



Channellox Solar Roof Mount System



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**SEE ANNEX A
FOR DESIGN OPTIONS & ACCESORIES**

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 equipment 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 mounting clips are the highest quality and strength to ensure safe secure 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**

**COMMENTS ON DESIGN, PLACEMENT AND INSTALLATION OF
THE ROOF PENETRATION MOUNTS IS
FOR INFORMATION ONLY.
CONSULT THE MANUFACTURER FOR INSTALLATION INSTRUCTIONS**

One Page Installation Guide - for those impatient installers who don't like long manuals.

Locate rafter line and horizontal rails with a chalk line

Install Roof Penetrators/standoffs with F-Clips on each intersection. Exact F-clip position not critical yet

Install Horz Rails, level Secure with Self Tap through F-Clips.

Work top to bottom.

Parallel and level Horizontals

Mount Panel-Clips on each Panel
Insert T-Bolts in Horizontals

Install 1st row of panels Landscape
Nest Panel-Clips
Make electrical connections
Install additional rows of panels

Torque Pairs of Panel-Clips as you go

1. Snap a chalk line on the rafter locations you plan to attach to and approximately locate the lower horizontal rail attachment points. The intersections of the vertical and horizontal chalk lines are where the standoffs will be located. *In landscape layout this will also be roughly the lower edge of the lowest row.*
2. Locate the highest penetrator/flashing/standoff/F-Clip points anywhere near the peak of the roof but no higher than about 0.5m (18in) down from the peak. This is the highest edge of a row of panels. See RED rectangles on Pg 8 Layout diagram. These are standoff locations.
3. These attachment points vertical spacing for each horizontal rail need only be approximately the width of a panel (+28mm, ~1") space between the panels. When using Standoffs this spacing need not be more precise than about half the length of a standoff (+- 50mm ~2"). *The distance between F-Clips either vertically or horizontally should not exceed ~1.4m (4.5ft) unless 50x50mm heavy or larger Channellox is used. Consult a licensed engineer for specific recommendations compatible with your roof structure.*
4. Follow penetrator/flashing/S5clip attachment installation instructions (whichever method is being used) and mount an F-Clip and ribbed lock washer with each penetrator bolt. *The F-Clip orientation up or down does not matter. Just be consistent.* Fix the F-Clips with M8 x 22mm socket head bolt and ribbed lock washer.
5. Mount horizontal rails in a row of loosely fitted F-Clips. Align the rail with a level and torque the F-Clips to each horizontal rail with self-taping screws (2 screws on each F-Clip. 4 screws only used for butt connections).
6. Pre-mount Panel-Clips on panel mounting holes with M6 x 16mm socket head bolt, flat washer and nylock nut, before taking them to the roof. Panel mounting holes width dimension must match the rail spacing +28mm but this distance can be finely adjusted on the roof by loosening the F-clips on one row. Ensure that the top, or first, row of panels has all Panel-Clips flat side down. The remaining panels should have both the clips on one side flat side UP so it can nest with the upper row clips and both clips on the other side flat side DOWN. *For M6 use ~12nm torque.*
7. Slide two (2) M8 x 25mm T-Bolts onto each horizontal rail for each panel in that row.
8. Hang the first row of panels on the T-Bolts making electrical connections as you go. *Start at either end.*
9. Secure the upper row of T-Bolts with M8 flat washer, ribbed lock washer and hex nut using a torque wrench or automatic torque driver set to 20nm of torque. **DO NOT USE nylock nuts with the T-Bolts as they tend to gall and freeze when making multiple adjustments.**
10. Now mount the next rows of panels the same way, nesting each Panel-Clip to the Panel-Clip in the row above.
11. Secure panel plugs and torque each row T-Bolts as you go and **YOU'RE DONE!**

Note: If you forget or miss electrical connections you only need to undo that panel, lift it up or out, make the adjustment and reinstall the M8 hex nuts.

DISCLAIMERS AND GENERAL SOLAR PV RAIL AND PANEL MOUNTING INFORMATION

1. Introduction

This document provides recommendations for the installation of a mounting system for virtually any photovoltaic or thermal module large or small and identifies the hazards associated with the handling and installation of these products. Please read this document in its entirety before installing roof penetrators, rail, wiring, or using your solar modules.

1.1. Disclaimer of Liability

All True North Power 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, use 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. Channellox have no user serviceable parts. Your warranty will be invalidated, in the event of a claim, if there is evidence that the 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.

Channellox is intended to operate under normal climate conditions between -40 and +50 deg C.

2. Safety and Reliability

2.1. Electrical Hazard

Photovoltaic (PV) modules generate electricity whenever they are exposed to light. Potentially lethal voltages can be present when 2 or more modules are connected in series and, as PV modules produce DC current, special regulations may apply. Faulty electrical connections can result in electrical arcing which can ignite any flammable material located in close proximity. When flammable material is within 30cm (12 in) of either the solar module or any of the electrical connections then install an appropriate flame barrier to prevent potential risks of fire.

DO NOT damage, pull, bend or place heavy loads on the cables.

DO NOT connect the cables if the terminals are wet
DO NOT disconnect module cables when panels are producing power. Turn the breakers off first.

2.2. Fire Rating (Also refer to the panel specifications)

Most modules have been certified by Underwriters Laboratories or similar agency to comply with UL1703 Class C fire rating. To satisfy the conditions of this rating when installing on a building or roof, you must mount modules using a rack standoff method like Channellox, over a fire resistant roof covering rated for the application. The module listing does not apply if modules are mounted in direct contact with the roof or wall of a building, and may not be approved for marine or vehicle applications. Consult your PV module manufacturer's compliance claims.

2.3. Prior to Installation

Ensure that the installation and wiring of solar modules is performed by a qualified installer in accordance with ALL local standards or codes. Before attempting installation on a roof ensure that the structural integrity of the roof is sufficient to carry the weight of the structure and panels. Consult a qualified structural engineer. Before performing any operation involving the penetrators, rails or system electrical connections, perform a risk assessment paying particular attention to the environmental conditions and personal protection equipment required. ALWAYS obtain guidance from a certified professional engineer to verify the suitability of the mounting arrangement 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.

2.4. Handling Safety

Use appropriate protective safety equipment as recommended by local safety codes and practices (eg. hard hat, scaffolding, steel toe shoes, gloves and restraining harness) and exercise caution particularly when installing modules at height (e.g. on a roof). ALWAYS handle solar modules by their long sides and keep sharp edges of rails or clips away from the module surface when handling. Solar modules are heavy and should always be handled by 2 people; furthermore they contain glass which can be easily broken if mistreated. DO NOT walk on, bend or drop the solar module. Similarly, DO NOT place heavy loads or drop objects on modules while installing rails.

