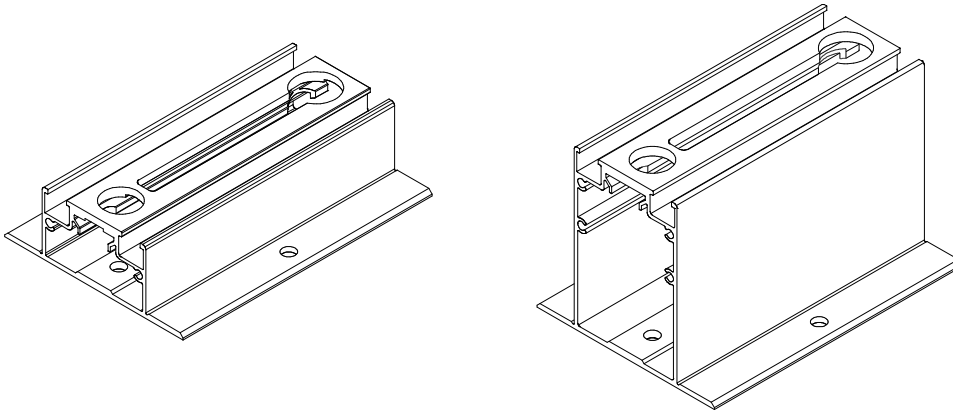


INSTALLATION MANUAL

RT-[E]Mount® 2

E Mount AIR® 2



Contents

- INTRODUCTION -----1
- SYSTEM FIRE RATINGS -----2
- BONDING/GROUNDING of MODULES -----2
- PERIODICAL INSPECTION -----2
- Tools & Supplies Required for Assembly -----3
- INSTALLATION SAFETY -----4
- PART A: Materials -----5
- PART B: Landscape Layout -----8
- PART C: Portrait Layout -----32
- PART D: Electrical Setup -----51
- ADDENDUM: Metal Roof Installation -----59
- APPENDIX: Module List -----62



333 H Street Suite 5000
 Chula Vista, California 91910
 TEL (619) 551-7029



Contents

• Introduction	1
• System Fire Ratings	2
• Bonding/Grounding of Modules	2
• Periodical Inspection	2
• Tools & Supplies Required for Assembly	3
• Installation Safety	4
PART A: Materials	5
PART B: Landscape Layout	8
1. Installation of Brackets	8
(1) Bracket Layout	
(a) Rafter Installation	8
(b) Roof Deck Installation	11
(2) Bracket Installation	14
2. Installation of Panels	24
3. Eaves Cover: Skirt (Optional, E Mount AIR only)	30
PART C: Portrait Layout	32
1. Installation of Brackets	32
(1) Bracket Layout	32
(2) Bracket Installation	35
2. Installation of Panels	43
PART D: Electrical Setup	51
1. Cable Management Options	51
2. Mounting on the Module Frame	51
3. Cable Mounting Bracket (Optional)	52
4. Grounding Setup	53
5. Bonding Path Diagrams	55
6. Micro-inverter Bracket (Optional, E Mount AIR only)	58
ADDENDUM: Installation Instruction for Metal Roofing	
1. Requirements	59
2. Marking	60
3. Bracket Installation	61
APPENDIX:	
List of PV Modules compatible with this Racking System	62

Introduction

Please review this manual thoroughly before installing your Roof-Tech system. Aside from reading this manual, please review the PE Stamped Engineering Certification for the Roof-Tech [E]Mount and E Mount AIR Solar products for your State. This manual provides supporting documentation for the installation of Roof-Tech's [E]Mount and E Mount AIR products.

We recommend installer to carefully review the instructions provided by the PV module manufacturer and become acquainted with OSHA's safety procedures prior to installing the PV system.

The installer is solely responsible for:

- Handling and installing the PV modules according to the manufacturer's instruction, with special attention for the suggested clamping locations on the frame.
- Complying with all applicable local or national building codes, standards and industry best practices including any code that may supersede this manual.
- Ensuring that Roof-Tech's and other products are appropriate for the particular installation and the installation location.
- Ensuring that the roof, its rafters, connections, and other structural support members can support the array under all code level loading conditions.
- Using only Roof-Tech parts and installer-supplied parts as specified by Roof-Tech. (Substitution of parts may void the warranty and invalidate the letters of certification.)
- Verifying the strength of any alternate mounting devices used in lieu of the anchoring screws.
- Maintaining the waterproof integrity of the roof.



Attention

To maintain the flashing performance, avoid installation when the temperature is below 22F or above 176F. RT Butyl must be installed on a dry surface.

- Ensuring safe installation of all electrical and mechanical aspects of the PV array.
- Ensuring correct and appropriate design parameters are used in determining the design loading used for design of the specific installation. Parameters, such as snow loading, wind speed, exposure and topographic factor should be confirmed with the local building official or a licensed professional engineer.

System Fire Ratings

Roof Slope	Mount	Module* ¹	Skirt (Wind Deflector)	Fire Rating* ²
Steep Slope ($\geq 2/12$)	E-Mount	Type 1 & 2	—	Class A
	E-Mount AIR	Type 1 & 2	—	Class A
Low Slope ($< 2/12$)	E-Mount	Type 1	—	Class A
	E-Mount AIR	Type 1	Required	Class A

*1: Module Type per UL 1703 (November 18, 2014).

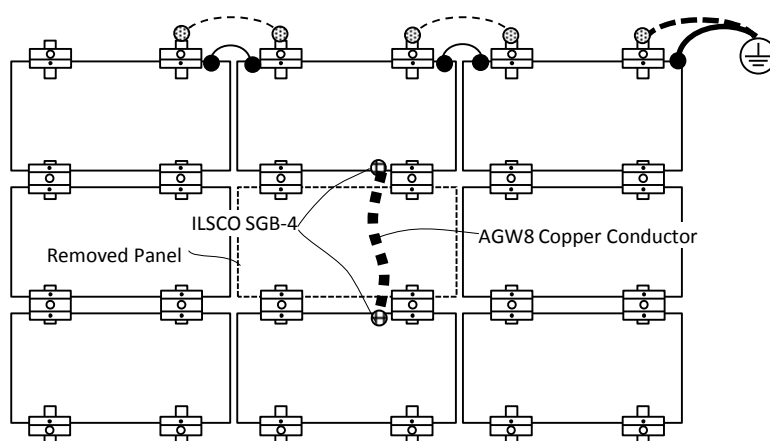
*2: Class A fire rated PV systems can be installed on Class A, B, and C roofs.

Bonding / Grounding of Modules

This racking system may be used to ground and/or bond a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the Roof Tech's UL2703 classification.

Periodical Inspection

Roof Tech Inc. recommends inspecting installed racking system periodically for loose components, loose fasteners and any corrosion. If found, those components are to be re-tightened, or replaced immediately. When a PV module needs to be removed from the PV array for maintenance and/or replacement, the electric bonding system will need to be temporarily restored to maintain the electrical bonding path. Please make sure the system electrical circuits and disconnects are in the open position and the entire system is powered down. Use adequate components that have evaluated to Roof Tech's UL2703 (see page 7) and AGW 8 copper bonding conductor/strap. Cover the fronts of modules in the array with an opaque material to stop the production of electricity. Use appropriate safety equipment such as insulated tools and insulating gloves to protect yourself.



Example of Temporary Bonding Path

Maintenance of the PV modules should be carried out by licensed contractors, according to the PV manufacturer's installation/maintenance instructions and Roof Tech's installation instructions.

Above maintenance should not be conducted under a wet and/or high wind conditions.

Tools & Supplies Required for Assembly

Tools needed for building the array

- Hex bit socket (13 mm) : Long socket
- Hex bit socket (8 mm)
- Drill and ϕ 3 mm Drill Bit for sheet metal (for Installation on Metal Roof)
- Measuring tape
- Chalk line
- Torque wrench
- Scissors

Torque Values for Dry Bolts: 20 N·m applied to Middle and End Clamps. (in-lbs)

Item	Torque
M8 Carriage Bolt(Clamp)	20 N·m (180)
M6 Bolt	5 N·m (45)
4.0x16 Screw	1.5 - 2 N·m (14 - 18)
5.0x60 Wood Screw	Fully seat*
**Ilsco Lug SGB-4	3.96 N·m (35)
**Weeb-Lug 6.7	Gr 9.5 N·m (84) - N&B 13.55 N·m (120)
M8 Bolt Set	12 N·m (106)

*Proper torque values for a wood screw will vary depending on the rafter and/or deck characteristics; hardness, age, and moisture of the wood. Tighten until the washer just stop rotating easily. (see page 19). ** Hardware provided by Mfc.

Technical Note:

Stainless hardware is soft and if dry torqued too quickly it may cause the nut and bolt to seize.

Roof Tech recommends all stainless steel threads should be lubricated before being assembled. This will make it easier to tighten nuts to bolts, avoid galling, and facilitate adjustments before the nut is properly torqued. Therefore, avoid tightening the nut with an impact driver.

Installation Safety

The installation process requires working on sloped and elevated building surfaces, in outdoor weather conditions, using tools and heavy components designed for the generation of electricity.

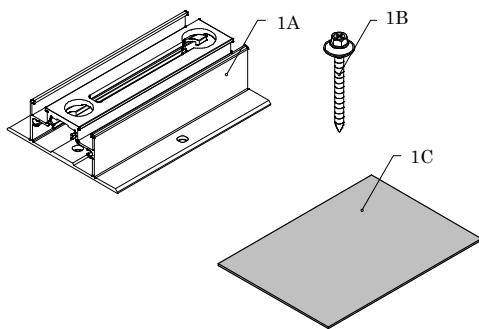
- Use properly anchored fall protection equipment.
- Use caution to prevent objects from falling or dropping off the roof area.
- Cordon off ground areas directly beneath the roof work area when possible.
- Always use personal protection equipment such as safety glasses, gloves, etc.
- Do not perform installation in excessively wet, windy, or inclement weather conditions.
- When working in hot weather, work crews should take care to prevent symptoms of over-heating or dehydration.
- Use proper lifting and carrying techniques when handling heavy components at the job site. If conditions are challenging for moving PV modules to the roof area, use a mechanical lift.
- Follow best practices when working around high-voltage electrical equipment.
- Do not anchor fall protection equipment to roof mounts, or any other inappropriate roof structure

PART A: Materials

1. Items with RT-[E]Mount 2

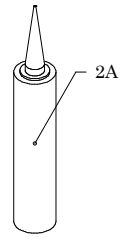
① [E]Mount Bracket Set

	Item
1A	[E]Mount
1B	Screw 5.0×60
1C	RT butyl Spacer



② Roof sealant

	Item
2A	Roof sealant

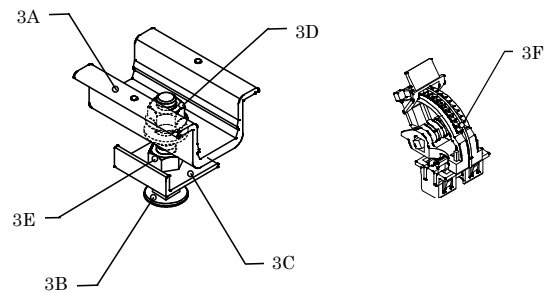


※Recommended Product

- Henry : 208R, 209, 925 (Black)
- Geocel:S2, S4 (Black)
- Sashco : Through the Roof
- Boss : 125 (Black)
- Top Industrial: Rain Buster 850, 900
- Chem Link: M1

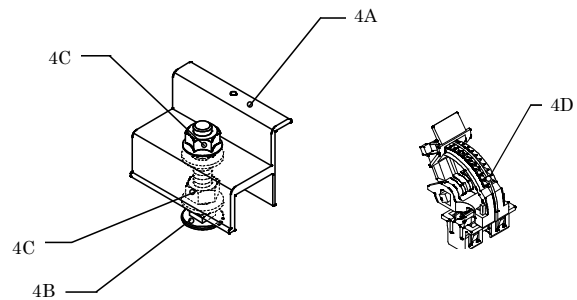
③ Middle Clamp Kit

	Item
3A	Middle Clamp
3B	Carriage Bolt set M8-**
3C	Panel Spacer
3D	Flange Nut
3E	Hex Nut
3F	Cable Holder



④ End Clamp Kit

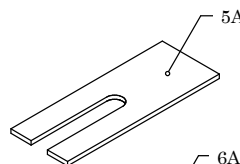
	Item
4A	End Clamp
4B	Carriage Bolt set M8-**
4C	Flange Nut
4D	Cable Holder



※ The nuts in RTM-MCB45BK-B-00 are silver and black.
The nuts in RTM-MCB50 and 55BK-B-00 are black.

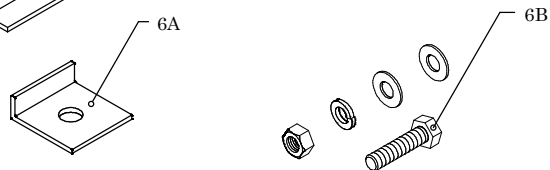
⑤ Shims

	Item
5A	Shim



⑥ Stopper Set (Portrait only)

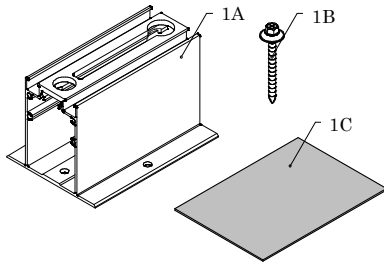
	Item
6A	Stopper
6B	M6-25 Bolt Set



2. Items with E Mount AIR 2

① E Mount AIR Bracket Set

	Item
1A	[E]Mount AIR
1B	Screw 5.0×60
1C	RT butyl Spacer

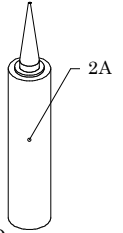


② Roof sealant

	Item
2A	Roof sealant

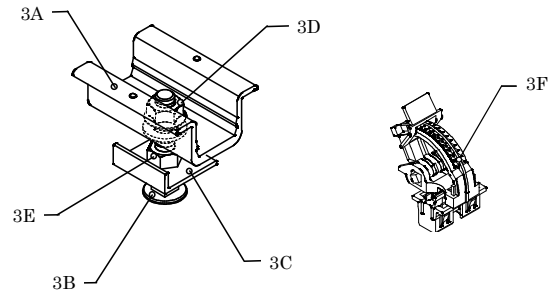
※Recommended Product

- Henry : 208R, 209, 925 (Black)
- Geocel : S2, S4 (Black)
- Sashco : Through the Roof
- Boss : 125 (Black)
- Top Industrial: Rain Buster 850, 900
- Chem Link: M1



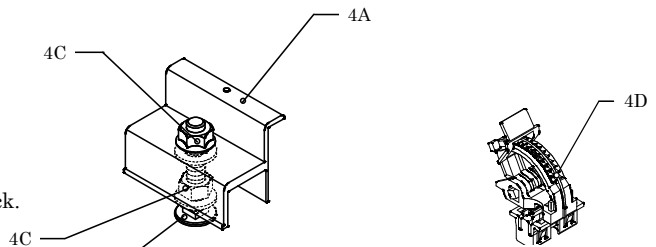
③ Clamp Kit

	Item
3A	Middle Clamp
3B	Carriage Bolt set M8-**
3C	Panel Spacer
3D	Flange Nut
3E	Hex Nut
3F	Cable Holder



④ End Clamp Kit

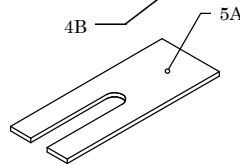
	Item
4A	End Clamp
4B	Carriage Bolt set M8-**
4C	Flange Nut
4D	Cable Holder



※ The nuts in RTM-MCB45BK-B-00 are silver and black.
The nuts in RTM-MCB50 and 55BK-B-00 are black.

