two lower attachment points of the lifted array with additional ropes held by persons on the ground to ensure stability of the assembly during a lift. DO NOT Attempt lifting in windy conditions.

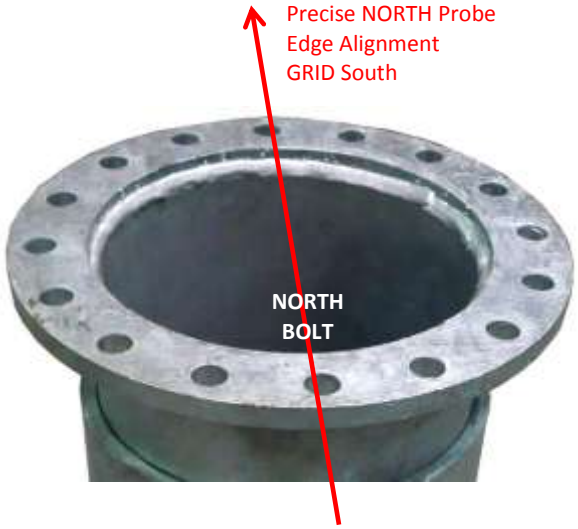


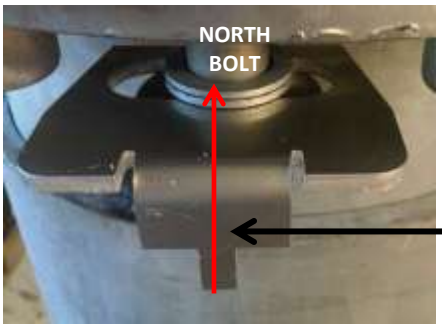
SunpointGPS – Power Connection and Operations

Operations Overview

SunpointGPS is self-powered, self-contained and self-aware. It uses its own 10-20W PV panel and charging system to keep a 12v AGM sealed battery charged. When full this battery will support at least 3 days of operation and after a further number of cloudy days it may be more than half depleted. If this happens the array will stop at SOUTH and wait for the sun to recharge the battery.

IMPORTANT CALIBRATION NOTE
It is important to initially orient the Lower Flange of the SunpointGPS tracker Slew Drive, or the tower flange if directly attached, aligned GRID with 2 opposite bolts on the lower flange and the LEFT edge of the NORTH probe. The North Probe has a + or- 10deg adjustment so flange holes only needs to be roughly aligned to GRID N-S. N and S orientation is reversed in the southern hemisphere. With the North Probe adjusted correctly, the unit will always be able to correctly re-establish its orientation even after shutting down the unit for annual inspection.





ORDER of INSTALL

1. Dual Lock Washer
2. North Probe (Adjustable)
3. Large FLAT WASHER
4. Bolt

Adjust left or right up to 10 deg to align with GRID NORTH SOUTH through the center of the post the array is mounted on.
Tighten securely, does not have to be 200lb torque

Each day, the SunpointGPS controller moves the array in several discrete "steps" from horizon to horizon and when not actually moving it goes to sleep (powers down) and waits. The unit uses less than 2.4AH per day of its own power a day to operate. The battery holds 12AH when full equal to about 5 days power with no charging. When the power is turned on (fuse installed) it determines it's position and time from the GPS, points in azimuth just ahead of the sun and waits for the sun to go by, sleeping while it waits. It steps about every few minutes and therefore keeps the array always pointing at sun azimuth. At the end of the day, it moves to south and waits there over night. Prior to sunrise, if the battery power is sufficient, it back to its known reference point, re-calibrates and goes to Sunrise Azimuth just before dawn.

Two additional emergency stop limit switches will stop all motion should the motor somehow attempt to go too far east or west. You can restart the program at any time to recalibrate its position. Simply remove the RED BATTERY POS terminal wire, and also disconnect the PV IN (during daylight), wait a couple of seconds and reconnect. The system will restart, recalibrate and then move to the current sun position.

On 16 panel (PS3200) and smaller models, elevation is set seasonally by hand at any time by loosening bolts on the tilt arms and tilting the array to the new angle. SP3600 and larger have a tilt actuator with hand-held remote for tilting the array. All True North Power arrays are balanced at the tilt pivot point for easy handling. Two tilt changes per year (shallower for summer, steeper for winter) are all that is really needed to gain the most useful effect. Adjusting tilt more monthly may add no more than 1% additional energy capture. Keeping panels clear of ice, snow, dust and bird debris have a much larger impact.