2.5. Installation precautions

DO NOT attempt any installation in adverse weather conditions (high winds, rain or when ice or snow is present). Remove any jewelry 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 rail active circuit elements. Modules should be installed at an angle of at least 10 degrees from the horizontal to aid self cleaning. Ensure that all electrical connections are properly connected and protect them from interference from unauthorized personnel or animals.

Secure cables properly using either the wire-hold features of the junction box or other appropriate cable fixing methods and ensure that cables are routed away from sharp edges that could damage the cable sheath. The power production of a solar module is related to the amount of sunlight and temperature. To avoid localized temperature build up or damage to the back of the panel, DO NOT attach anything to the back of the module and ensure that there is adequate ventilation behind the modules.

3. Mechanical Installation

Virtually all modules require mounting using 4 front mounted module holes on the back of the panel. Channellox panel clips are designed to comply with specifications to ensure both a strong mechanical connection and avoid stress or damage caused by “gripper” clamps that may void your panel warranty. Use M8 or 5/16” or M6 hex-head bolts as specified for your panels with a torque of 20-22 Nm (175-200 lb-in). To comply with the requirements of UL1703 the modules must be fixed using hex-head bolts. For greater longevity all Channellox 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.

Be sure to review mounting instructions for your panels for correct advice on mechanical, electrical and grounding connections.

4. Electrical Configurations

Modules are connected in series by connecting the positive (+) connector of one module to the negative (-) connector of another. Plan the locations of these connections before installing the panels mechanically. ONLY use modules of the same type for series connections. To determine the maximum number of modules that may be connected in series, divide the maximum system voltage as stated on the label (or the maximum allowed by local standards or codes, whichever is less) by the module open circuit voltage (Voc) printed on the label, after correcting for temperature as required by local codes or standards. The maximum number of modules that can be connected in series, for an operating temperature of -10°C (14°F) is shown in the following table.

	Europe	N. America
Governing standards	IEC/Class II	UL-NEC
Max System Voltage (V)	1000v	600v
Max N° 50-cell modules in series	32	17
Max N° 60-cell modules in series	27	14
Max N° 72-cell modules in series	22	11

The number of module strings connected in series without protective fuses should be limited to 2. If more than 2 strings are to be connected in series then a series fuse is required for each string in each non-earthed pole. Only DC fuses or breakers rated at maximum system voltage should be used, maximum rating should not exceed the maximum system Voltage rating stated on the module label. When calculating the minimum fuse/breaker size, multiply the short circuit current of the module by a factor of 1.56.

4.1. Wiring Considerations

Always use cables and connections designed for the anticipated environmental conditions of the installation. Cables should be at least 3mm² (AWG 12) and as RHW-2 or USE-2. Cables should be selected for sunlight (UV) stability and rated for at least 90°C. They should be fixed & supported with adequate strain relief behind the panels. If cables are installed within a building then they should be installed in metallic conduits properly grounded to the support rails and panels.

Further safety factors may be required. Refer to the local standards to ensure compliance with legislation. The minimum voltage rating of any of the system components should be determined by taking the circuit voltage (Voc) printed in the PV Panel data and also on the label adhered to the rear side solar module and multiply this by 1.25 times the number of series

connected solar modules to the minimum required. ie:
 $1.25 * N(\text{in series}) * V_{oc}$

4.2. Special considerations

To reduce the risk of an electrical shock, always connect the frame of module to ground by fixing an appropriate grounding cable to one of the grounding points of the module and or the mounting system. You may use the extra Self-Tap screw found in each F-Clip pack for connecting (grounding) F-Clips to the rails and for connecting rails to the system grounding points. The self-tap screw will make a secure ground to the rail.

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. *THESE SYSTEM ELECTRICAL AND GROUNDING REQUIREMENTS ARE BEYOND THE SCOPE OF CHANNELLOX MOUNTING HARDWARE WHICH IS SIMPLY A MECHANICAL STRUCTURE THAT CAN BE GROUNDED. TRUE NORTH POWER NG INC. MAKES NO CLAIMS OR WARRANTY ON THE ELECTRICAL SUITABILITY OF THE STRUCTURE.*

5. Care and Maintenance

True North Power recommends that system maintenance is carried out, on a regular basis, by qualified personnel. This maintenance should include verification of the integrity of electrical and mechanical connections, confirmation of the system isolation (Riso tests), checking that system alarms are operating correctly and cleaning of the solar modules (if required).

5.1. Module Cleaning

Channellox rail and PV modules are relatively self-cleaning systems and should require minimum maintenance except in dry dusty locations. The energy output of the solar module can be impaired if the glass is dirty. Cleaning the modules periodically will ensure maximum output, however, if modules are installed at height e.g. on a roof then this should only be performed by qualified personnel. When cleaning rails or solar modules take the following precautions:

- Clean the rails or modules with a soft cloth or sponge using clean and neutral water based cleaning solution (no ammonia).
- Only clean modules during low solar radiation when panels are producing less energy.
- Rails may be pressure wash cleaned but panels should be hand wiped
- DO NOT use high-pressurized water or steam cleaner or any kind of abrasive cleaning tool on PV modules.
- DO NOT clean modules with hot water in cold weather to remove ice or snow, or with cold water when the modules are hot as this may crack the glass surfaces. *CONSULT YOUR PANEL MAINTENANCE INSTRUCTIONS.*

6. Useful References

- A5/ANZ 5033:2005 Installation of photovoltaic (PV) arrays
- IEC61140 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)

How to configure and order Channellox Rail Systems

Channellox Rail
50 x 25 mm

Channellox Rail
50 x 50 mm

Channellox Rail
50 x 75 mm

3 Standard Rail Sizes and 3 Standard Lengths
Order custom lengths if required (cut charge)
See load specifications for selecting rail size (next page)

2438mm

4880mm

6100mm

FOR ORDERING CHANNELLOX SYSTEMS
Choose From Standard Rails and Component Packs Below

Assembled configuration

SS Self Tap Screw

F-Clip

8x16mm SHCS

8x16mm ribbed washer

Square Nut

50 x 25 mm Channellox Rail

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Roof Penetrator F-Clip Pack

Penetrator Pack 1
1 F-Clip, 3 SS Screws and bolt only

Penetrator Pack 2
1 F-Clip, 3 SS Screws
1 Quick Mount PV Flashing with 6 inch Leg-bolt

Rail Intersection F-Clip Pack

1 F-Clip
1 8x16mm SHCS
1 Ribbed washer
1 Square Nut
3 SS Self-Tap screws
1 spare screw for ground wire

Panel Packs

"First Row" Panel Packs contain 4 of everything above. "Add a Row" Panel Packs contains 2 T-Bolts instead of 4