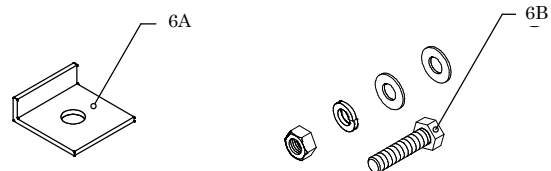
⑤ Shims

	Item
5A	Shim



⑥ Stopper Set (Portrait only)

	Item
6A	Stopper
6B	M6-25 Bolt Set



3. Module Clamp Table

Clamp	Panel Frame Height	Item ID	Description
End Clamp	32 mm	RT-E32G2-00	[E]Mount End Clamp 32 mm kit
	33 mm	RT-E33G2-00	[E]Mount End Clamp 33 mm kit
	35 mm	RT-E35G2-00	[E]Mount End Clamp 35 mm kit
	40 mm	RT-E40G2-00	[E]Mount End Clamp 40 mm kit
	46 mm	RT-E46G2-00	[E]Mount End Clamp 46 mm kit
	50 mm	RT-E50G2-00	[E]Mount End Clamp 50 mm kit
Middle Clamp	32 – 40 mm	RT-M45G2-00	[E]Mount Middle Clamp kit CB45 kit
	46 – 50 mm	RT-M55G2-00	[E]Mount Middle Clamp kit CB55 kit

4. Grounding ••• Lugs & Straps

All electrical installation and procedures should be conducted by skilled, licensed and bonded electricians. All work must comply with all national, state and local installation procedures, product and safety standards. These standards include but are not limited to applicable National Electrical Code NEC 690 and NEC 250, National Electrical Installation Standards (NEIS™), UL Standards, and OSHA Regulations.

Note: **Maximum Series Fuse Rating of 30 A.**

Grounding, Bonding Lugs and Straps are not provided by Roof Tech Inc.

1) BURNDY

• WEEB LUG

①	WEEB-LUG-6.7
②	WEEB-LUG-6.7AS
③	WEEB-LUG-8.0
④	WEEB-LUG-8.0AS
⑤	WEEB-LUG-8.2MS
⑥	WEEB-LUG-15.8

• WEEB-BONDING JUMPER

①	WEEB-BNDJMP6.7
②	WEEB-BNDJMP6.7AS
③	WEEB-BNDJMP8.0
④	WEEB-BNDJMP8.0AS
⑤	WEEB-BNDJMP8.2MS
⑥	WEEB-BNDJMP9
⑦	WEEB-BNDJMP12
⑧	WEEB-BNDJMP24
⑨	WEEB-BNDJMP36

2) ILSCO

• ILSCO Dual Rated Lay-In Ground Lug type SGB

①	SGB-4
---	-------

• ILSCO Dual Rated Lay-In Ground Lug type GBL

①	GBL-4
②	GBL-4SS

• ILSCO Copper Lay-In Ground Lug Direct Burial type GBL-DB

①	GBL-4DB
②	GBL-4DB-14
③	GBL-4DBT
④	GBL-4DBT-14

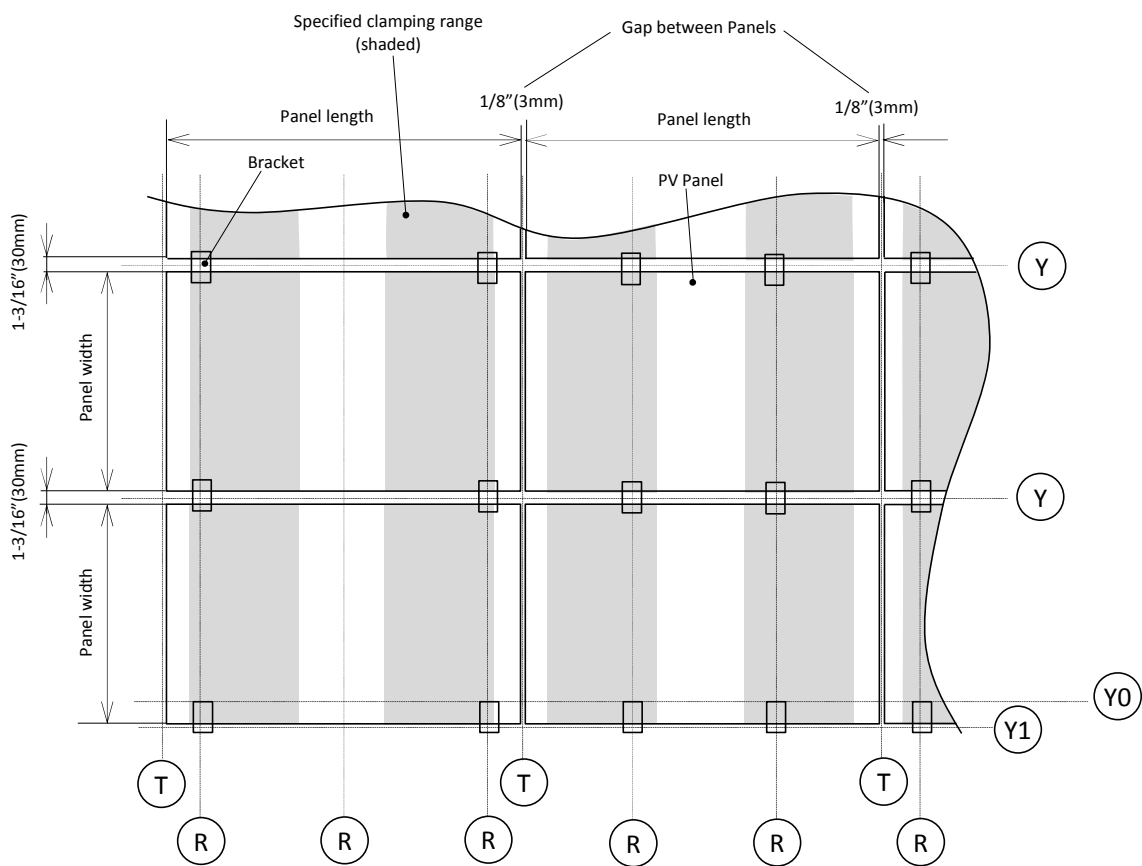
PART B Landscape Layout

1. Installation of Brackets

(1) Brackets Layout

a) Installation on the **RAFTER**

Example (Scale: Not to Scale)



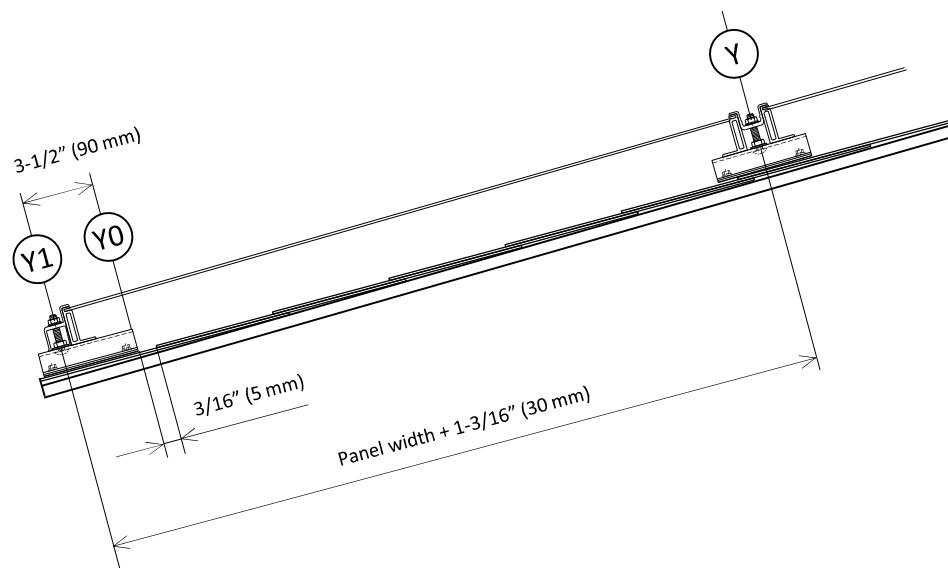
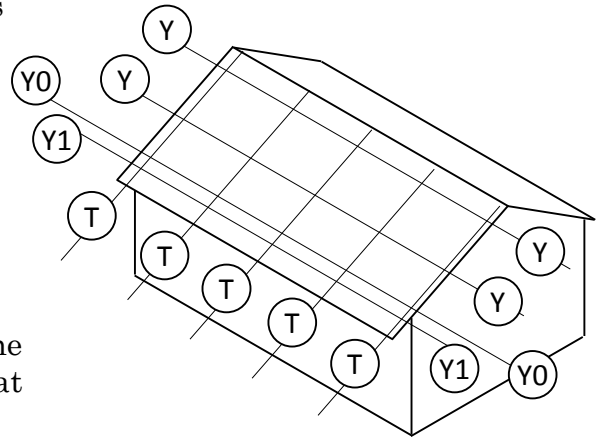
Note: Minimum distance 1/8" (3 mm) between panels.

① Chalk line according to the layout plans to indicate bracket's position.

(i) Line Y0: Position the lower base upper edge at $\frac{3}{16}$ " (5 mm) from the edge of the upper composite shingle. (see illustration bellow)

(ii) Line Y1: Delineates the location of the carriage bolt for the first row at $3\text{-}\frac{1}{2}$ " (90 mm) from Line Y0.

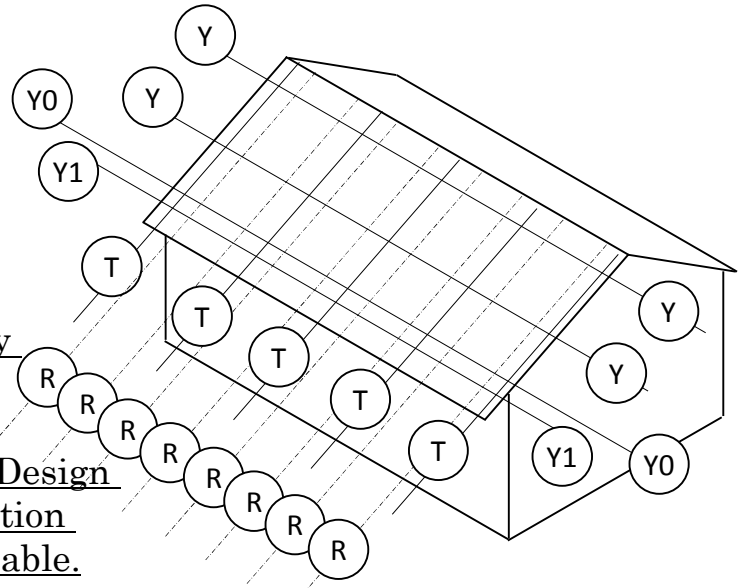
(iii) Line Y: Center of brackets of the second and subsequent rows. The distance between Y1-Y and Y-Y shall be the width of panel (refer to Pg. 8 illustration) plus $1\text{-}\frac{3}{16}$ " (30 mm, equivalent to the width of a Panel Spacer and middle clamp).



(iv) Line T: It delineates the center line of the spacing between adjacent rows. The distance between T Lines shall be the length of a panel (see illustration from Pg.8) plus the spacing between rows. We recommend a minimum of $\frac{1}{8}$ " (3 mm) spacing between adjacent rows to allow for thermal contraction and expansion.

LANDSCAPE
BRACKET LAYOUT

- ② Aligning the brackets. Choose the most suitable rafter for the array, then draw chalk lines to mark their center.
- (i) Line R: Rafter center line.



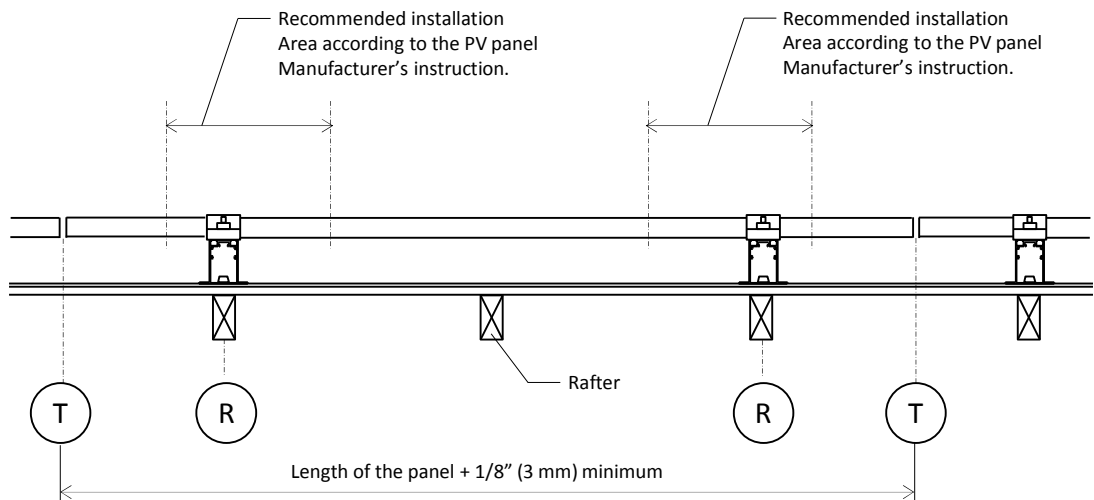
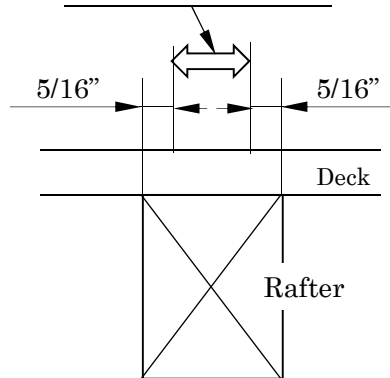
The Engineer of Record (EOR) shall verify the framing capacity and fastener installation for building code compliance including those of the National Design Specification for Wood Construction (NDS 2005/2012/2015) as applicable.