Studies show that in diffuse light regions, so called “dual-axis” tracking systems are of limited extra value. Detailed performance analysis done in conjunction with the University of Guelph show that the difference in annual collected energy between dual-axis trackers and azimuth tracking with seasonal adjustment is less 4% and SunpointGPS accomplishes this without the wear and tear of the constant motor drive motion needed by other systems that always point at the brightest spot in the sky. Choosing the right panel inverter combination have a bigger impact. The dual-axis tracker concept does add value in “specular light” regions like desert and equatorial regions but they generally use much more energy, but are less reliable in harsh cold climates due to environmental and mechanical wear and tear on components and sensors. This is unnecessarily complicated and does not add significant value, when used in the diffuse light environment of southern Ontario. Contact True North Power for detailed analysis.

CAUTION
All PowerSeries arrays are designed to handle simultaneous loads of up to 50lbs/Sq Ft of ice and snow at 45degrees of tilt, in winds up to 90 mph (145km/hr). This means that the array must be tilted 45 degrees or more during months when snow fall can exceed about 2.5 feet (~750mm) of fluffy fresh snow or about 12-15 inches (~300-400mm) of heavy wet snow accumulation.

SUNPOINTGPS Controller Installation and Wiring

1) Install the SunpointGPS controller box using the PS5000 mounting bracket using 2 M6x16mm HHCS bolts, Flat washer, Split lock washer and Nut.
2) Install the 20w PV panel onto the 500mm Channellox rail with 2 x M8x16mm HHCS, ribbed lock washer and square nut. (See Fig 5)
3) Mount 2 titanium U-Brackets to the rail as shown in figure 5 spaced about 300mm (1ft) apart with M8x16mm HHCS, ribbed lock washer and square nut.
4) Mount the assembly at either end of one of the horizontal rails on the main array a few inches outboard of the panels with 4 x #10 Tek screws. Choose a higher horizontal rail to mount it on, where it is less likely to get bumped or damaged.
5) Connect the PV panel POS NEG wire ends onto the POS NEG terminals on the back of the panel.

6) Plug the connection wires into the 12v PV Connector coming from the controller and secure with zip ties.
7) Connect Slew Drive motor control cable harness to the motor and secure the cable with zip ties.
8) Install limit switch wiring harnesses to the labelled locations on the side of each slew drive and secure with the 3 screws already installed in the ends of the drive. Use blue Medium strength Loctite on these screws. Use peel and stick tabs and zip ties to secure wires.

WEST

EAST

Note: the two harnesses and mounting plates are unique shape and only fit on one location EAST and WEST.

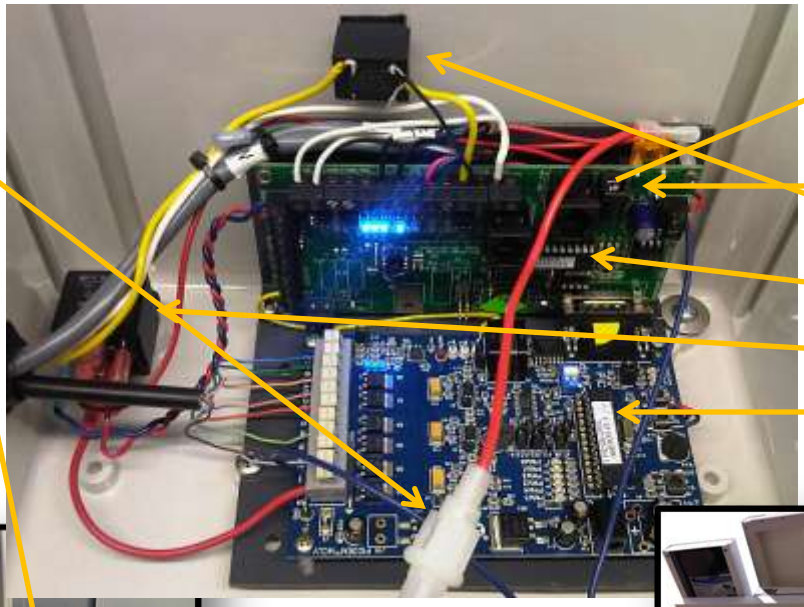
9) Ensure the power connection to the BATTERY is disconnected (Remove 2A fuse).
10) ENSURE NO FINGERS, TOOLS, WIRES OR OBSTRUCTIONS ARE ROUND THE SLEW DRIVE.
11) Install battery (terminals to the right), connect the cables and install 2A fuse to provide power and start the controller program.
12) Some LEDs will light up but nothing will happen immediately.
13) After a few minutes the SunpointGPS will acquire position and time and the array will slowly turn fully eastward to the EAST Reference Point to calibrate before commencing normal operations.