Channellox Stand-off
25 or 50x 100mm with 4 - 6" leg-bolt

Tilt Rail Pack

3 Stainless Pivot-Clips with 2 bolts ribbed washers & nuts
1 50x50mm Tilt Rail
1 50x50mm Support Rail (lengths cut to order)

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Typical Panel Measurements Needed
Length, Width and Hole Spacing

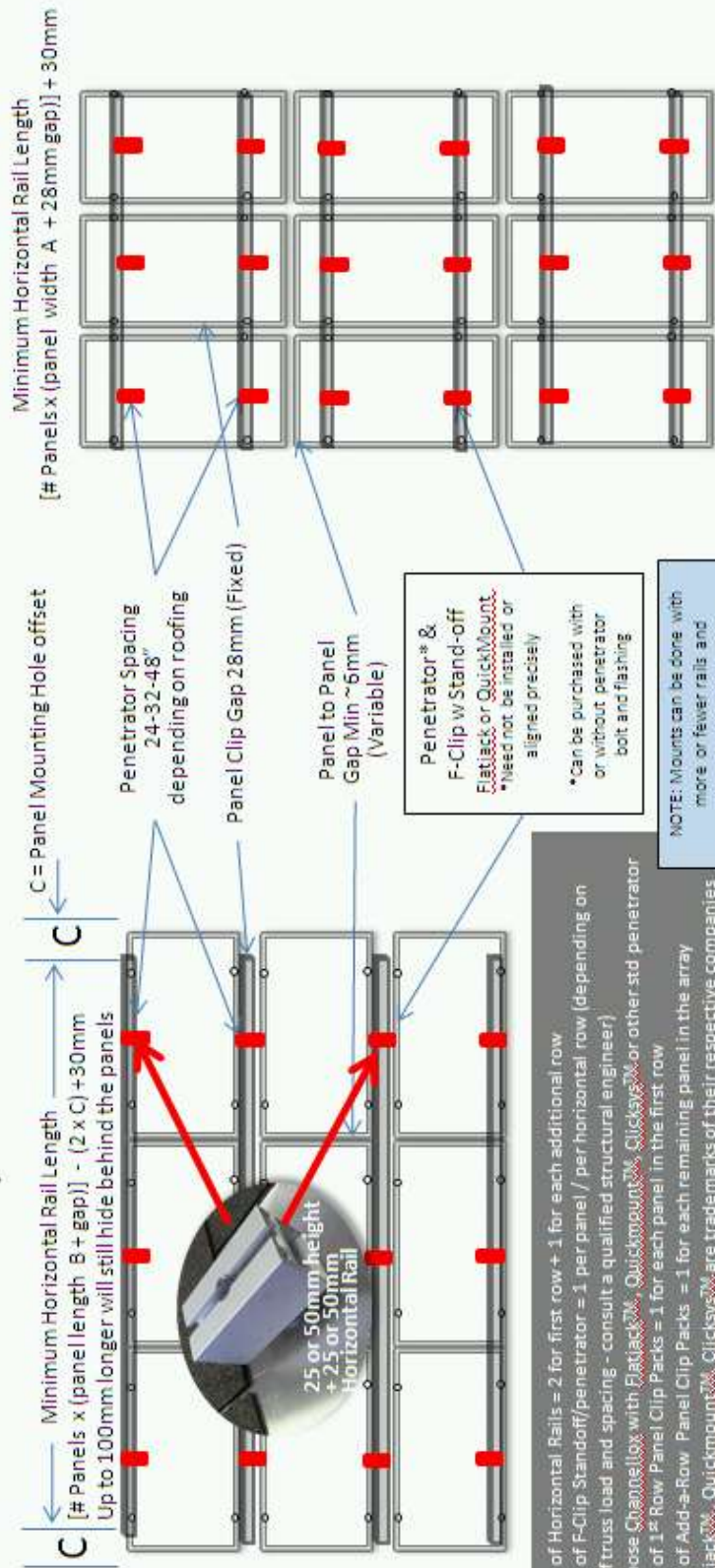
A = Width
B = Length
C = Mounting Hole off-set

Choosing Rail Size, Lengths and Quantities

NOTE: Check your panel specification sheet for exact measurements – Choose a rail length longer than the minimum calculations shown

Landscape ← (Landscape can use fewer components – Costs Less)

Portrait



Qty of Horizontal Rails = 2 for first row + 1 for each additional row
Qty of F-Clip Standoff/penetrator = 1 per panel / per horizontal row (depending on roof/tilt load and spacing - consult a qualified structural engineer)
Choose Channellox with Flatlax™, Quickmount™, Clickays™ or other std penetrator
Qty of 1st Row Panel Clip Packs = 1 for each panel in the first row
Qty of Add-a-Row Panel Clip Packs = 1 for each remaining panel in the array
Flatlax™, Quickmount™, Clickays™ are trademarks of their respective companies