! Attention

According to the NDS, the distance from the side edge of the rafter and the 5 mm diameter mounting screws for E Mount and E Mount AIR shall be more than 5/16" (7.9 mm).

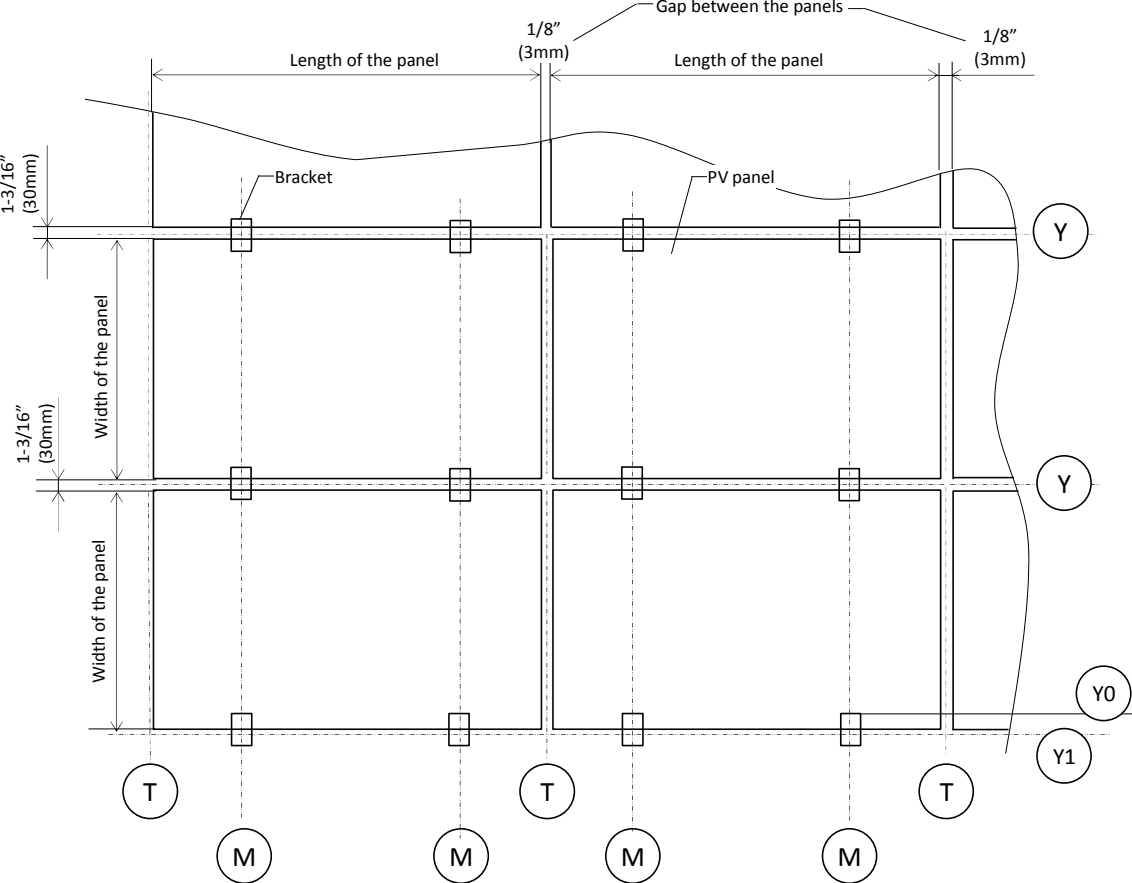
Note: Minimum Edge Distance = 1.5D
Where D is the Diameter of the screw.
Direction of Loading: Parallel to Grain
(See NDS 2015 Table 12.5.1c.)

The mounting screw shall hit this area.



b) Installation on the **DECK**

Example (Scale: Not to Scale)



Note: Minimum distance 1/8" (3 mm) between panels.

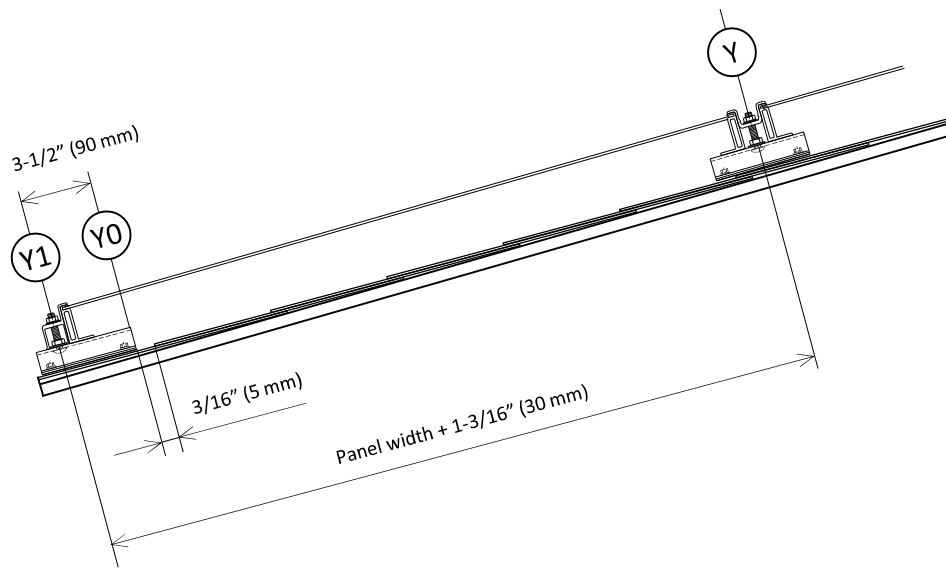
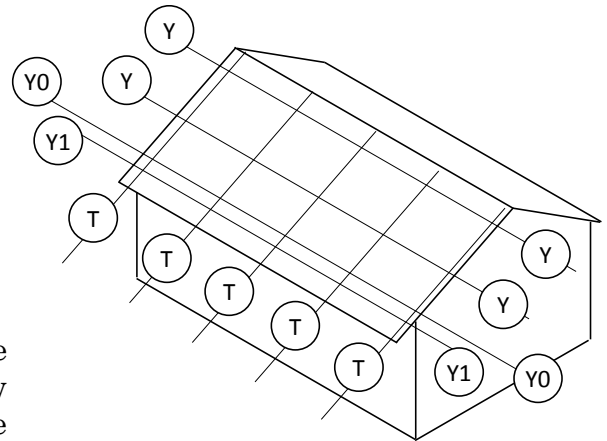
LANDSCAPE
BRACKET LAYOUT

① Chalk line according to the layout plans to indicate brackets position.

(i) Line Y0: Position the lower base upper edge at $\frac{3}{16}$ " (5 mm) from the edge of the upper composite shingle.
(see illustration bellow)

(ii) Line Y1: Delineates the location of the carriage bolts for the first row at $3\text{-}1/2$ " (90 mm) from Line Y0.

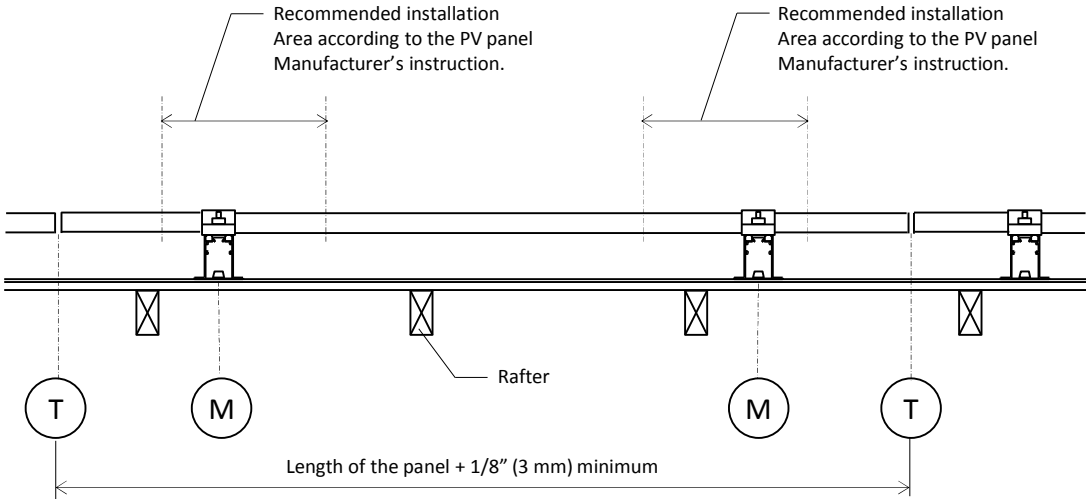
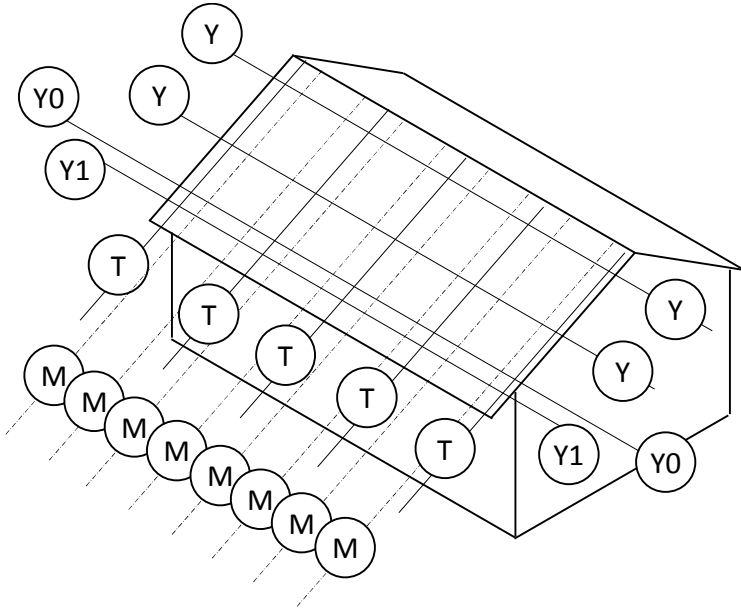
(iii) Line Y: Center of brackets of the second and subsequent rows. The distance between Y1-Y and Y-Y shall be the width of panel (see figure of previous page) plus $1\text{-}3/16$ " (30 mm, equivalent to the width of a Panel Spacer and middle clamp).



(iv) Line T: It delineates the center line of the spacing between adjacent rows. The distance between T Lines shall be the length of a panel (see illustration from Pg.11) plus the spacing between rows. We recommend a minimum of $1/8$ " (3 mm) spacing between adjacent rows to allow for thermal contraction and expansion.

② Position the brackets. Select the clamping location (M) according to the PV module installation instructions.

(i) Line M: Bracket center line.

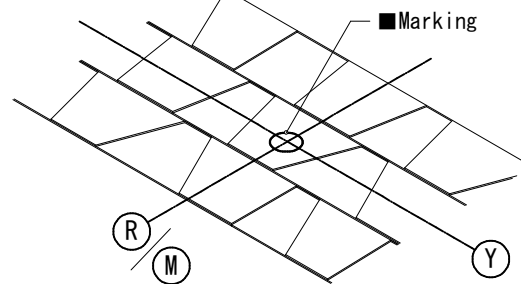
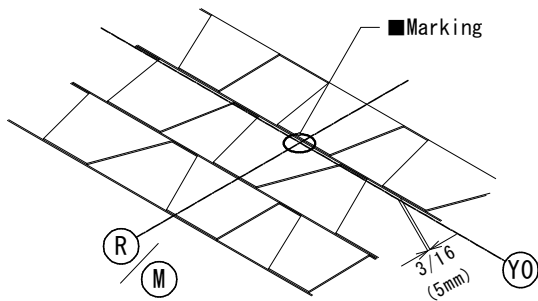
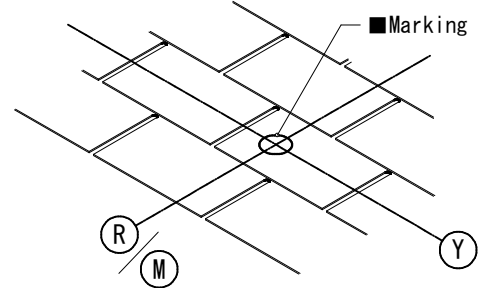
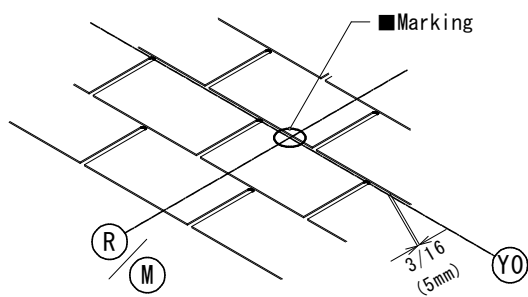


(2) Bracket Installation

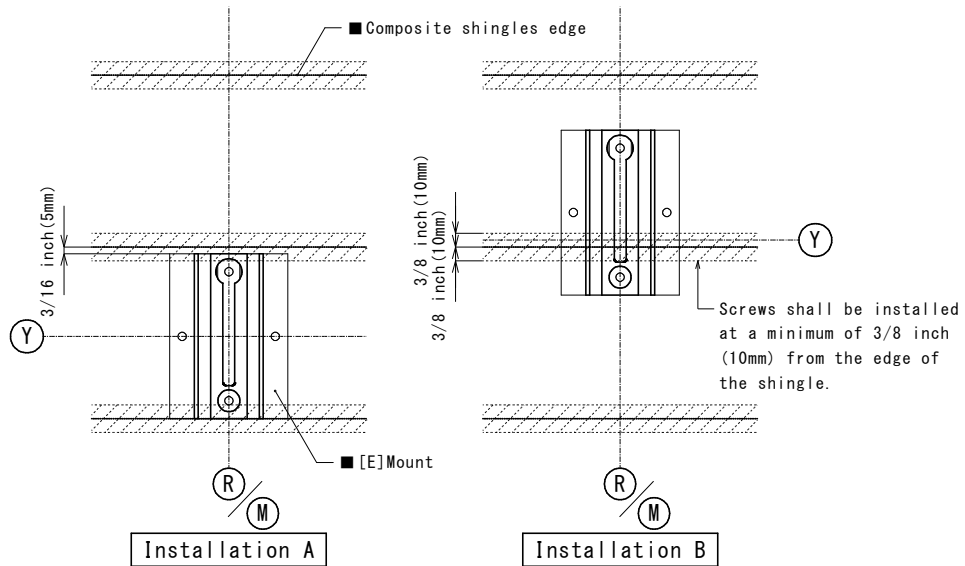
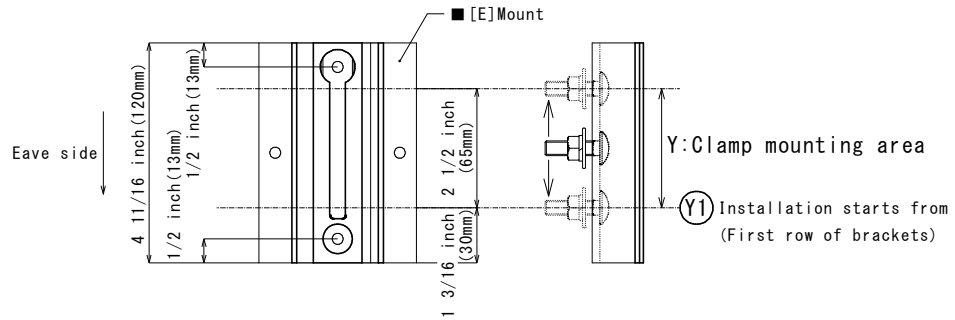
! Attention

To maintain the flashing performance, avoid installation when the temperature is below 22F or above 176F. RT Butyl must be installed on a dry surface.