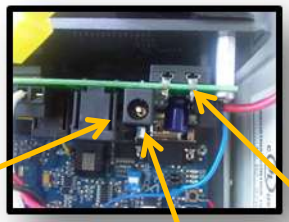
Controller Installation

The controller box mounts to the aluminum mounting plate with the 4 bolt adapter kit included in each box. The controller box mounting plate is then secured to the angled vertical of the lower strongback with the predrilled holes using self tap screws.

The SP3600 and SP5000 controller bolts to the mounting plate that is screwed into the lower Strongback support .

Figure 4 – Sunpoint2GPS Controller and PV Panel Installation





Battery 5 A Glass fuse holder

East/West Ref Switch Wires

Solar IN FEMALE YELLOW POS BATTERY

12v DC Plug-In and 5A Fuse holder

SolarPV charging Relay

Sunpoint2GPS ASTRO CHIP

Motor Board Control Relay

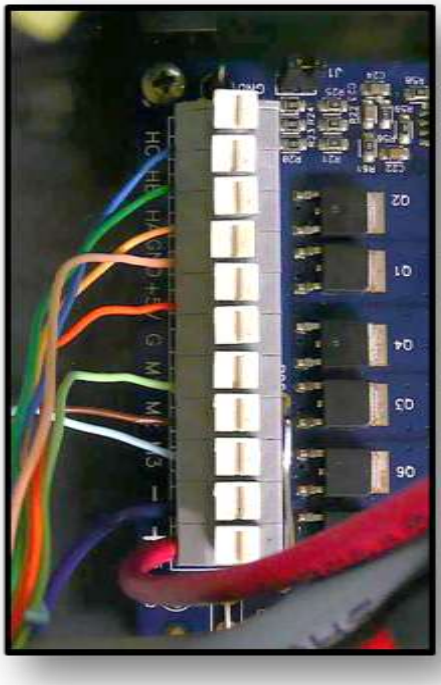
Motor Control CHIP

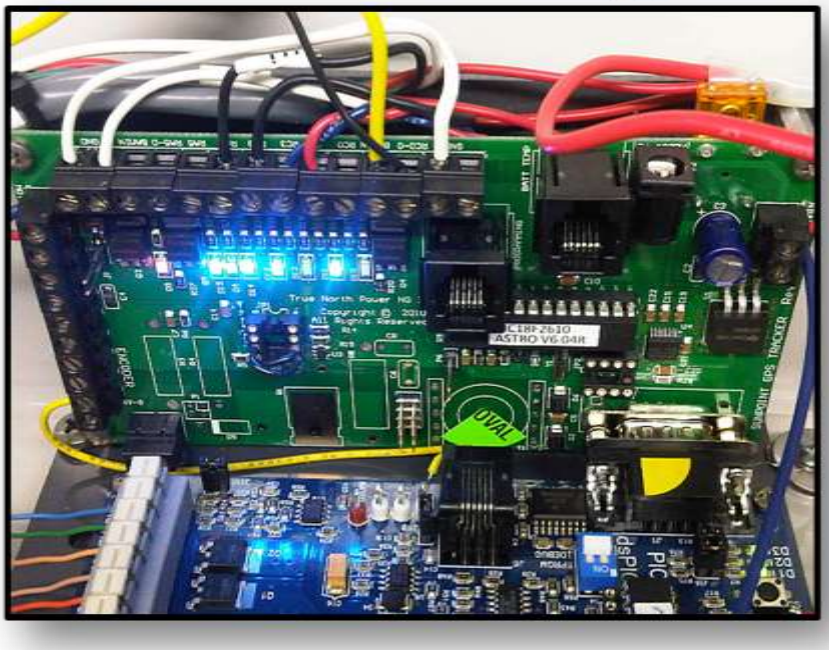
ABS Lockable Cabinet (See-thru Cover)

12AH STANDARD AGM Battery 12v
NOTE: Connect NEG BAT Terminal to array or tower ELECTRICAL GROUND

Sunpoint PV Panel mounted with F- Clips with M8x16mm SHCS to small rail and 4 self-tap screws to the array rail

Motor Controller Wiring





SunpointGPS Solar Panel Connection and Settings

Once the small 10-20w panel is installed check the voltage of the 2 leads of the bayonet plug coming from the panel (at the controller other end of the long grey panel wire) when the panel is in sunlight, (DO THIS BEFORE IT IS FIRST PLUGGED IN), to ensure there is voltage there (should be 13-20vDC) and check polarity. Make sure the yellow lead is both Male on the panel side and POS (+). On 10W panels check to be sure the BLACK wire is plugged into the panel terminal "2"(RED (+) on the panel) and the WHITE lead is plugged into terminal "5" the GREY (-)wire on the panel. On 20w panels the POS+ is both RED and on the right. Also be sure to check the YELLOW/WHITE plug on the other end mates with the YELLOW/WHITE plug coming from the controller AND that YELLOW mates with YELLOW and WHITE with WHITE. If they only plug in reverse DO NOT INSTALL. Call True North Power NG for advice. You can simply reverse the Panel ends but this is non-standard and can lead to problems in the future if someone does not know with has been done. You should obtain the correct mating plug that takes POS (+) from the panel + to the controller "BMAIN" terminal of the green board on the controller.