Component Packaging

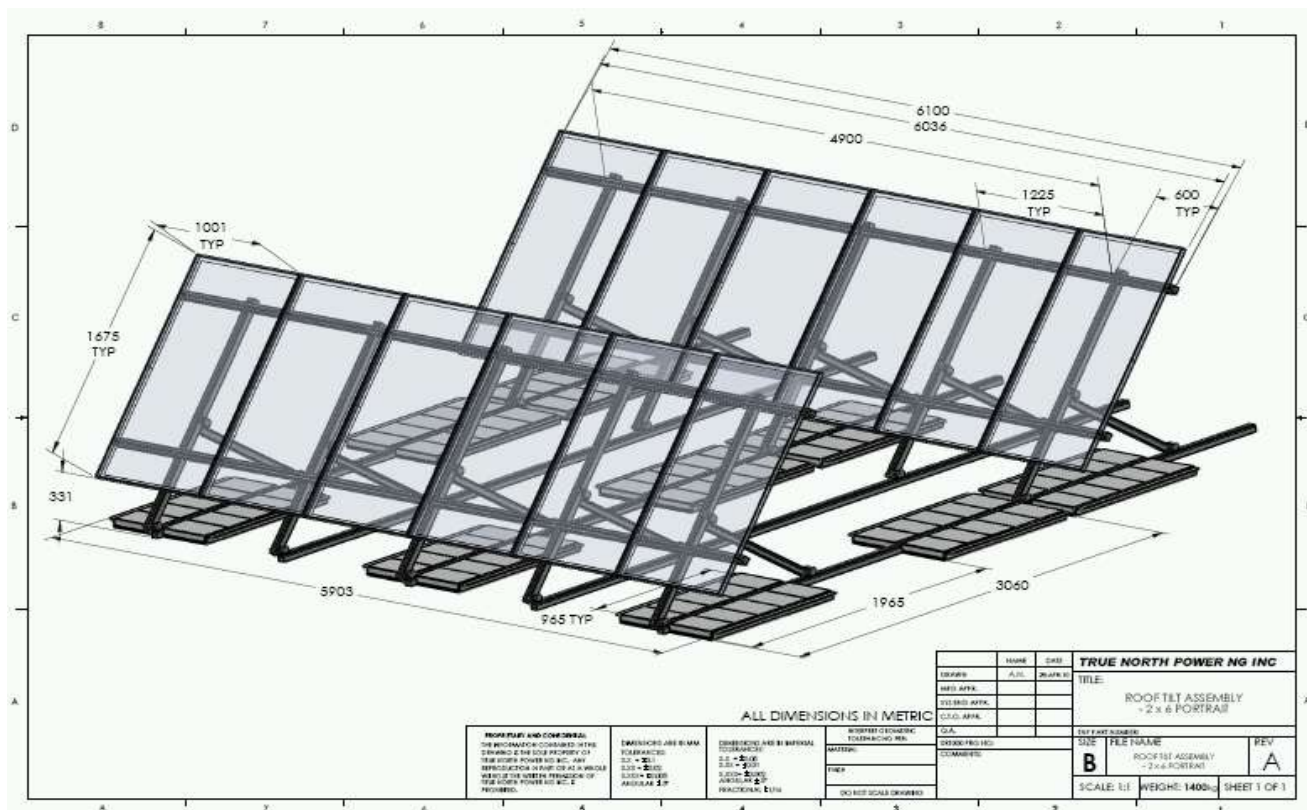
- First Row Panel Pack - 4 Panel-Clips & M6 bolts with flat washer & nylock nut + 4 M8 25mm T-bolts, flat washer & nylock nut
 - Add-a-Row Panel Pack - 4 Panel-Clips & M6 bolts with flat washer & nylock nut + 2 M8 25mm T-bolts, flat washer & nylock nut
 - F-Clip Penetrator Pack 1 - 1 F-Clip + 3 Self-Tapping screws (Lag-bolt - Customer specified or supplied) (extras for grounding)
 - F-Clip & 1 Quick Mount or Flatlax Penetrator with 6 in lag bolt + 3 Self-Tap SS screws
 - 100mm Channellox Stand-off - used alone on steel roof or with any std penetrator on asphalt roof
 - Pivot Clip Pack - 3 Stainless Pivot Clips, 6 M8 SHCC, with ribbed washer & square nut, 3 M10 Bolt, flat washer & nylock nut
 - * 50x50mm rail is available in Light or Heavy cross-section
- | | | | | |
|---------------------------------|---|--------------|---|---|
| 2435mm 8ft Rail | x | x | x | x |
| 4880mm 16ft Rail | x | x | x | x |
| 6100mm 20ft Rail | x | x | x | x |
| Custom Length Angled Tilt Rail | x | - Cut Charge | | |
| Custom Length Support Tilt Rail | x | - Cut Charge | | |
- Rail Loading Specification (6069-T6 Al Anodized) (Test Dec09)
Profile: Weight capacity per 1 meter span
50x 25mm = min. 180kg 400lbs ->354kg 780lbs to deformation
50x 50mm = min. 300kg 667lbs ->620kg 1370lbs to deformation
50x 75mm = min. 444kg 978lbs ->890kg 1960lbs to deformation

Qty of Horizontal Rails = 2, needed per row of panels
Qty of Channellox Penetrator and F-Clip Packs = 2 per panel
Channellox with Flatlax™, Quickmount™, or any std flashing
Qty of 1st Row Panel Clip Packs = 1 for each panel in the first row
Qty of Add-a-Row Panel Clip Packs = 1 remaining panels in the array
Flatlax™, Quickmount™, Clickays™ are trademarks of their respective companies

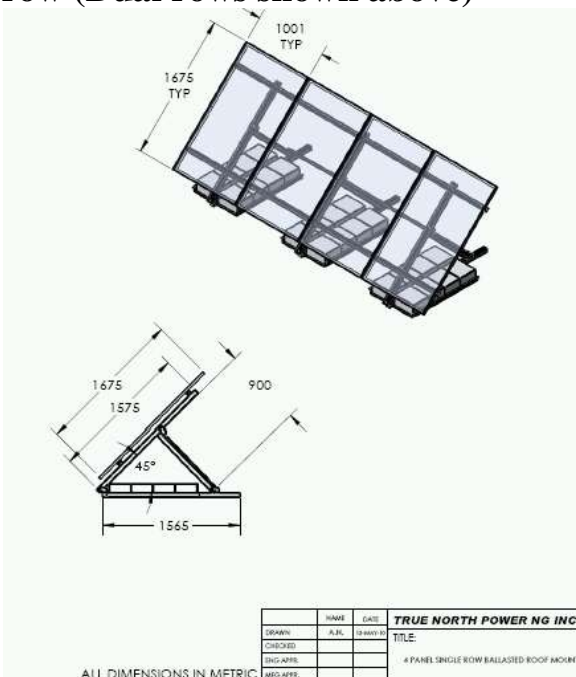
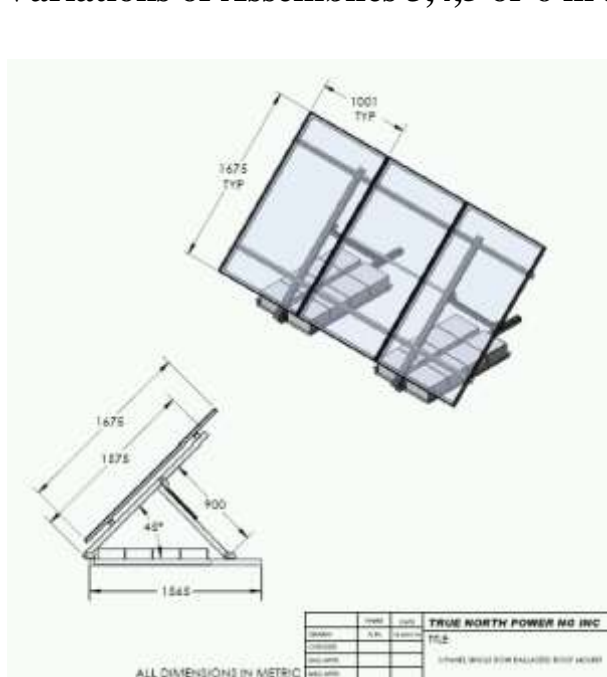
Enhphase mounting kit also available.
Specify Enhphase kits when ordering.
1 per panel

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Ballasted Tilt Systems for Flat or Sloped Roof



Variations of Assemblies 3,4,5 or 6 in a row (Dual rows shown above)



Design and Layout Strategies

Channellox mounting systems are designed for simplicity and versatility. There are many correct ways to use it, and many variations on certain principles that make it quick and easy to design layouts as well as easy to install and maintain. There is only one type of rail in three heights and 4 weights or strengths (25mm light, 50mm light, 50mm heavy and 75mm heavy) for strength and the same sizes of roof penetrator standoffs. Typically there are three recommended standard span lengths. Under 1.0m span use 25x50mm rail. From 1-1.5m use 50mm rail heavy or light, 1.5-2m use 50x50mm heavy only and 2-3m spacing use 50x75mm heavy rail for strength. All sloped roof layouts can be accomplished with only two other parts F-Clip and Standoff. For most sloped roof applications, an F-Clip for securing rails to standoffs and a universal Panel-Clip to join panels and attach them to the rails is all you need.