- ① Mark the location at the intersection of the Y0 or Y Line and R/M Line. (Top of the first row bracket.)



② Choose “A” or “B” installation at each bracket location.



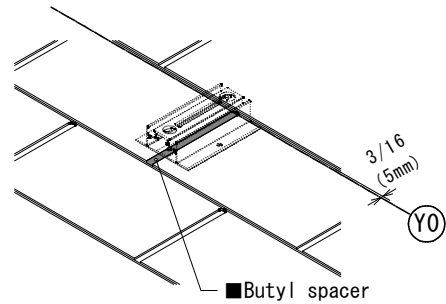
Attention

Minimum clearance between mounting screws and the edge of the roofing shingle shall be 3/8" (10 mm).

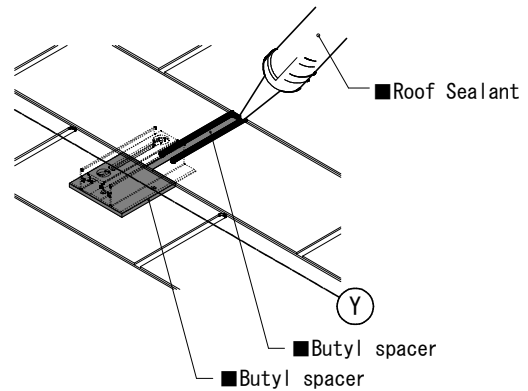
In case the stainless screw hit the nail underneath the shingle;

- 1) Tip the driver at an angle.
- 2) Use a 3 mm steel drill to make a hole.
- 3) If possible, remove the nail from underneath.

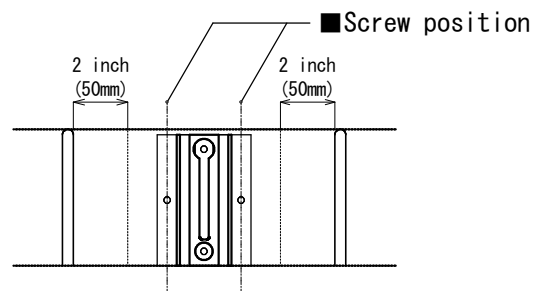
- ③ Adjust the RT butyl tape to match the height of the upper shingle. When there is a gap, a slit, or a height difference at the mounting location of the bracket, use additional RT butyl tape (Installation B).



- When there is a slit at the installation spot, fill in with the additional RT butyl tape. The slit must be filled with RT butyl tape.

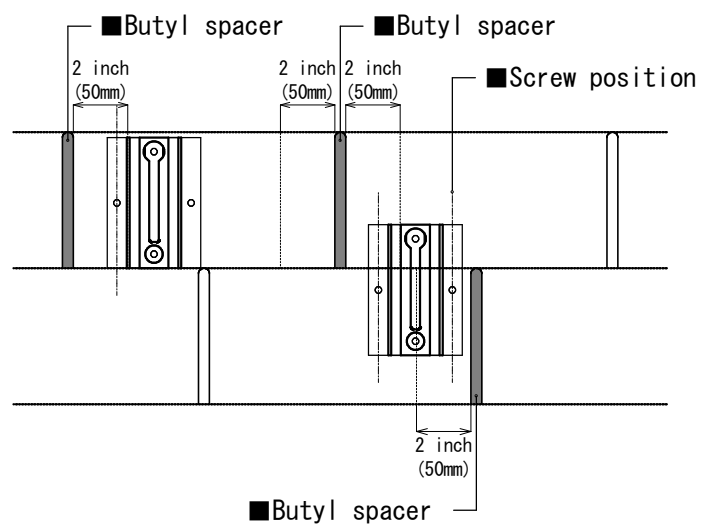


- When there is a slit above the bracket, fill it in with RT butyl tape to match its shape. Apply roof sealant around the RT butyl tape.



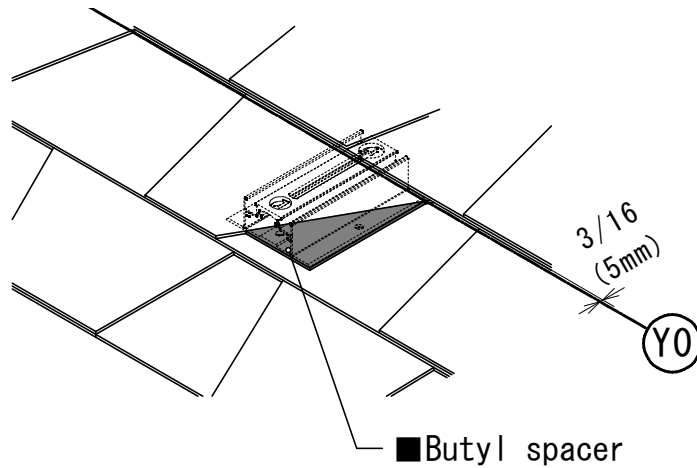
Notice that the roof sealant is only used to add a protective layer to the RT butyl tape.

- Best to position the bracket 2" away from the slit.
- If the mounting screw is within less than 2" from the slit, fill the slit with RT butyl tape.



- When there are gaps in the position to install, cut RT butyl tape to the shape and apply it.

Note: Each bracket comes with a RT butyl tape, and is supplied with an additional tape.



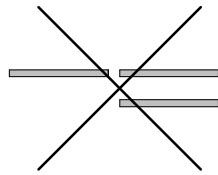
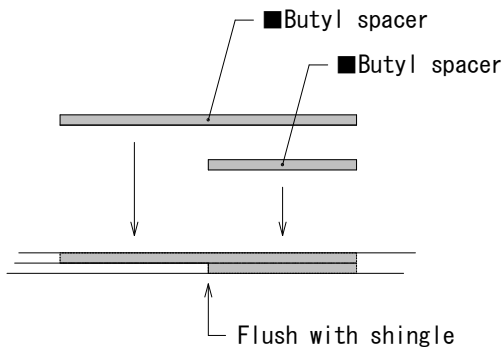
Attention

Peel off the protection paper from both side of butyl tape.

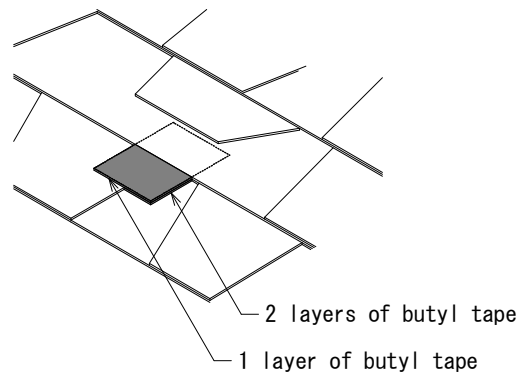
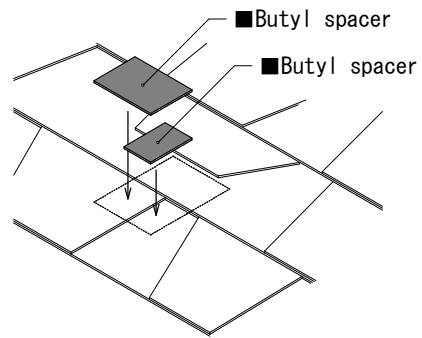
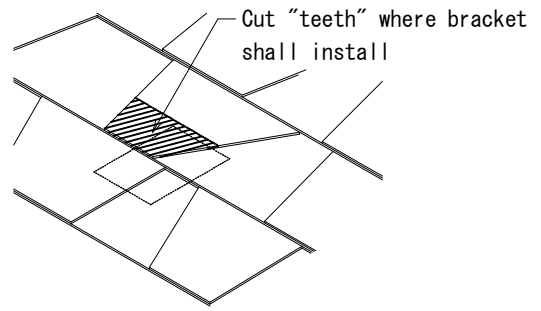
LANDSCAPE
BRACKET INSTALLATION

[Case 1]

- Use RT butyl tape to level the surface of the composite shingle roof.



Note: Do not splice the butyl tape.



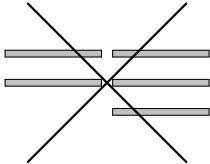
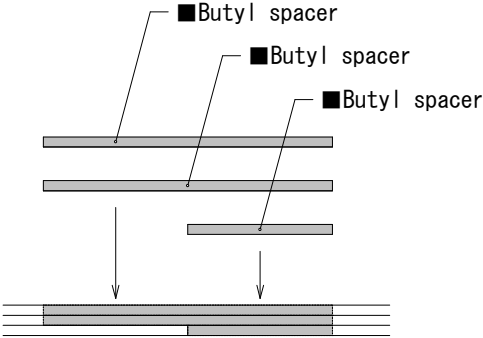
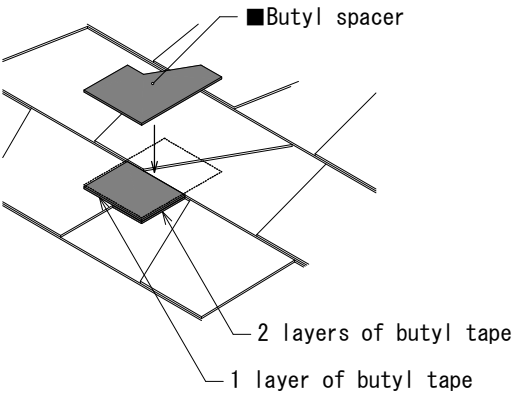
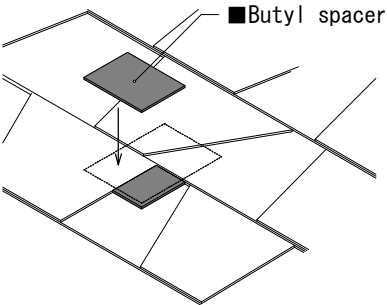
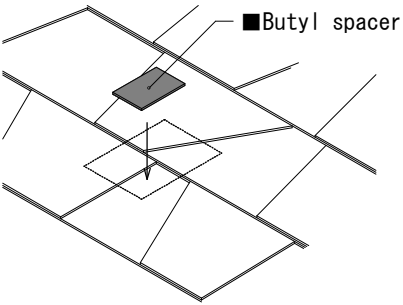
[Case 2]

- Building layers of RT butyl for the bracket to be mounted over the teeth region of composite shingle roofs.

We recommend 4 layers maximum.

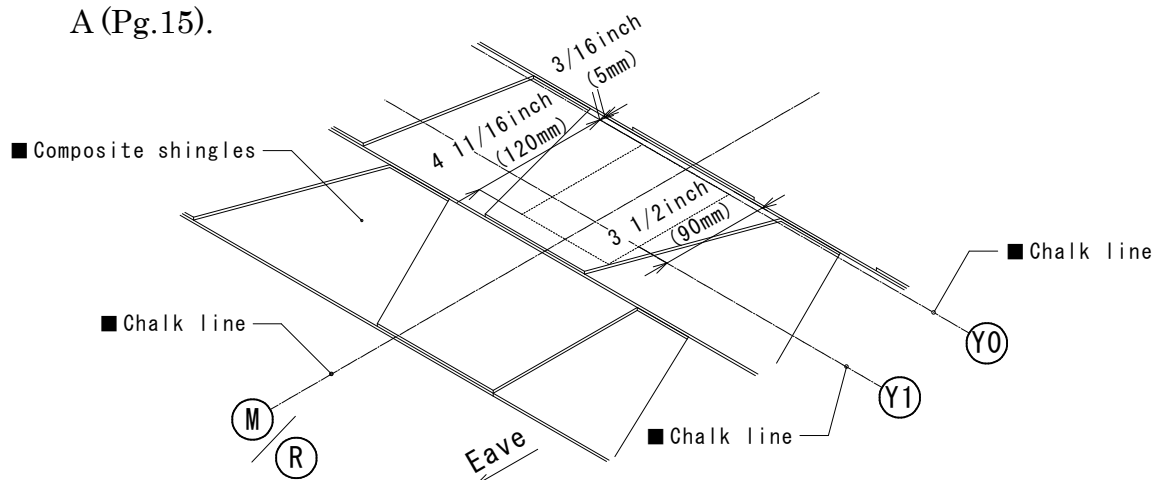
Layer 1 is already applied to the bottom of the bracket.

The following layers must be cut to shape to cover the surface of the bracket at each location, assuring a leveled surface.

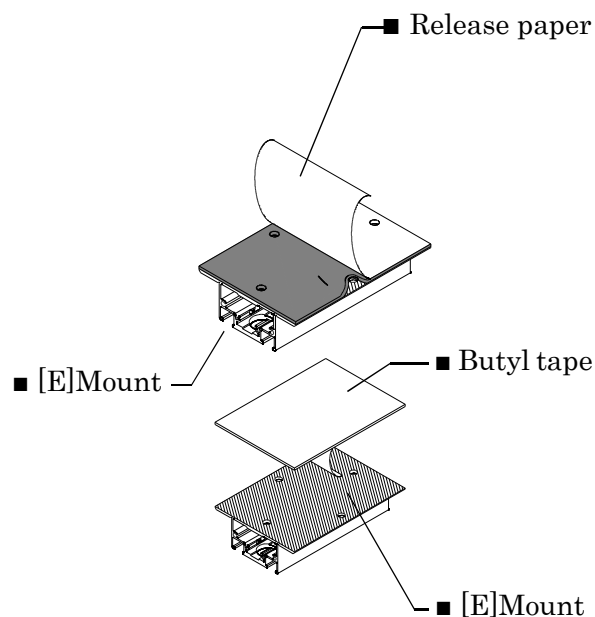


Note: Do not splice the butyl tape.