EQUIPMENT MONITORING

Solar arrays, trackers and small wind turbines are mechanical devices that operate in all climate and weather conditions. As such they are prone to wear and tear and damage caused by the elements.

Small changes in the condition of the system can lead to catastrophic system failures and severe damage if left unattended for extended periods without observation or correction of the loose part or wear.

Owners should pay attention to weather conditions and observe the equipment on a regular basis. If components become loose they can wear to the point of failure over a few days or weeks or sometimes within hours if there has been a major storm or ice, snow, wind or lightning.

Always inspect the condition of the tower, slew drive or panel attachments or the turbine as it flies. Listen for unusual noises, particularly with turbines. Regular annual inspections are mandatory and more frequent close inspections are recommended especially before or after a major storm. Check torques and condition of bolts and attachments and grease slew drives at least annually.

No bolt can be considered torqued properly once and then never inspected again. It is the owner's responsibility to ensure the equipment remains serviceable. If you as an owner do not or cannot perform this activity regularly, then please hire a professional whom you trust, that can do it for you. Regularly means at least be aware of it every day if you live on the property. Pay attention to the status of the equipment and look at it closely once in a while. Regular visits can be less frequent for maintenance contracts, every month for the first 2-3 months after installation and thereafter 6-12 months intervals or after major storms.

Panels may need to be cleaned of dust and dirt in the summer and cleared of snow or ice in winter. This is a good time to inspect the condition of fasteners and equipment. Pull on a few things and if they move or rattle tighten them immediately to the proper torque. (see the maintenance notes and torque specs in the manual). Lack of appropriate anchoring, electrical grounding or improper assembly can possibly destroy the entire PV array including the mounted PV panels in a single high wind event. You may also find additional installation and maintenance tips in the current Technical Bulletins on the website. ***Long and incident free operation is your responsibility after installation.***

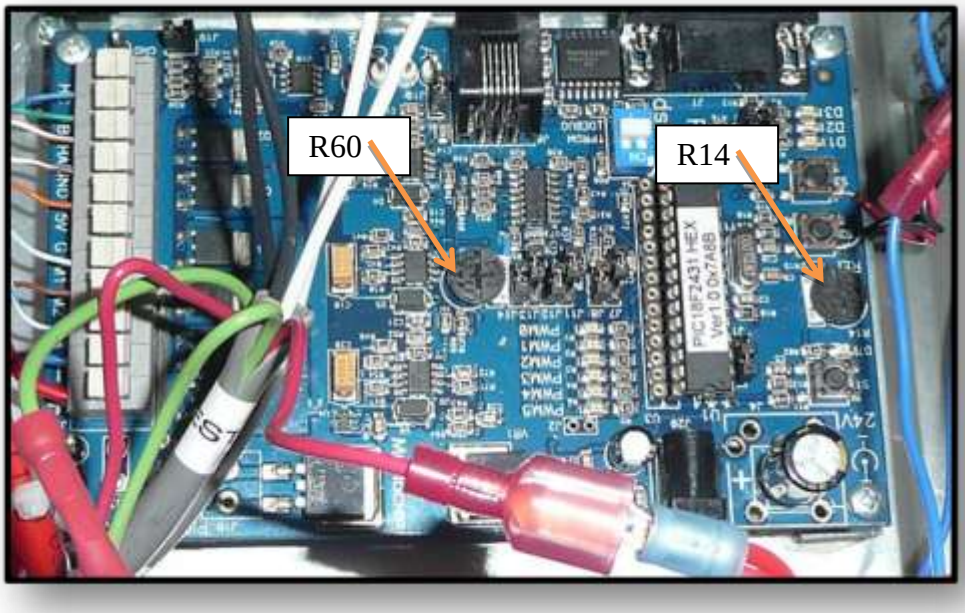
SUNPOINTGPS POWER AND FAULT CONDITIONS

1) With a full charge, the 12AH battery contains enough power to run the slew drive for about 2-3 days of low sun and poor charging from its own PV panel. The 120v wall plug power supply is standard with all sunpoint controllers. Solar charging system is OPTIONAL. If the battery is more than 50% depleted the unit will move to face SOUTH at the end of the day and wait for the sun to recharge the unit above about 70% before returning to normal tracking operations*. (NOTE: If this happens following days of sunny weather call True North Power to determine the cause.)*