Landscape layouts with 48" centers using 50x50 heavy rail is considered the most common and cost effective combination. It uses the least rails and penetrators but offers good strength for most panels up to 1678x1001mm size (~245w).

Panel-Clips come in packs of 4 with stainless bolts, washers and nuts and joining T-Bolts, washers and nuts. There are "First Row Panel-Clip" packs with four rail mounting T-Bolts and "Add-a-Row" Packs for each additional row of panels with only two T-Bolts. Each F-Clip comes with 3 self tapping screws and a square nut channel bolt. You may not use all of the components in every assembly but there is enough for virtually any configuration. Finally, for flat roof ballasted systems or for tilted roof systems there is a stainless clevis called a Pivot Clip that allows rows of panels to be adjusted seasonally or permanently to any angle.

The Channellox rails "Standoffs" are 100mm long segments of any channel height and these are used to provide standoff separation from the roof height for snow clearance as well as to increase air circulation for cooling and increased panel performance. When panels get hot they are less efficient and their output can be reduced by 15-20%. Channellox standoffs also provide the mechanical attachment point between the array and the roof, especially steel roof, since the back of the standoff has a "peel and stick" sealant on the back that can assist in keeping water away from the 4-6inch bolt that attaches them and the array to the roof. Channellox standoffs can also be used in combination with Flat Jack, Quick Mount or other asphalt roof flashing, as shown below. Here the sealant is around the bolt and flashing not the standoff.



Channellox Standoff on Clicksys



F-Clip on S-5 For Standing Seam

Asphalt Flashing Types



FlatJack ClickSys and Quickmount

As shown above F-Clips and rail can also be mounted on S-5 Clips for mounting on Standing Seam steel roof. S-5 Clips come in many shapes to suit most roof seam profiles. F-Clips bolt directly to the S-5 with an M8 bolt. Roof penetrator bolts come in 4" or 6" depending on type of roof and truss.

For basic layouts, you place your roof penetrators horizontally spaced to match the roof truss separation and space then space these attachment points vertically the width of a panel (PLUS 25mm or 1") of landscape orientations. For portrait panel orientation you will need to measure from the outer edge of where you want the edge of the panel to be in relation to the roof to the center of the first rail. Then the second rail will be located the distance between mounting holes of the panel. These dimensions and penetrator locations can be determined by measuring the hole spacing on the panel or is usually shown on any panel specification diagram. This is the approximate vertical spacing between horizontal rails you need when mounting panels in portrait.

With a Channellox standoff on top of a roof penetrator flashing, this measurement and placement of penetrators only needs to be approximate, (within +/- 1-2cm, 1" or so) and with an F-Clip on top of the standoff you will then have as much as 5-6cm 2-3" of adjustment to level the horizontal rails and make them parallel. Always try to measure and fix F-Clips as close to the center of the Standoff as practical to ensure the rails is close to the penetrator bolt centerline. This will ensure the stress from the array is located on or close to the center of the attachment points and not providing leverage against the bolt itself or the roof.

Standard rail lengths also provide a building block approach. Landscape layouts are preferred to minimize the number of rails and attachment points needed. See ANNEX A for options.

1. Install standoffs first on-center of joists or roof trusses. The vertical spacing of almost any type of roof penetrators does not have to be measured precisely even for portrait mounting. Typical portrait penetrator spacing is 48" rafter spacing depending on the rail bridging strength needed. Consult an engineer for the type of roof and local construction codes. The extrusion material is 6063-T6 heat treated and anodized aluminum with the following load parameters: (detailed load charts are available to engineers on request)
 - a. 50x25mm (2x1in) Channellox rail can;
 - i. Safely carry 220kg(488lbs) of load/linear meter (3 feet)
 - ii. Sustain 430kg(950lbs) of load/linear meter before permanent deformation occurs
 - b. 50x50mm (2x2in) Channellox rail can;
 - i. Safely carry 300kg(667lbs) of load/linear meter (3 feet)
 - ii. Sustain 517kg(1372lbs) of load/meter before permanent deformation occurs
 - c. 50x75mm (2x3in) Channellox rail can;
 - i. Safely carry 440kg(978lbs) of load/linear meter (3 feet)
 - ii. Sustain 882kg(1960lbs) of load/meter before permanent deformation occurs
2. For portrait panel orientation 2 horizontal rails will be required for each row. For landscape, two horizontal rails are required for the first landscape row of panels, but each additional row of panels only requires one more rail, because it shares a rail with the previous row. Almost all PV modules are designed to be attached from the rear, so Panel-Clips are the most secure, lower stress and reliable means of attachment, and will not void your warranty as some top down clamps may. Top-down clamps with T-Bolts also work but are not recommended and you will have to purchase these clamps from panel makers or other suppliers. Panel Clips are recommended and ensure no bolting has to be done from under or behind the panels. Pre-mount the panel clips before taking them to the roof. Mount panel clips reversed on each side of the panel and do it consistently on every panel so they "nest" with the next panel as they install.

3. Long horizontal rows can be accomplished without joiner parts because of the strength and rigidity of the Channellox rail. If you wish to join horizontal rails it should be done at a penetrator by using the F-Clip with 2 self tapping screws in each rail and locate the F-Clip/Standoff/Penetrator in a joist or truss. Normally you need only place the penetrator on the next available joist and leave a gap appropriate to the width of a panel from the last mounting hole to the edge of the panel +~6mm gap. This saves horizontal rail for landscape layouts and vertical rail for portrait layouts, (about ½ panel width or length). Continuous longer spans can be done with 6.1m (20ft) rails in portrait or landscape. Portrait layouts can extend higher above the roof line and give you more watts/column but require a larger quantity of horizontal rails. If you want to ensure electrical integrity simply butt two horizontal rails as close as 5-6mm (1/4") before fixing their position on the F-Clips, and run a grounding strap between the two rails. Why not just join them? Longer rails should not be physically joined to avoid thermal expansion stress, however; they can be close enough to conveniently slide a bolt with square nut across the gap from one rail to the next.