- ④ Starting eave edge installation. Brackets shall be installed per installation A (Pg.15).



- ⑤ Be sure to inspect RT Butyl tape have paste in all underface of the brackets.
If have not paste all underface of brackets, use the new RT Butyl tape and repaste in all underface of brackets.
After completing process, peel off the protective paper from the RT butyl tape.

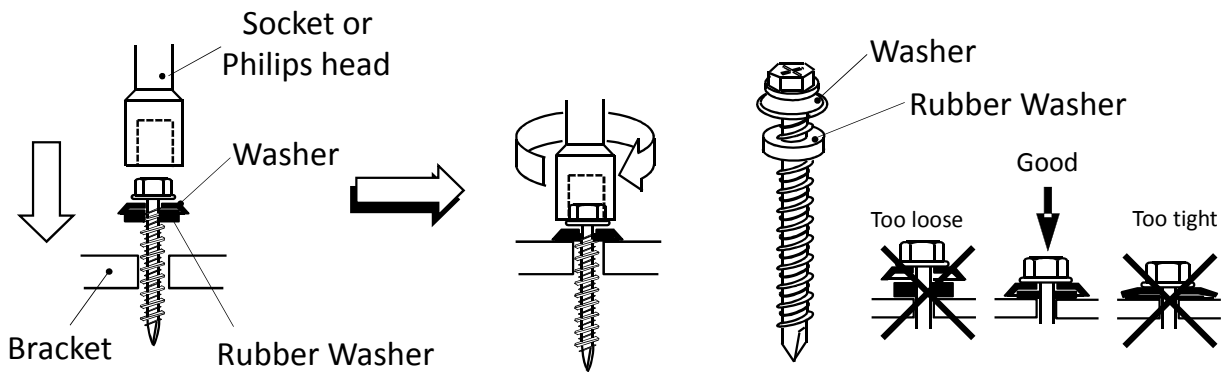


! Attention

Do not leave any protective paper on the surface of the RT butyl tape, it can cause an improper seal and may allow water intrusion under the bracket.

! Attention

Note: Proper torque values for the 5.0×60 mm screw will vary depending on the rafter and/or deck characteristics; hardness, age, and moisture of the wood. Tighten until the washer just stop rotating easily.



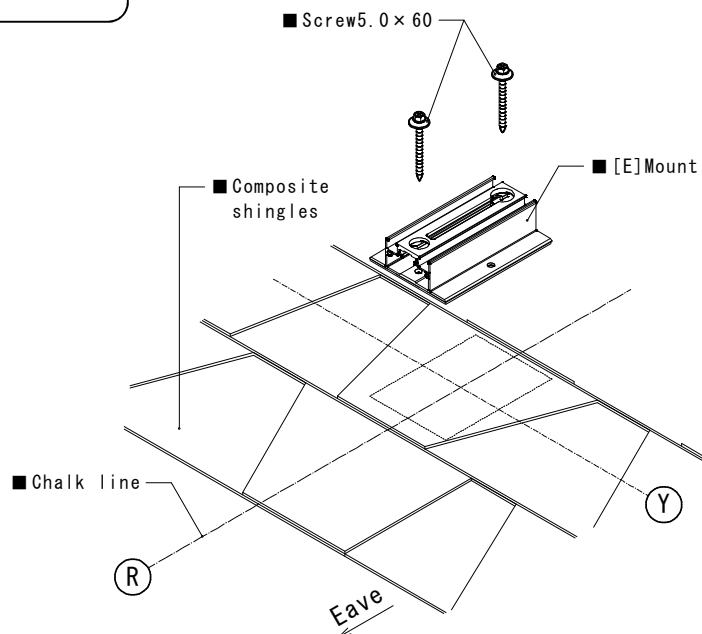
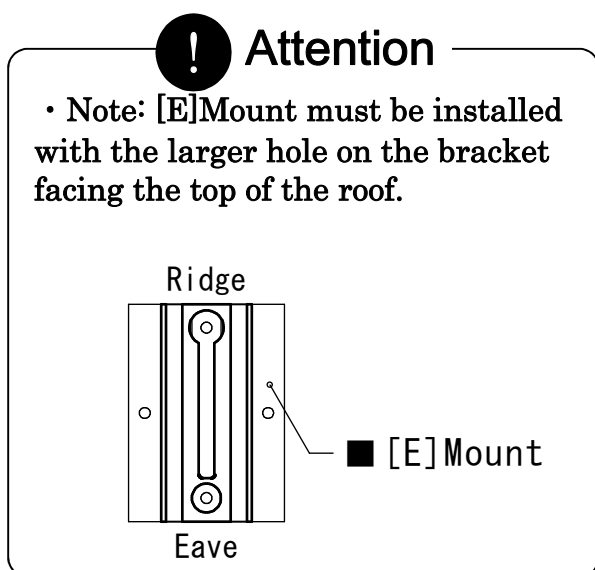
When tightening the screws please tighten all screws equally and avoid using an impact driver as it can over torque the screws or even snap off the head.

⑥ Installing the bracket.

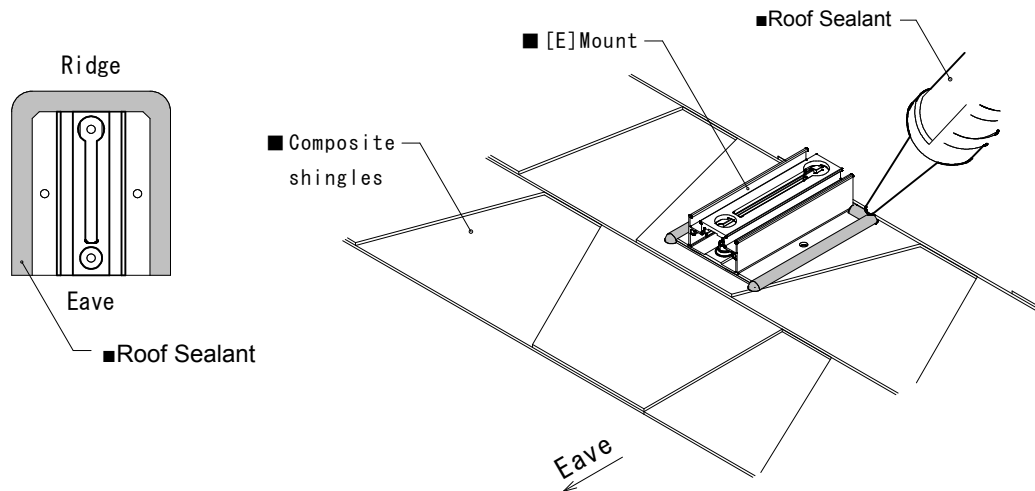
Place the brackets at the specified position with RT butyl tape and make sure the RT butyl attaches well to the roofing surface.

Set the bracket with 2 ea. screws (for RAFTER), or 4 ea. (for Roof DECK), 5.0×60 mm stainless wood screw using 8 mm×L110 mm socket.

After completing process, make sure the brackets are securely fixed.



- ⑦ Apply roof sealant around the brackets, the top and each side edge of the brackets.
- Cover the exposed RT butyl tape with roof sealant.
- Do not seal the bottom of the brackets.



Attention

You may verify that screws come out from the deck panel together with butyl rubber, that indicates good flashing performance.

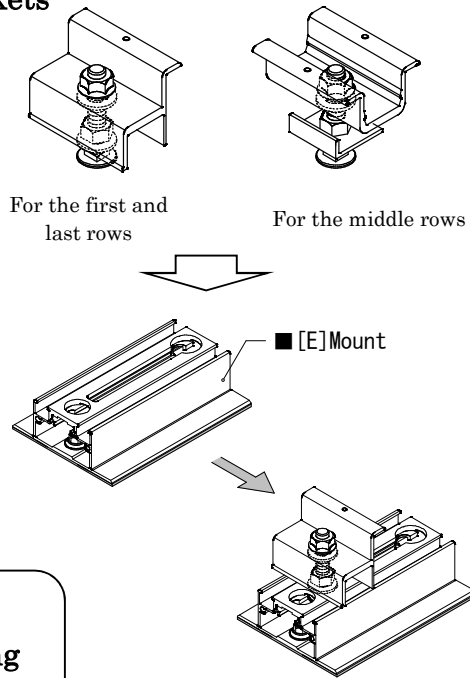
2. Installation of Panels

(1) Aligning and Leveling the Brackets

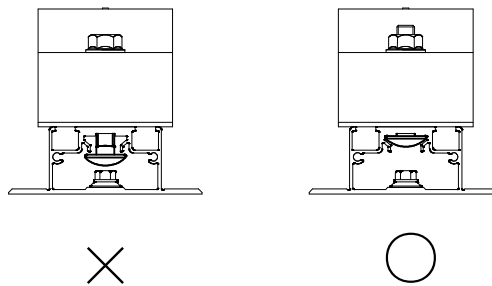
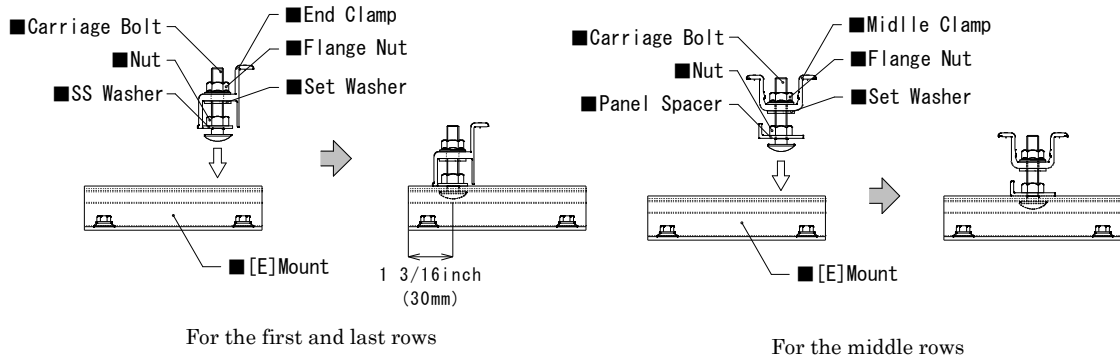
- ① Insert the carriage bolt head into the T-slot of the bracket, then hand-tighten the lower M8 nut.

Use Middle clamp kit instead of End Clamp kit when install skirt on eaves side of the array.

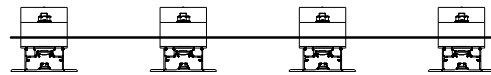
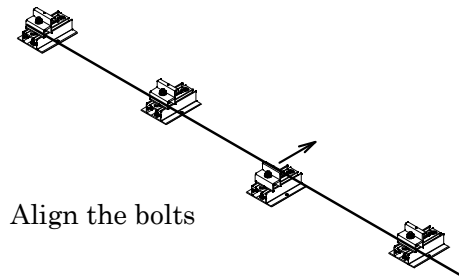
(See page 30)



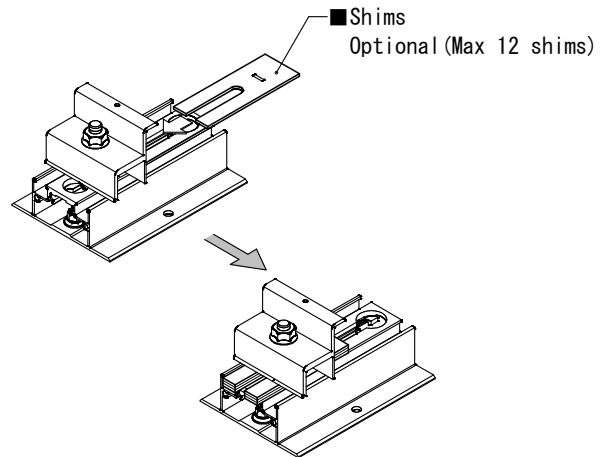
! Attention
Be aware of the sharp tip of bonding pin at underside of the clamp flange.



- ② Stretch a string line tight along the Y1 line between the first and last brackets in the first row.
- ③ Align the carriage bolt positions of all the brackets in the row, using the string as a guide.
- ④ Next, level the height of the brackets using max. of 12 shims.
- ⑤ If shims are to be used to level the brackets, insert the shims between the Washer/Panel Spacer and the E Mount/E Mount AIR.

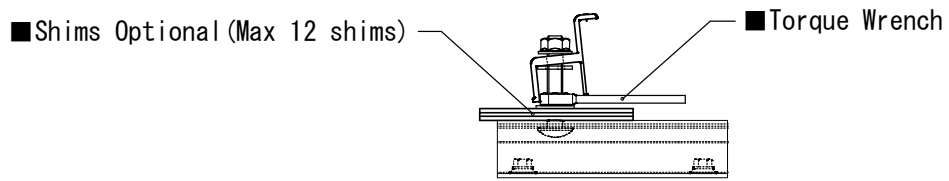


Level the bracket height



LANDSCAPE
PANEL INSTALLATION

- ⑥ Set the carriage bolt and lower M8 nut to torque 180 in-lbs (20 N·m).



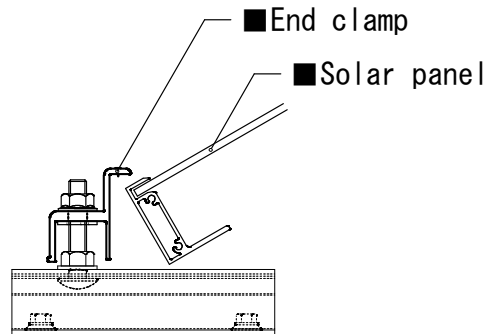
- ⑦ After aligning the first row, follow the same aligning and leveling process vertically on far right and far left columns. Then align each of the remaining rows of the array (in any order).

For the rows other than the first one, leave the lower M8 nuts hand-tightened to allow for adjustments as the PV modules get installed.