2) If the array seems to be pointing away from the sun, first check the north probe is aligned the:
    a. The 5A fuse may have blown and must be replaced. (possibly caused by heavy loads or a jammed slew drive due to some obstruction of drive such as ice, frost, foreign object or high winds loads)
    b. Array is facing SOUTH during the morning but tracks afternoons only. The battery is likely marginally low ie not getting a full charge. You can normally either wait for more sun to increase battery voltage or replace or recharge the battery from an external charger, or plug is the standard external AC charger. AC Charger became standard power after October 2011 and solar PV became the OPTIONAL Power source.
    c. Extreme cold. Under extreme cold temperatures (-30-40Deg C) all batteries have substantially reduced capacity. In extreme cold the electrochemical reactions simply cannot take place and so very little if any energy can be extracted. Either warm the battery or hook up a 12v DC power source that does not depend on battery chemistry temperature.
    d. Ice or heavy frost under the slew drive or around the switches may have activated one of the limit switches. Check and carefully remove all ice/frost around the underneath of the slew drive and around the switches to allow the switches and probe to operate freely. If the array is within limits, unplug the battery POS+ AND the solar panel connector. Reconnect the batter and the system will reset. Then reconnect the Solar PV.
    e. Unknown software/GPS fault. Make sure the GPS chip (located on top of the green controller board) is fully seated and no pins have been bent during insertion. Press down with your finger or a non-conductive probe so no pins are visible. RESET the controller as described above .

3) **FAULT CONDITION -** SunpointGPS trackers have two (2) safety LIMIT switches that monitor the position of the slew drive. They are located just below the maximum EAST WEST Reference points and activate to cut power off. Either safety switch will stop the motor by turning off all power to the drive unit if it attempts to travel beyond the EAST or WEST limits. Should this happen the system must be brought back within travel limits manually by manually reversing the drive travel back within limits. FIRST disconnect all power to the system. Remove the 2 motor/limit switch bolts and the motor control cable and without removing the motor gently rotate the motor to any position. Reinstall the bolts and cable. *(Always investigate thoroughly as to why this failure may have happened before manually moving the system to ensure it does not happen again. Call true North Power if this happens.)*

4) **DC MOTOR FAULT CONDITION: OVERCURRENT**
    a. If the motor stops and LED D1 on the motor board is blinking, (indicates overcurrent). Reduce the R14 speed adjustment R14. Normal R14 setting is 3 o'clock position or slightly past clockwise. R60 should be at 9 o'clock position See photos next page.



5) **MANUAL DRIVE OPERATION**
   a. Unplug 10-20watt Sunpoint PV Panel and unplug 12v DC Battery terminal (RED connector or separate the glass fuse holder)
   b. Remove the motor Drive/WEST REF mounting plate bolts only and the black Motor control plug wire. DO NOT REMOVE THE MOTOR. *Be careful not to pull the motor or shaft out as you may drop and lose the keyway from the motor shaft.*
   c. Rotate the motor in it's mount and replace the motor wire and bolts.
   d. Motor mounting bolts must be replaced or the slew drive may turn in the wind.

6) REPLACING OR UPGRADING THE SUNPOINT CONTROLLER CHIP
   a. As new SunpointGPS controller software is introduced you may be offered an upgrade for FREE or at a nominal charge either by replacing the controller chip or by a True North Power technician site visit, where the technician may upgrade the program from a laptop without removing the chip. If you receive a new SunpointGPS program chip:
      i. Unplug the SunpointGPS PV Panel
      ii. Unplug the battery and AC Plug-in of used (this will power down the controller)
      iii. Use chip puller to remove the old chip and install the new one. Be extra careful to pull the chip out "under control" so as not to bend the delicate pins
      iv. NOTE: the notched LEFT end of the chip should match the white notch printed on the controller board. Press gently at first to ensure all 14 pins are aligned to the socket and then firmly grasp the chip and board together to seat the chip
      v. Then plug in the battery, wait for RESTART and reconnect the PV panel