Important Safety Notice: Please Read Carefully

Safety Considerations – A Common Sense Approach

Channellox mounts are simple and easy to install but common sense and caution should be used in assembling and installing any roof mount system. Some appropriate safety considerations are:

- ✓ Plan your work before doing it. Read this entire manual at least once first.
- ✓ Work systematically in the order recommended. Don't rush.
- ✓ Keep your tools and equipment organized to avoid making mistakes.
- ✓ Wear thin leather or rubber palm gloves to avoid minor cuts and pinches.
- ✓ Wear sturdy shoes or steel-toe work boots and construction hat in case something heavy falls.
- ✓ Always work in pairs and use safety harnesses.
- ✓ Test for voltage present on electrical connections with a multi-meter or voltage sensing pen before touching or connecting them. Don't forget the grounding connections.

WARNING

Unconnected PV panel strings can build up dangerously high voltages especially when they are wired together in series. Exercise caution when handling PV panel connectors and follow the manufacturer's instructions when connecting and disconnecting panels or the wires to the combiner box.

CAUTION

The setup of a solar panel mounts should only be attempted on a calm dry day with little or no wind, ice or snow. Sudden wind gusts can catch solar panels and result in costly panel damage and personal injury. ALWAYS wear a safety harness on the roof.

Installing solar panel mounts is not a one person job. Always work with at least 2 person teams for efficiency and safety. Panels weigh 15-30kg or more and can be unwieldy on a sloped roof. Use gloves.

Although you may think to assemble the entire structure on the ground and then lift into position on the roof, this is not recommended because of the weight hazard and the difficulty of aligning such a heavy object onto the roof penetrators. Only install panels after the rack is assembled on the roof.

There is a significant pinch hazard to fingers and skin when mounting the panels onto the rails especially where the F-Clips and rails join and where panels connect together. Exercise caution with fingers and skin in this area.

Tools Required

- 1) Extension or step ladders as appropriate for working safely at roof level
- 2) A set of standard Metric Hex Keys (Allen Wrenches)
- 3) A set of standard Metric Open End or Adjustable Wrenches
- 4) Hand power tools with hex head drive for fixing F-Clips to rails with self-taping screws, and also useful for driving Panel-Clip connectors on with a consistent torque.
- 5) Chalk Line
- 6) T-Square is useful but not required

Parts List

The parts shipped with the PowerSeries Channellox rails and solar mounts are listed in the packing slip with each shipment. Please reference the actual packing list you received and verify all parts are present. There may be a couple of extras, just in case. If you have problems identifying parts or there are missing parts please refer to page 7 and contact your supplier or call True North Power NG at the number listed on the cover of this manual.

Channellox Systems are shipped in “packs” of components that are grouped to make configuration and ordering simple and fool-proof. (see pages 7 and 8 for details)

*Check your packing list
for the actual quantities of parts shipped for your configuration.*

Installation Instructions for PowerSeries, Channellox Roof Systems

Preparation:

Plan your roof layout on graph (squared) paper to scale or have an architect or civil engineer do proper drawings that account for wind and snow loads for the type of roof structure and rafter spacing you will be mounting on. Generally, you want to have a well thought out plan and everything ready on the ground before taking larger components up to the roof for installation. Once you have the layout, take a box of penetrators, standoffs and F-Clips up to the roof and start by locating the rafters and installing the roof penetrator/standoffs/F-Clips at each rafter/horizontal rail intersection point. Follow the process outlined below with reference to the photos. Layout and install vertical rails, then mount horizontal rails then panels.

1. Snap a chalk line on the rafter locations and approximately locate the horizontal rail attachment points. *In landscape the first or lowest rail is located roughly the lower edge of the lowest row and also the location of the lowest F-Clip.*
2. Penetrator vertical spacing should be about a panel width apart, but also need not be precise. *The distance between F-Clips horizontally should normally be a rafter spacing and not exceed ~1.2m (4ft) unless 50x50mm or larger Channellox is used. If spans are more than 1.4m (72") the 75mm rail would be recommended for strength. Consult a licensed engineer for specific recommendations compatible with your roof structure.*
3. Follow penetrator installation instructions and mount an F-Clip with ribbed lock washer on each penetrator bolt. F-Clip orientation, up or down, does not matter. Just be consistent and try to place the F-Clip in the center of the standoff. If the Channellox standoff is used you just need to be close to the desired rail spacing. Final adjustment and exact spacing is done with the F-Clip.

Roof penetrator design and installation methods vary and often call for silicone filled holes for water tightness. Follow the roof penetrator's installation instructions. Use whichever rafter spacing works for your layout, as long as the overhang on the horizontal does not exceed about 0.5m (~18in). *After consulting load tables a structural engineer may recommend a more appropriate overhang length for both penetrator F-Clips and outer intersection F-Clips.*



Note: The vertical and horizontal distance between penetrators is not critical, nor does their spacing need to be identical (see upper right photo pg14), as long as they are aligned roughly horizontally on the rafters.

4. Mount standoff/penetrator/F-Clips. Align lower ends to the roofline or desired lower horizontal rail location. Install horizontal rails and slide to align horizontally in position. Adjust the end of the vertical rails to their exact position before permanently fixing the F-Clip to the rail with the self-taping screws. Use a minimum of two (2) self-taping screws on each F-Clip, at least 1 on each side. The groove on the side of each F-Clip will help start the screw. The third screw in each F-Clip pack is a spare that can also be used for grounding leads where needed.

The F-Clips clips may be turned outward from the edge of a standoff to gain an extra 100mm of horizontal rail separation if needed (See photo Page 18) Minimize the overhang to avoid stressing the penetrator bolt.

5. *The first rail is now the parallel reference for the roof line, and the rest of the array. It also defines the placement of the upper attachment hole in landscape layout. A T-Square may be useful but not necessary if the roofline is square. Continue the same procedure on the next lower rail.*

Do a quick calculation of the spacing using panel bolt hole width + 28mm (Clip to Clip panel separation) and make that the maximum separation of the upper and lower rails. Measure any edge rail to rail. It will be the same for T-Bolt centers (Photo below shows using full vertical rails. Using standoffs instead of verticals saves rail and costs in both Portrait and landscape layouts. Using full vertical rails is somewhat stronger).

6. Now mount the next horizontal rail the same way with F-Clips and self-taping screws. Leave the intersection F-Clips loosely tightened to the rail below for final adjustment, as each row is laid and leveled. If your vertical rails are not truly parallel because the rafters are off, just move and level the horizontal rails close to final parallel position before installing the self-taping screws.