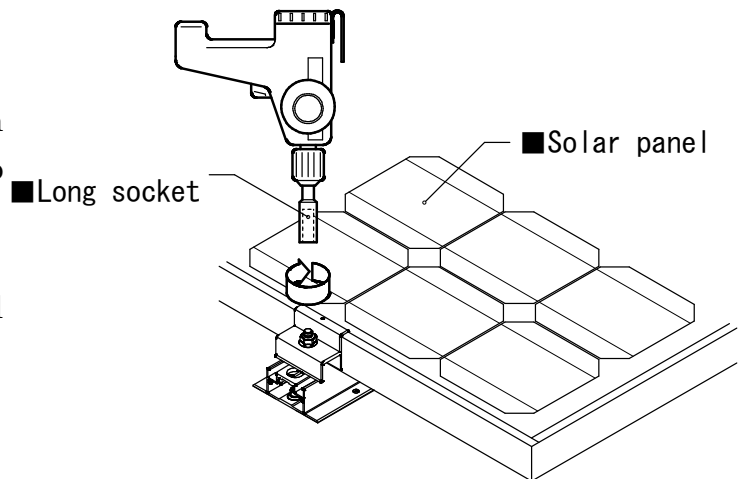
If you are installing the Eaves Cover (Skirt) for E Mount AIR, Skip to "3. Eaves Cover : Skirt (Optional, E Mount AIR only)" on page 30.

(2) End Clamp and the First Row Panel Installation

- ① Place the PV panel on the bracket.



- ② Make any adjustment then tighten the flange nut to 180 in-lbs (20 N·m).



- ③ Repeat ① and ② for all the first row panels.

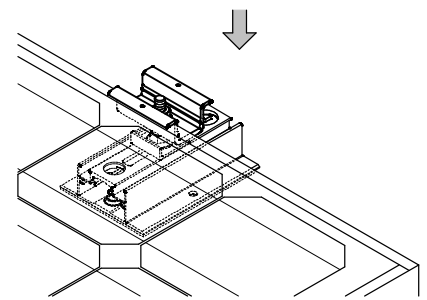
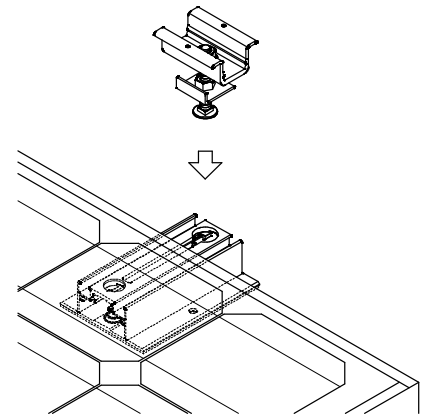
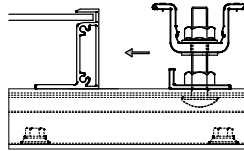
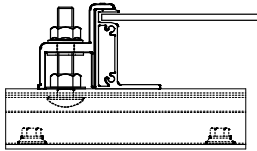
Technical Note:

Stainless hardware is soft and if dry torqued too quickly it may cause the nut and bolt to seize.

Roof Tech recommends all stainless steel threads should be lubricated before being assembled. This will make it easier to tighten nuts to bolts, avoid galling, and facilitate adjustments before the nut is properly torqued. Therefore, avoid tightening the nut with an impact driver.

(3) Middle Clamp Installation

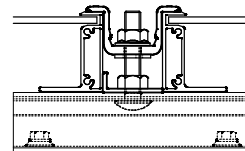
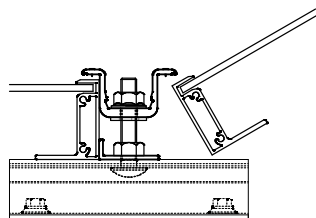
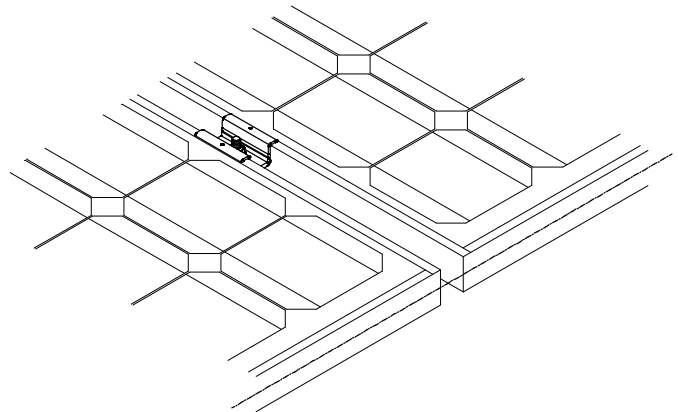
- ① Slide the panel spacer until it is flush to the frame of the panel already installed.



- ② If necessary, add or remove shims for leveling. Then tighten the Panel spacer (lower M8 nut) to 180 in-lbs (20 N·m).

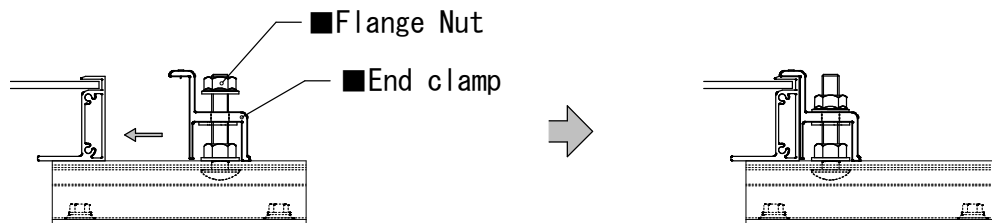
- ③ Set the next Panel in place and make any adjustment.

Once the panel is at the correct and final position, set the M8 flange nut to 180 in-lbs (20 N·m) torque.



(4) Upper End Clamp Installation

- ① Make the End Clamp to touch the PV Panel. Tighten the lower M8 nut, then the flange M8 nut to 180 in-lbs (20 N·m).



For Cable Management Go to “PART D: Electrical Setup” on page 51

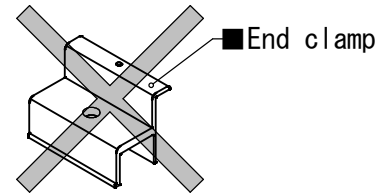
3. Eaves Cover: Skirt (Optional, E Mount AIR only)

! Attention

Skirt is not recommend in areas where the ground snow exceeds 40 PSF.

The Skirt when installed across 2 adjacent rows of PV modules will create a bonding path that replaces the bonding clamps.

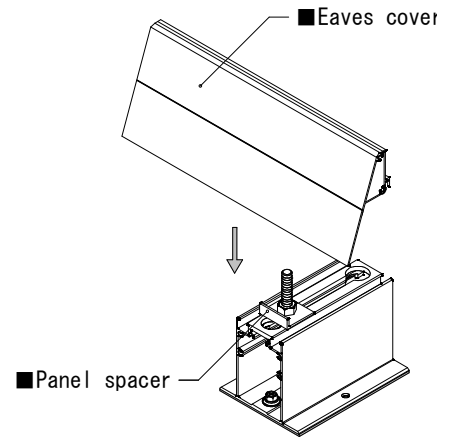
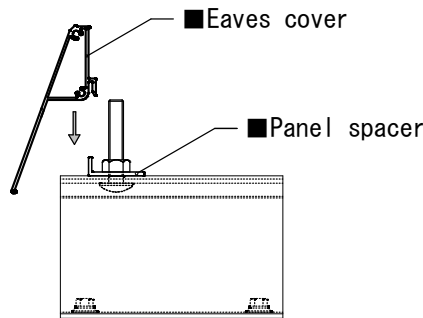
Install Middle clamps for skirt installation on eaves side of the array.



Note: No need for eaves side

(1) Install the first row

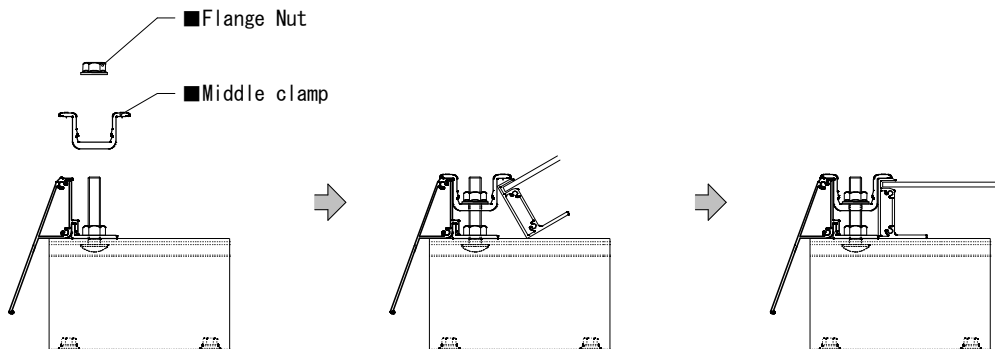
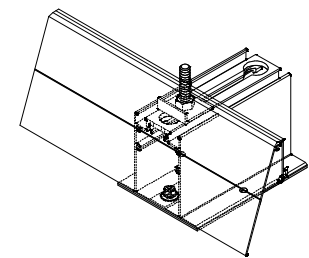
- ① After alignment of the first row, remove flange nut and Middle Clamp, then tighten the bottom nut to 180 in-lbs (20 N·m) and slide the skirt into the spacer.



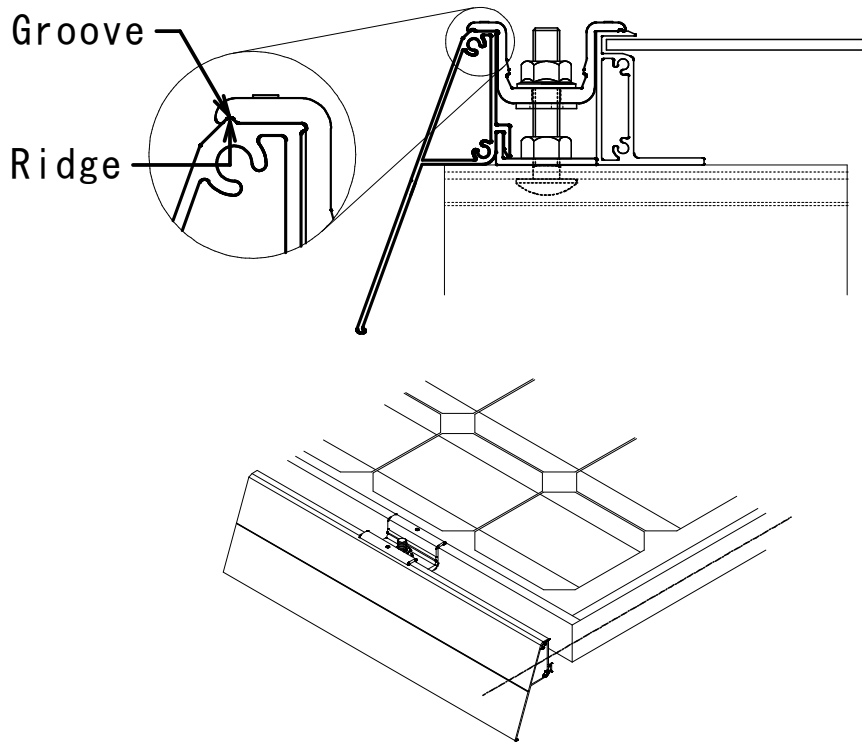
- ② Put Middle Clamp and flange nut, then set the Panel in place and adjust its position.

Once the panel is at the correct and final position, set the nut to 180 in-lbs (20 N·m) torque.

(See figures in the next page.)



- ③ Be sure that the ridge of the eaves cover fit into the groove of the middle clamp.



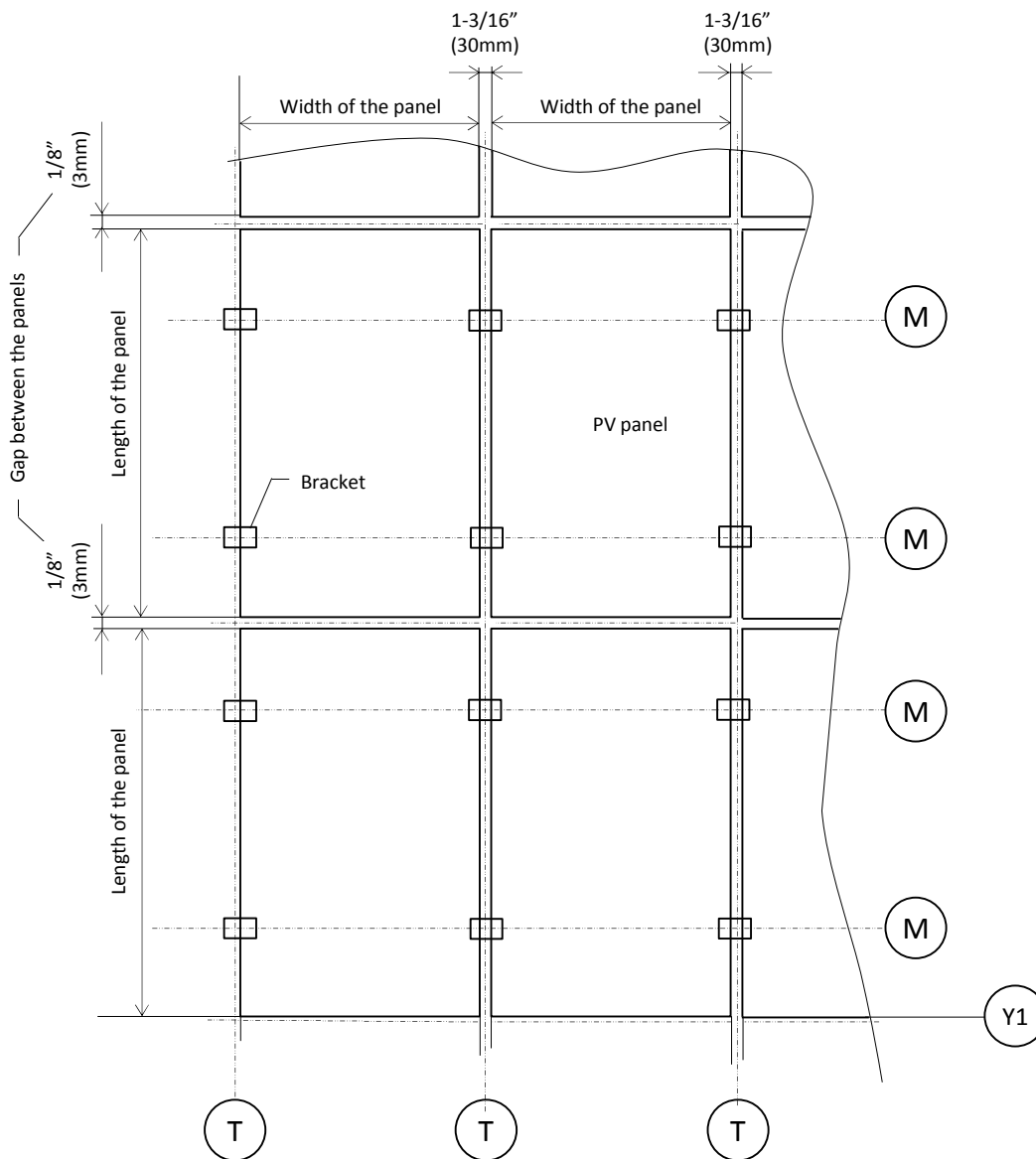
Back to “(3) Middle Clamp Installation” on Page 28.