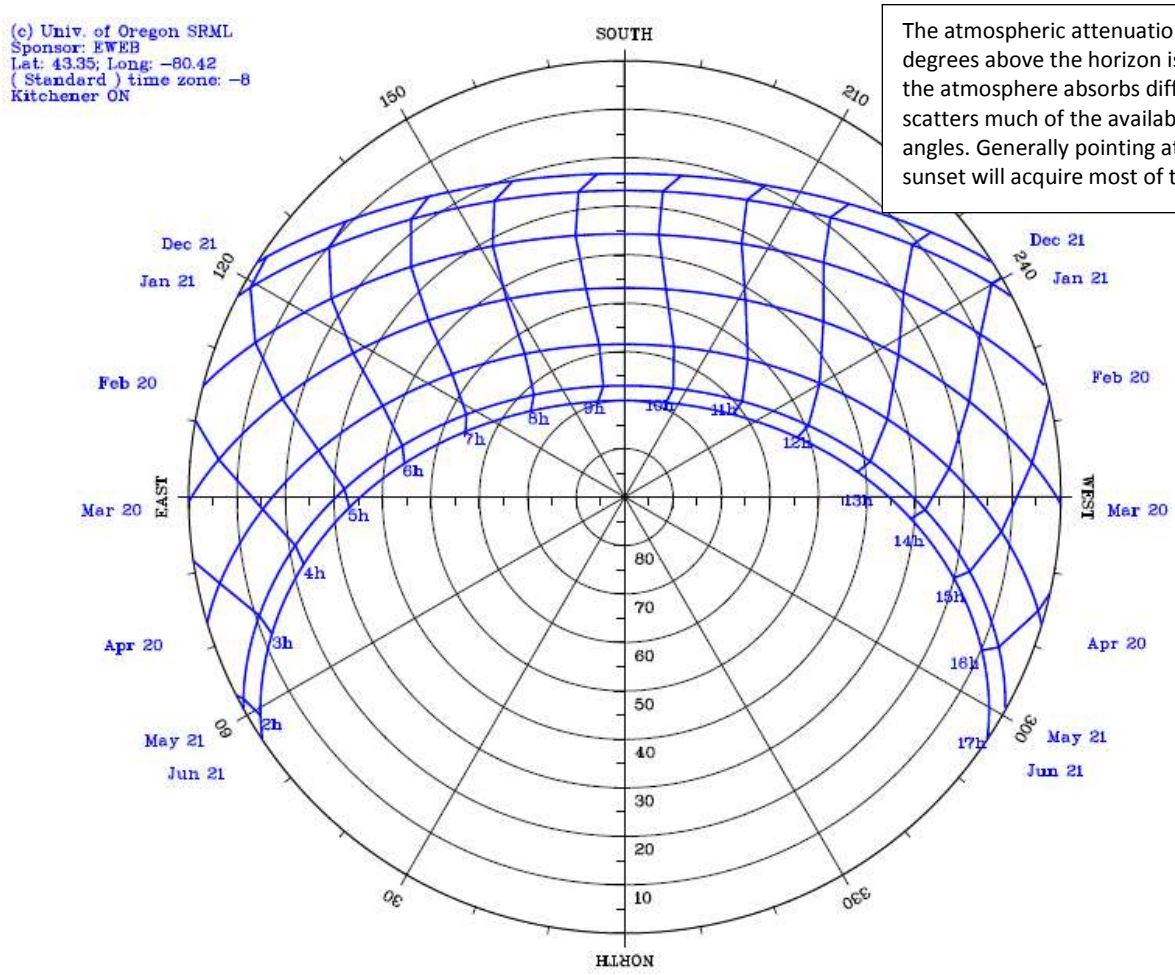
Service Call Checklist

1. **Where is the array pointing?** If it is daylight an NOT pointing at or near the sun.
    a. The North Probe may not be aligned exactly. More obvious when all three arrays are always slightly off from each other or all ahead or behind.
    b. If generally south the battery may be low (<12.3v).
    c. Still sitting WEST in the morning. Check Battery voltage and RESTART if above 12.5.
    d. Never left EAST REF? Check GPS is seated and criss-crossed GPS Jumpers are in place. (Just under the Red Wire in photo Pg 13)
2. **What is the resting battery voltage?** If it's below 12v, like really low 8v or less the solar panel is not charging. Check PV polarity and confirm charging. If it's freezing cold (<-10degC) plug in Aux Power Supply. If BATV is >12.6 then charger likely working.
3. **Are there lights on the Sunpoint3GPS controller board.** Normally only 2-3 Green LEDs are on. One BLUE may be blinking. This means GPS signal is being received and processed.
4. **Are any motor control RED lights or Green flashing but no movement?** System is stalled. Motor board has been sent a command but not able to process. Power ON RESET (POR) should normally restart automatically within a few min.
5. **Is the array STALLED at EAST REF?** The GPS chip may not be seated properly (When seated properly no metal pins are showing - ie black-to-black plastic only)
6. **Are there no lights at all?** (check the fuses, there are 2)
7. Is the small PV panel making 14-20v with correct polarity. Unhook the PV plug and use multi-meter to prove the MALE YELLOW (panel side) is POS+ and at least 14-20v DC)
8. **Is the charging relay and circuit working?** While the PV is unplugged and the motor not moving, measure the BATV and look for a rise in BATV as you plug the PV back in. You will need to have a multi-meter capable of 00.00V resolution and should see a slight rise in low sun and fairly rapid rise in full sun. In good sunny conditions you may hear the charge relay clicking on an off between approximately 13.7 and 13.2v.
9. **What is the Firmware version of the Controller Chip?** Confirm 6.0.4R or higher on the label.
10. **Current Limit and Speed Control Rheostats not set properly.** See adjustment photos in section 4 on pg 16 above.
11. **Is either the EAST REF or WEST REF switch engaged?** Array stuck at EAST REF is indication GPS signal is poor or missing. WEST REF is only engaged when SUNSET is north of about 290 deg TRUE. In mid-summer this is normally engaged while the array waits for sunset and civil twilight before returning to south. This should happen about 30min after sunset.
12. **Are the EAST REF or WEST REF switch wired hanging below the Slew drive?** Use zip ties or other means to ensure no wires hang below the slew drive casing than can get caught or damaged by ice or north probe or other obstructions.
13. **Is the North Probe properly installed and aligned on TRUE NORHT/SOUTH?** New adjustable North Probe (+- 10degAzimuth) is now available from True North at nominal cost.
14. **If the motor board will not light up or drive at all** . . . Are there any loose wires or burned MOSFETS on the GREEN board or the blue motor controller. It must be replaced.

CAUTION
1) Installation of the panels and Strongbacks should only be attempted on a calm day with little or no wind. Sudden wind gusts can catch the array and result in costly panel damage and personal injury. There is a significant pinch hazard to fingers and skin. Wear gloves.