Level each rail and lightly tighten the intersection F-Clip M8 x 22mm socket head bolts to the vertical rail using a 6mm Allen key. Once you add panels you may want to do some fine adjustment on the F-Clip spacing before final tightening.

When installing horizontal rails, it does not matter if your vertical rails are not truly parallel. There are some pretty wonky roofs out there. Just move the horizontal rails, resting in their F-Clips, close to final horizontal position before tightening the F-Clips and installing self-taping screws. The F-Clips will naturally adjust slightly to accommodate.

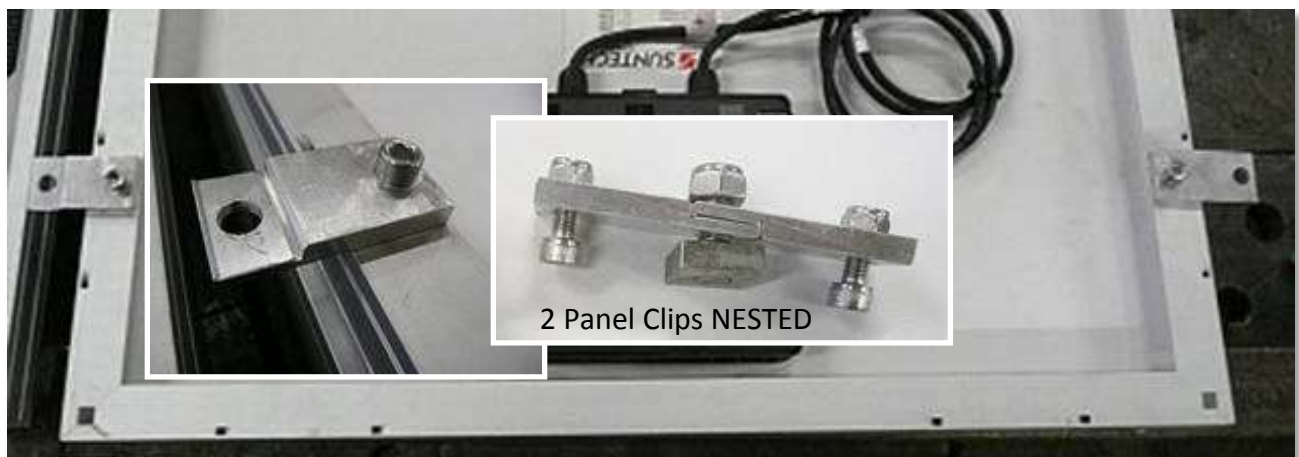




7. Pre-mount Panel-Clips on panel mounting holes with M6 x 16mm socket head bolt, flat washer and nylock nut, before taking them to the roof. In portrait mounting use the panel inner holes for strength and also to shorten the required rail length. Ensure that the top, or first, row of panels has all Panel-Clips flat side down. The remaining panels should have both the clips on one side flat side UP to nest with the upper row clips and both clips on the other side flat side DOWN. *For M6 Nylock nut use ~12nm torque.*

Each Panel Pack comes with four (4) Panel-Clips that should be pre-installed on each panel using an M6 x 16mm socket head bolt, flat washer and Nylock nut, as shown in the pictures below. It's best to do this before taking them up to the roof. Panel-Clips are symmetrical and designed to nest with each other so each has a flat side and a nesting side between the panels. Use the 1mm ridge on the Panel-Clips to install the clip against the panel frame for a square fit to the edge of the panel.

Most panels have 4 mounting holes but some can have up to 6 or 8 mounting holes in their frames. The inner mounting holes will normally provide the strongest support for snow and wind loads. Very large panels such as 280-300w may be up to 2 meters long and carry a center pair of mounting holes. For panels over ~1.8m an additional horizontal rail may be advised for high snow and wind load areas. Consult your panel manufacturer or design engineer. See panel drawings. If necessary be sure to specify the need for extra rails in your order.





CAUTION

This Panel-Clip mounting system is more reliable and secure than clamping the panel from the top. The manufacturer's mounting holes are designed for strength and reliability and avoid the potential problems of thermal expansion and contraction in caused by temperature extremes. Clamping from the top is prone to stress deformation and can crack under extreme heat or cold. Under winter cold and windy conditions panel fasteners that just press on the frame can lose their grip and begin to wear to the point of failure.

NOTE

If your panels have more than one set of holes, the inner panel mounting holes should be used for maximum strength and snow loads.

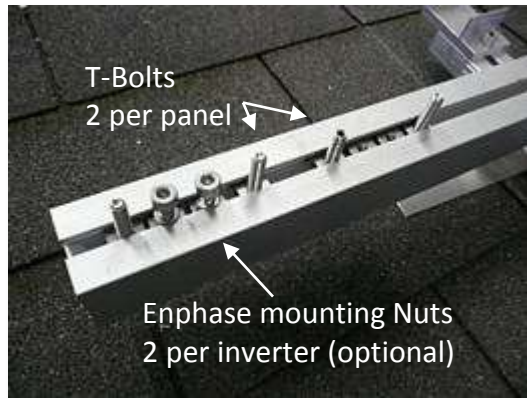
8. Slide two (2) M8 x 25mm T-Bolts onto each horizontal rail for each panel in that row.
9. Hang the first row of panels on the T-Bolts making electrical connections as you go. *Start at either end.*

Now slide a number of M8 x 25 mm T-Bolts onto the horizontal rails, two (2) for each panel in a row. If you are using Enphase inverters or other hardware be sure to slip in 2 extra M8 x 22mm socket head bolts with ribbed lock washer and square nuts to mount the inverters. T-Bolts have the square nut head captured within the rail with the bolt pointed upward through the channel. Begin at the top row and simply hang the first row of panels on the protruding bolts, making electrical connections and adding inverters as you go. If you forget or miss one, you only need to undo the four M8 T-Bolt hex nuts on that panel, lift it up or out, check or fix the connections and reinstall the M8 nuts.

10. All the M8 T-Bolts on that row can now be secured with an M8 flat washer, ribbed lock washer and hex nut using a torque wrench or automatic torque driver set to 20nm of torque.

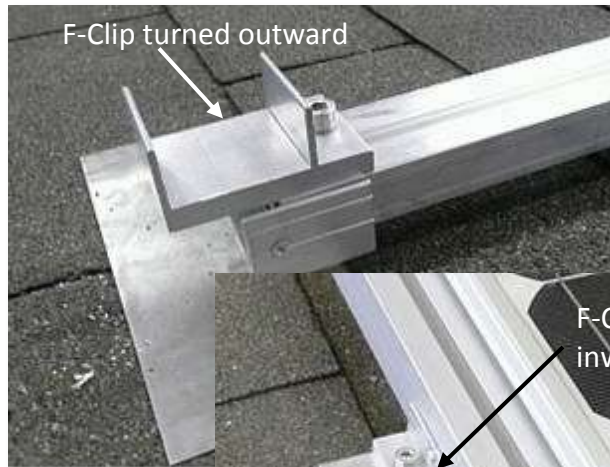
11. Now mount the next rows of panels the same way, nesting each Panel-Clip to the Panel-Clip in the row above.