PART C Portrait Layout

1. Installation of Brackets

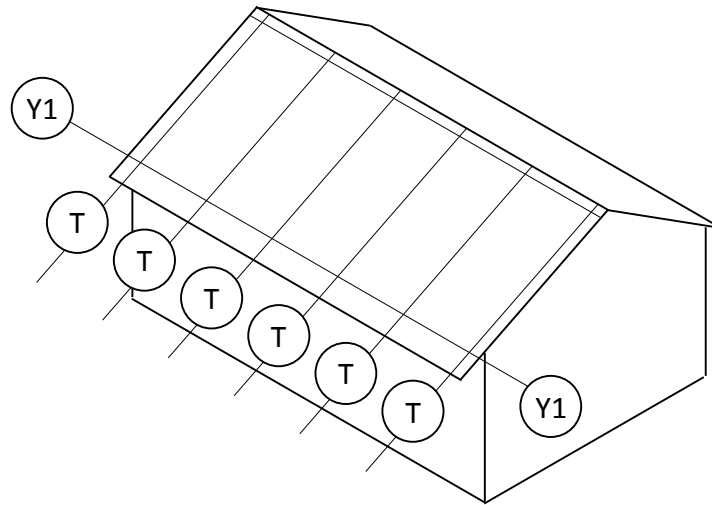
(1) Brackets Layout (Deck only)

Example (Scale: Not to Scale)

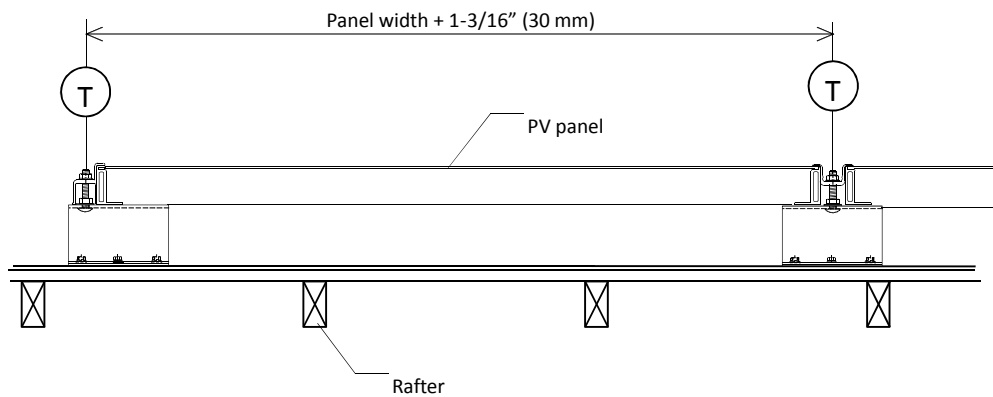


Note: Minimum distance $1/8''$ (3 mm) between panels.

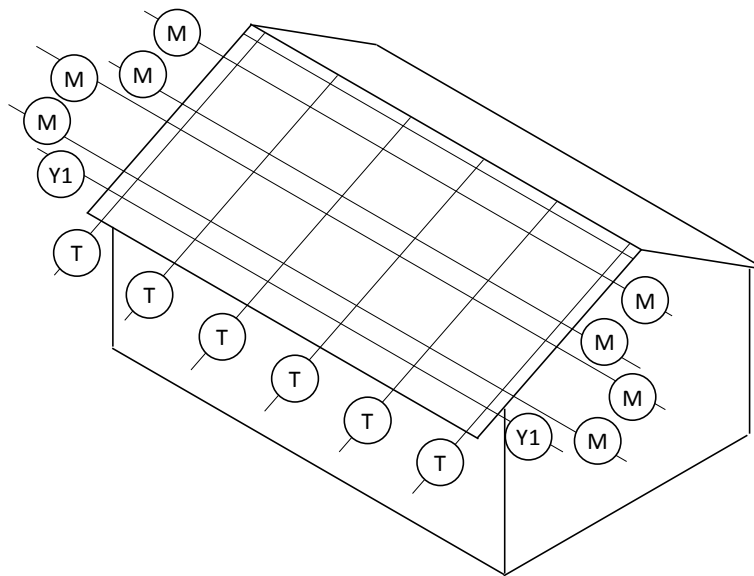
- ① Chalk the lines according to the layout plans to indicate brackets positions.



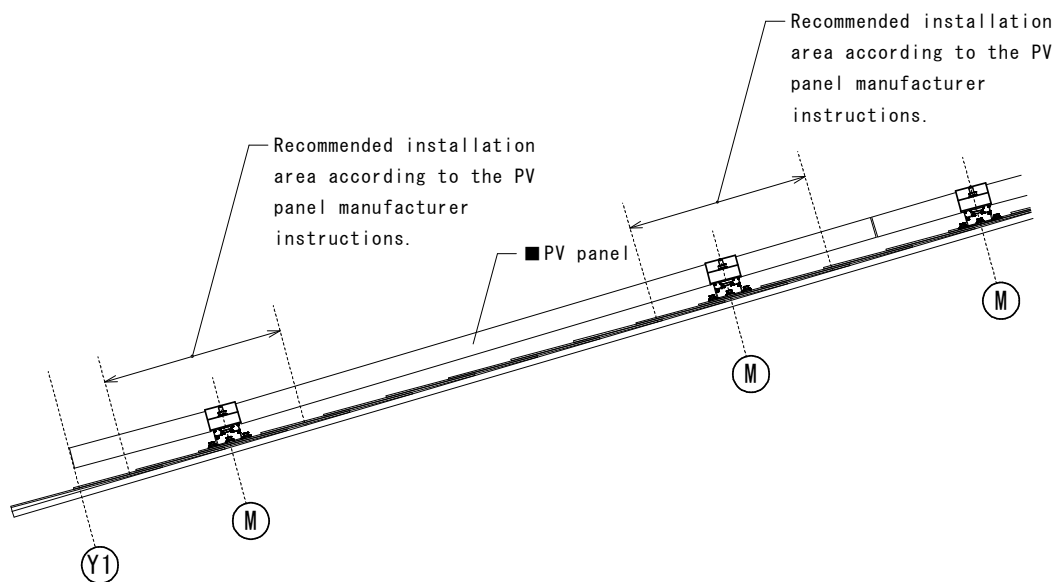
- (i) Line Y1: Delineates the location of the first row of modules.
- (ii) Line T: Center of the brackets. The distance between the lines shall be the width of the panel plus $1 \frac{3}{16}$ " (30 mm, equivalent to the width of the Panel Spacer and middle clamp).



- ② Position the brackets. Make a chalk line according to the PV panel installation instruction as for the clamping locations (M).



- (i) Line M: Bracket center line.
Refer to the PV panel manufacturer's instruction for adequate installation area.

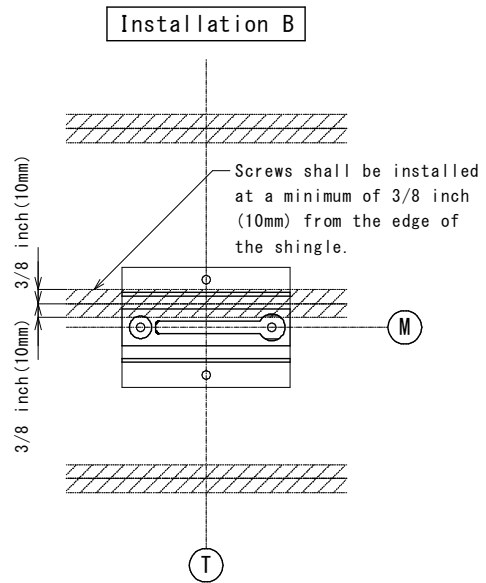
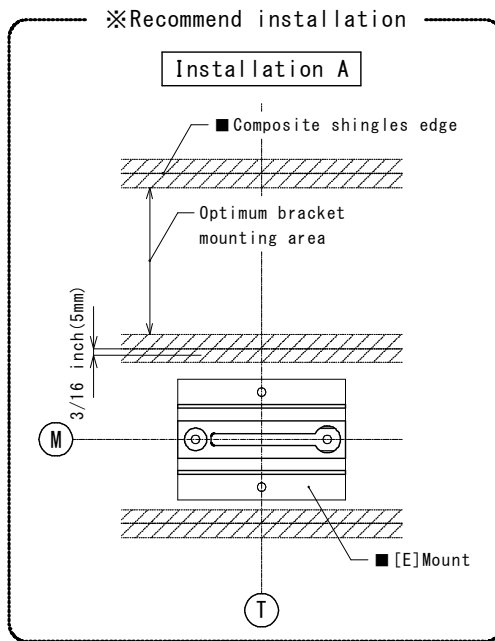
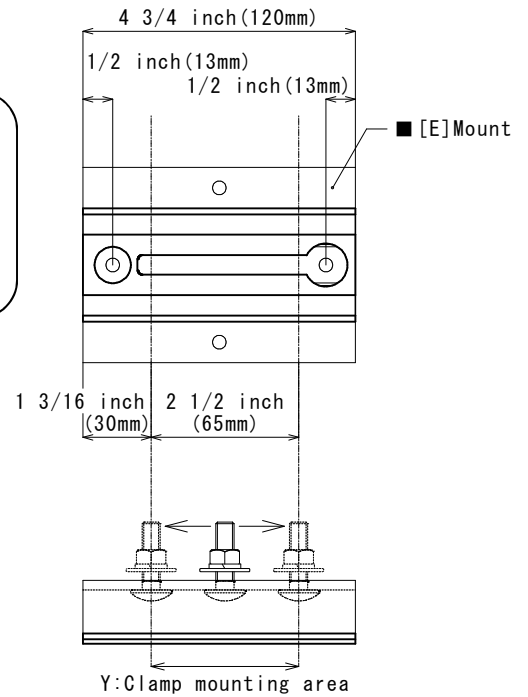


(2) Bracket Installation

! Attention

To maintain the flashing performance, avoid installation when the temperature is below 22F or above 176F.
RT Butyl must be installed on a dry surface.

- ① Mark the location at the intersection of the T Line and M Line.
- ② Choose “A” or “B” installation at each bracket location.



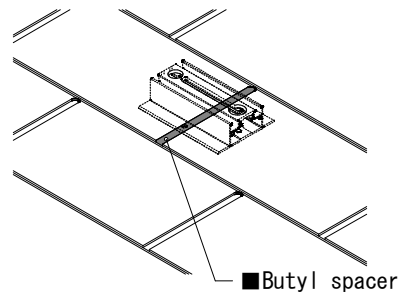
! Attention

Edge of the roofing Shingle shall be 3/16” (5 mm) from the edge of the bracket.
Minimum clearance between mounting screws and the edge of the roofing shingle shall be 3/8” (10 mm).

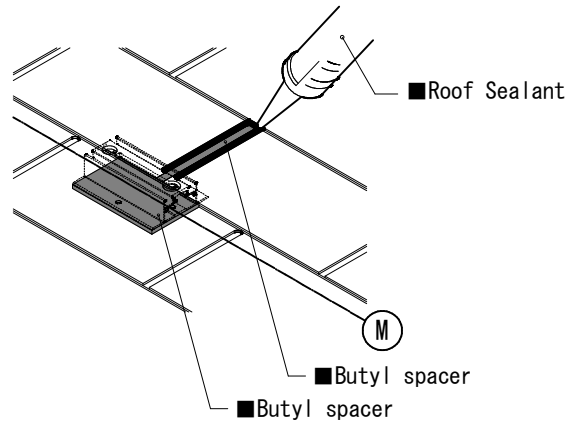
In case the stainless screw hit the nail underneath the shingle;

- 1) Tip the driver at an angle.
- 2) Use a 3 mm steel drill to make a hole.
- 3) If possible, remove the nail from underneath.

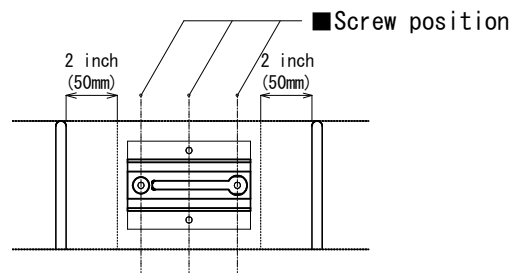
- ③ Adjust the RT butyl tape layer to match the height of the upper shingle. When there is a gap, a slit, or a difference in the height, in the mounting location of the bracket, use additional RT butyl tape.



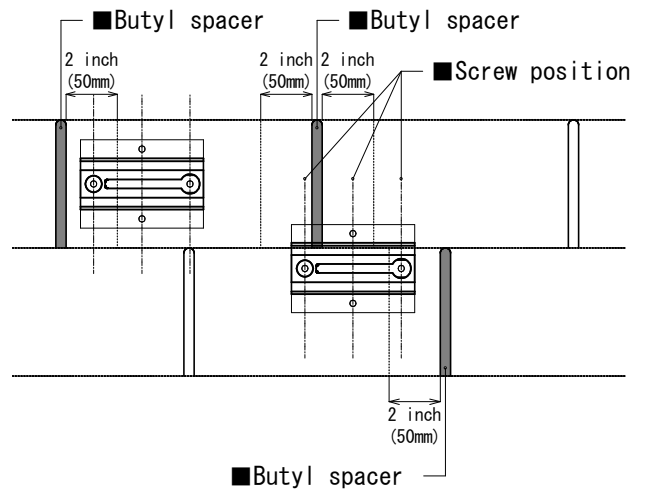
- When there is a slit at the installation spot, cut the RT butyl tape to match and place it in the slit. The slit must be filled with RT butyl tape.



- When there is a slit on the upper side of the bracket, cut the RT butyl tape to match the slit shape. And apply roof sealant around the RT butyl tape.