2) Unconnected PV panels can build up dangerously high voltages especially when they are wired together in series. Exercise caution around PV panel connectors and follow the manufacturer's instructions when connecting and disconnecting panels. Always incorporate an OPEN breaker when making the final wiring connection of high voltage strings.
3) Setup of this solar panel mount and the installation of solar panels is not a one person job and require at least 2 or more people to be done safely. The PS3600 and PS 5000 trackers require a crane or lift.

Adjusting the Solar Mount Direction

Locate the pedestal/mounting pole where it is completely clear of shadow as much as possible in all seasons of the year. Professionals will use a "Solar Pathfinder" or similar device but, if you don't have one it helps to have a diagram of the sun angle as it might be at every time of the day for all days of the year. Google now has a great java application for visualizing solar transit for any day of the year and any location on earth, called Suncalc. http://www.suncalc.net/#/43.2873,-80.4519,14/2010.11.21/07:51. Another interesting visualization tool can be found at http://pvcdrom.pveducation.org/SUNLIGHT/SUNCALC.HTM . If you wish to see an entire year of sun angles for your specific LAT/LONG a simple chart like the one below can be generated from a website at Oregon State University. http://solardat.uoregon.edu/SunChartProgram.html . It shows the azimuth and elevation that the panels should face in order to get maximum solar energy. A "Solar Azimuth" of 180 degrees will face GRID or TRUE SOUTH in the northern hemisphere. Use "Zero" degrees to create a chart for GRID or TRUE NORTH in the southern hemisphere. You can find TRUE SOUTH or TRUE NORTH on your property by noting the direction of the solar shadow at noon. (Standard time not Daylight Savings). You can also use a compass but don't forget that Magnetic South can be off by several degrees from GRID SOUTH so a compass alone will not give you an accurate angle. Using a compass you must account for "magnetic deviation" in your location. It is different everywhere on the planet. Just Google it.



The atmospheric attenuation below about 15 degrees above the horizon is dominant where the atmosphere absorbs diffracts, reflects and scatters much of the available energy at low sun angles. Generally pointing at the sunrise or sunset will acquire most of the available energy

Once you have determined GRID SOUTH or NORTH, adjust the Strongback to be GRID EAST WEST that is 90 degrees to NORTH SOUTH which is the direction the panels must face. Face the array GRID SOUTH in the northern hemisphere and GRID NORTH in the southern hemisphere. With the Strongback secured you can now adjust the angle of the array to something close to the highest point of the curved lines in the chart

above (based on the time of year). The closer you follow the maximum elevation of the blue lines throughout the year, the more power your array will produce, but adjusting it more than 2 times a year does not add significant amounts of energy (possibly <1-2%) for azimuth tracking arrays. If you do adjust the angle of the array seasonally, it should only be done once after the snow is gone (set the angle to Latitude -10Deg) and again in the early fall (set the angle to Latitude + a max of 5-10 degrees), or change the angle as often as you like if you just like playing with wrenches. Be sure to retighten all bolts to proper torque before leaving the array at a new angle.