12. Secure the bottom row of T-Bolts and you are finished.



The pictures below right show the final assembly of 2 rows. The F-Clips and Panel-Clips can be mounted as close to the ends of the rails as needed and normally the outer ends of the panels will overhang and hide the ends of the horizontals. An extra 100 mm of rail spacing can be achieved by flipping the F-Clips outward from the ends of the rails.

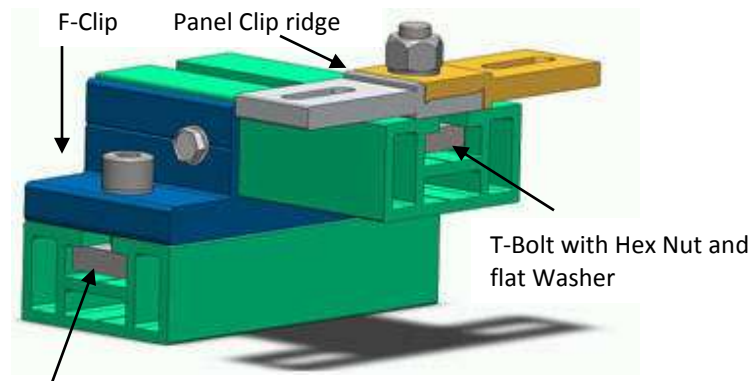
NOTE
Grounding straps or grounding lugs can also be attached to Channellox with self-taping screws. Extra screws are provided with each F-Clip kit.



ANNEX A DESIGN OPTIONS & ACCESORIES

Metric Torque Recommendations

Min Grade 8.8 Stainless Steel
Torque in Newton Meters (nm)
Panel-Clip - M6 course thread ~12nm
F-Clip - M8 course thread ~20nm
Pivot-Clip - M10 course thread ~54nm



INSTALLATION OPTIONS

Landscape vs Portrait Panel Orientation

Panels are best mounted in landscape orientation with the top rails mounted horizontally for the most compact array using the least amount of rail and clips. Panel-Clips should be pre-mounted to the panels for landscape or portrait attachment before taking them to the roof. For the first row panels Panel-Clips should all be FLAT SIDE DOWN. All additional row panels should have Panel-Clips FLAT UP on one side and FLAT DOWN on the other.

By using this two layer vertical and horizontal rail design, Channellox systems are much stronger and easily adjustable to match mounting hole spacing on any panel. This means less time on the roof and lower cost of ownership. When new more efficient panels are available you can upgrade without having to buy new rails or move any roof penetrators, just loosen horizontal rail F-Clips and adjust to the new panel dimensions.

Mounting With Standoffs and ONE Level Of Rail (lowest cost and fewest parts)

Channellox is versatile enough to accommodate using only single pairs of railing to mount panels in either portrait or landscape orientation using standoffs on penetrator flashing or an S-5 Clip. This saves the cost of the extra layer of rail but two things should be considered:

1. More careful placement of penetrators is required as all penetrators must be aligned in parallel and properly spaced lines to accept the panels.
2. Future replacement of panels would require removal and repositioning of at least half the penetrators to accommodate the new panel hole spacing. The two layer Channellox rail system is designed accommodate any solar panel size or bolt pattern, past present or future without moving penetrators.

Enphase Inverter Mounting

Enphase brackets can be mounted anywhere on the rails. Be sure to slide on two extra M8 x 22mm socket head bolts with square nuts between each panel T-Bolt as you build the array and before you install panels. Enphase modules then are attached to the socket head bolts and square nuts.



Penetrator Selection

Most roof penetrators for asphalt shingles are similar and have some sort of lag bolt through a short stand-off of some size that has metal flashing to allow water to drain. Quick Mount PV is a good example. There are often different size and type bolt heads offered (as shown below) depending on the type and size of rafter or the stand-off desired. They all work with the standard F-Clip. Consult with your roofer to select a type, size, quantity and spacing of bolt and penetrator suitable for your roof structure.

Other types of penetrator flashing/ bolt combinations are offered for tile or steel roofs.



Stand-offs (Heat Loads)

Photovoltaic panels are less efficient the hotter they get so air circulation behind the panels is important. Even in open air at 75 Deg F (24C) the back of panels in bright sun can reach over 130-150F (55-70C) with poor circulation. At this temperature a 1kw array may only produce 800 watts. The excessive heat also has a damaging effect on asphalt shingles over the years. Channellox extrusions come in 3 height sizes that can be used to achieve an additional 150mm (~6 inches) stand-off in addition to the roof penetrator stand-off height. Further height stand-offs are also available but wind and snow loads should be considered when doing so. Consult your local structural engineer for advice in your area since roof structure and climate conditions vary.

Tilting Arrays – Sloped Roof and Ballasted

Tilting arrays use the same panel attachment methods with two additional vertical rails and device for setting the angle. With vertical rails installed each lower intersection F-Clip is replaced with a Pivot-Clip. 50x50mm Tilt Angle Rails and Tilt Support Rails come predrilled with pivot holes to accept Pivot-Clips. If arrays are intended for regular tilt adjustment then the array should be made of sets of no more than 4 panels in landscape for ease of lifting. For arrays intended for a fixed and permanent angle, horizontal rails can be up to 24 meters or longer in 6 meter sections (>20-80ft).



Pivot-Clips are fixed to vertical rails in the same way as F-Clips but with two M8 x 22mm socket head bolts, ribbed lock washer and square nuts. The lower Pivot-Clips allow the Tilt Support Rail to slide up or down in the channel to achieve the desired angle and a reference angle decal is affixed to the lower vertical to show the angle. The angle “Set Screw” shown above is first tightened in position and the Lower T-Clip is allowed to come to a stop next to it before being torqued down and the Pivot-Clip M10 x 80mm hex head bolts tightened.



For ballasted flat roof installations penetrators are replaced by ballast. Lower vertical rails that lay on the flat roof can be as long as needed (up to 6 meters or more) to tie rows of panels together with the proper spacing to avoid shadows. Normally up to 4 horizontal rows of up to 6 meter or more are the building block for flat roof ballasted systems. Almost any ballast method can be used either bag, block or sand box, whatever is best for the roof membrane, gravel, tar or concrete used for the structure.

Truss location Example – 4 panel Landscape Orientation: (with permission from Leekor Engineering Inc.)