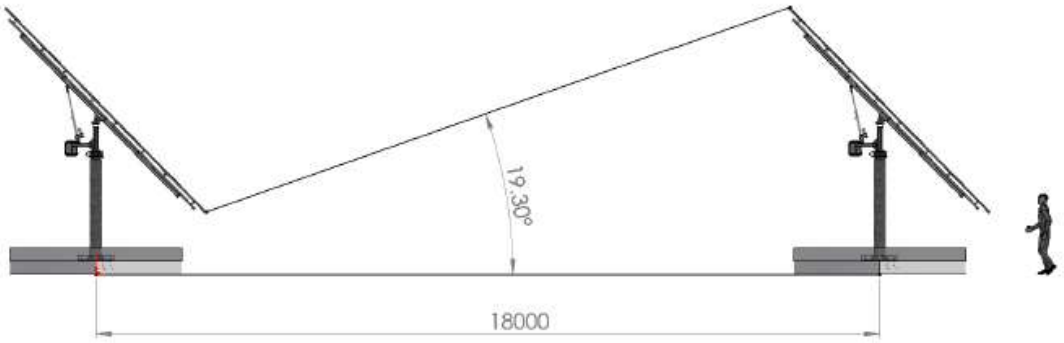
Siting Multiple Pedestals

If two or more pedestals are located near each other you will need to provide spacing for them so one does not shadow the others during various times of the day or the year. This is especially important for tracking systems where early morning and late afternoon shadows are longest. Below is a typical array siting analysis that you will have to create for yourself based on the location, the ground slope and the panels you choose. This "IDEAL" case shows how the shadows from one pedestal can interfere with production of the ones around it based on how close they are. Remember however that the low sun angles of winters solstice in the Northern hemisphere occur for only a few short days per year when the solar hours are fewest all year and when you can expect a lot of cloud cover anyway.

Designing systems for this limited case is more of an academic exercise rather than offering significant performance improvements, and practical spacing of closer distances can be just as operationally productive as the ideal case. Changing the height of the front row of pedestals and reducing the maximum tilt angle of just the front row can significantly shorten the row spacing requirement of the pedestals. Perhaps mounting the panels in landscape can reduce the height of each pedestal and likewise reduce the spacing required. Also check your ground slope on site as just a few degrees of slope can reduce the spacing significantly. In addition, siting for solar production below 15 degrees above the horizon is of limited value due to atmospheric attenuation. Consider all of these parameters before choosing pedestal spacing.

This is a minimum spacing of pedestal spacing for SP3600-5000 mounts, with 18-24 (1650x1000mm) ~200w panels mounted, 4 up and 6 across, in Portrait mode, at various azimuth angles. You will have to study your own location, panel setup and spacing to determine what works best for you. Using your site angles chart you created from the University of Oregon website, with a piece of squared paper and a protractor may be all the accuracy you need.

E.g. 45 degree tilt with typical panels and about 20 degree winter noon or sunrise solar angle.



Site preparation and post or pole installation is not always part of the equipment supplied by True North Power NG Inc. ALWAYS consult a qualified professional engineer.

1) Select the correct size and height support pole. Install according to local building codes and with the advice of qualified professional, civil or mechanical engineer.
2) Please read this entire manual including safety precautions carefully before starting work.

Steel Post (Pedestal) Requirements

PS5000	Post Type
10" Post 10.5"OD Height 7.5 ft or 9.5ft Base of panel min 4ft above Grade at 45deg tilt	Hollow Structural Steel (HSS) Round 0.5" wall ASTM Standard Grade 500C

CAUTION
Consult a qualified civil engineer before deciding the location and size of the supporting pier, concrete strength and/or post.

WARNING
This is not a one person job even if you have lifting devices or winching equipment as the mount is heavy and unwieldy. It can only be safely done with at least 2 or 3 people.

Strongback and Channellox Rail Materials Specifications
Including Wind, Snow and Load Bearing Test Data
is available on request

Engineered stamped drawings from Ontario engineers are also available at a nominal cost.

Contact info@truenorthpower.com