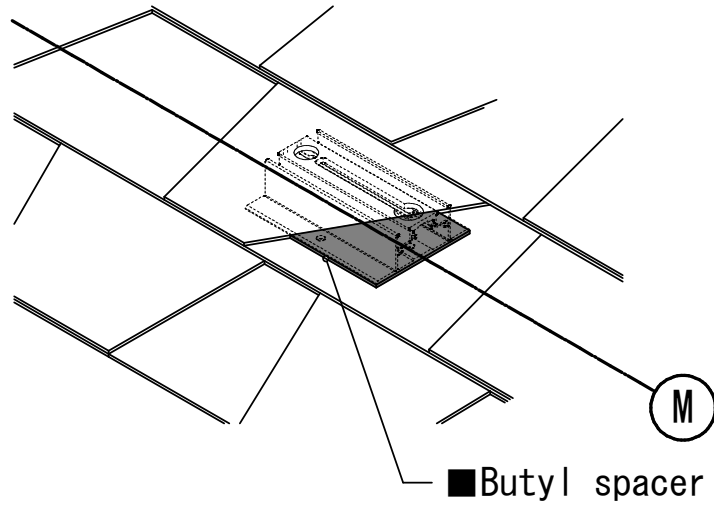
- Best to position the bracket 2" away from the slit.



- If the mounting screw is less than 2" from the slit, fill it with RT butyl tape.

- When there are gaps in the position to install, fill them in with the additional RT butyl tape provided.

Note: Each bracket comes with RT butyl tape installed, and is supplied with an additional tape.



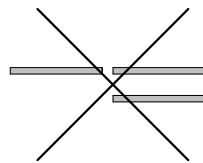
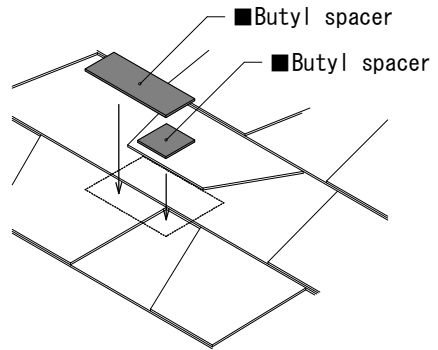
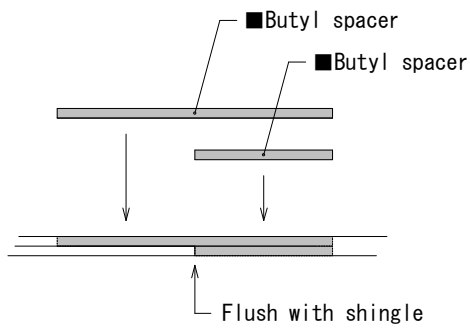
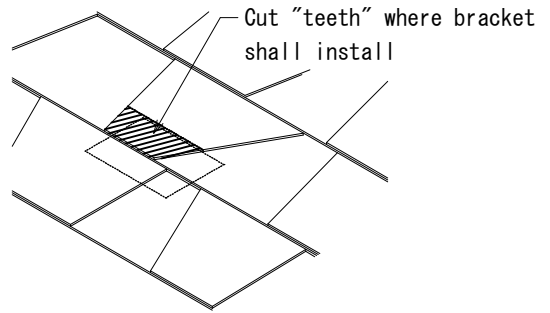
Attention

Peel off the protection paper from both sides of RT butyl tape.

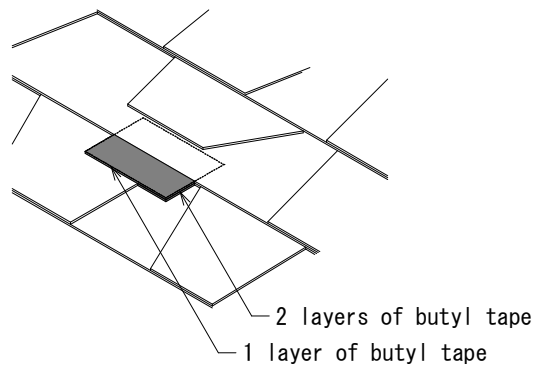
LANDSCAPE
BRACKET INSTALLATION

[Case 1]

- Use additional RT butyl tape to level it to the surface of the composite shingle roof.



Note: Do not splice the butyl tape.



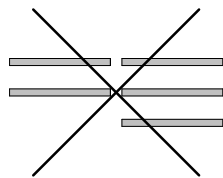
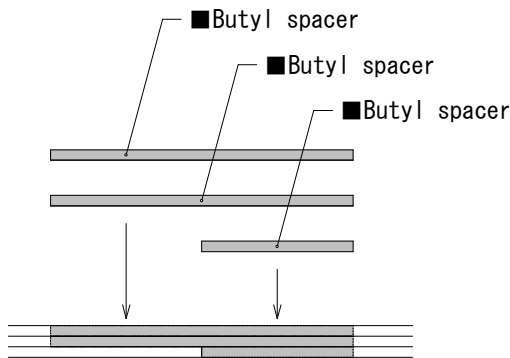
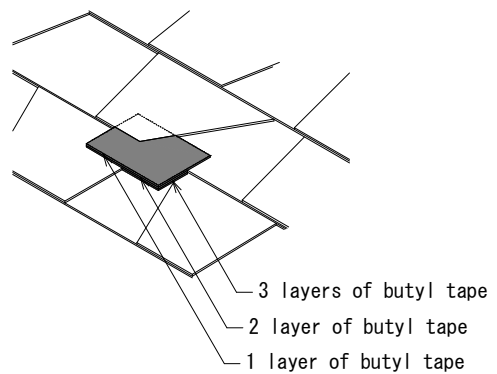
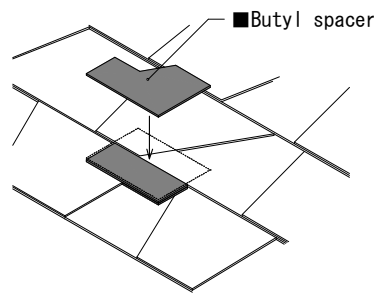
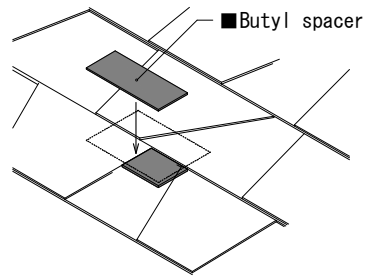
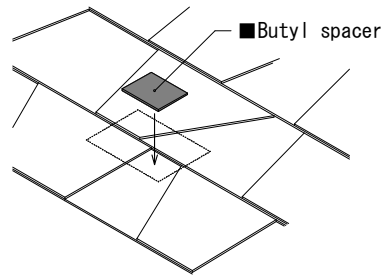
[Case 2]

- Build layers of RT butyl for the bracket to be mounted over the teeth region of composite shingle roofs.

A maximum of 4 layers are acceptable.

Layer 1 is already applied to the bottom of the bracket.

The following layers must be cut to shape to cover the surface of the bracket at each location, assuring a completely leveled surface.

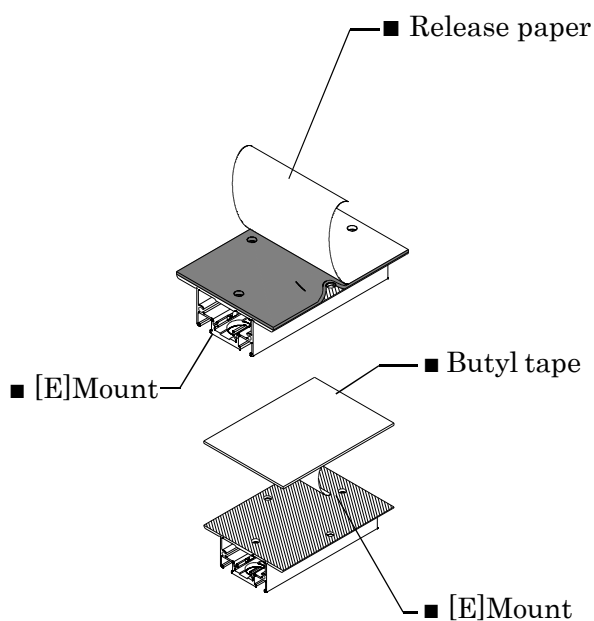


Note: Do not splice the butyl tape.

④ Be sure to inspect RT Butyl tape have paste in all underface of the brackets.

If have not paste all underface of brackets, use the new RT Butyl tape and repaste in all underface of brackets.

After completing process, peel off the protective paper from the RT butyl tape



Attention

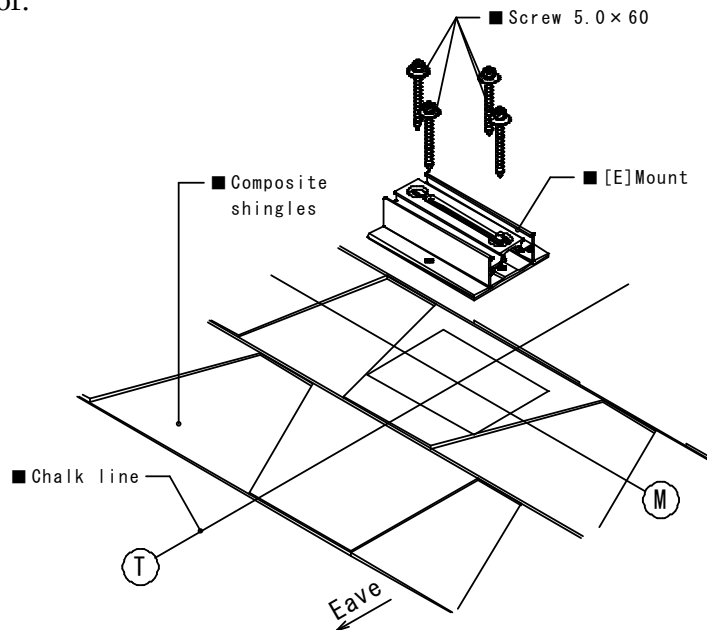
Do not leave any protective paper on the surface of the RT butyl tape, it can cause an improper seal and may allow water intrusion under the bracket.

⑤ Installing the bracket.

Place the brackets into position and make sure the RT butyl attaches well to the roofing surface.

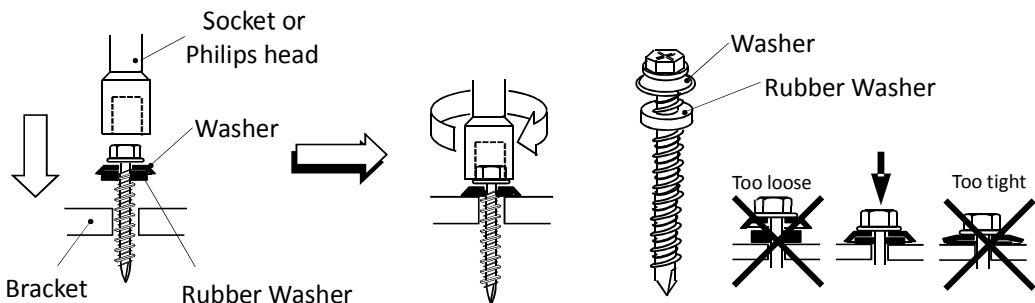
Set the bracket with 4 each 5.0×60 mm stainless wood screw using 8 mm×L110 mm socket.

After completing process, make sure the brackets are securely fit to the roof.



! Attention

Note: Proper torque values for the 5.0×60 mm screw will vary depending on the rafter and/or deck characteristics; hardness, age, and moisture of the wood. Tighten until the washer just stop rotating easily.



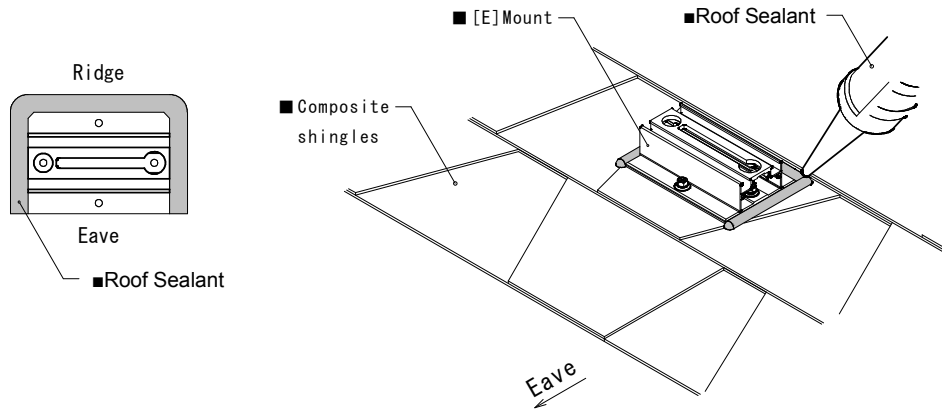
When tightening the screws please tighten all screws equally and avoid using an impact driver as it can over torque the screws or even snap off the head.

PORTRAIT
BRACKET INSTALLATION

- ⑥ Apply Roof Sealant around the brackets, the top and each side edge of the brackets.

Cover the exposed RT butyl tape with roof sealant.

Do not seal the bottom of the brackets.



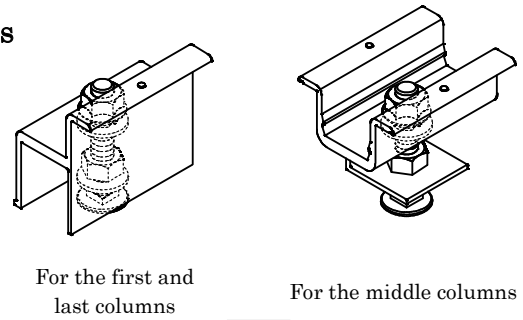
Attention

You may verify that screws come out from the deck panel together with butyl rubber, that indicates good flashing performance.

2. Installation of Panels

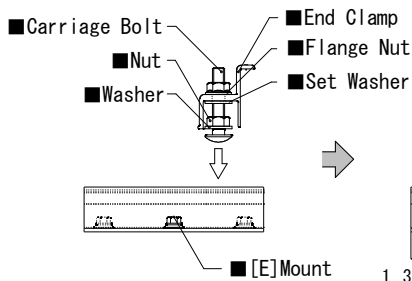
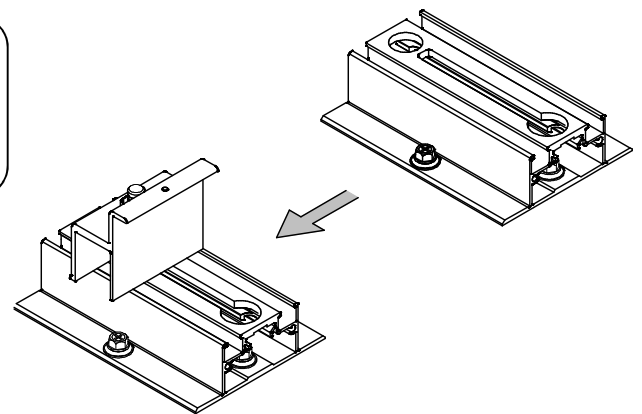
(1) Aligning and Leveling of the Brackets

- ① Insert the carriage bolt head into the T-slot of the bracket, then hand-tighten the lower M8 nut.

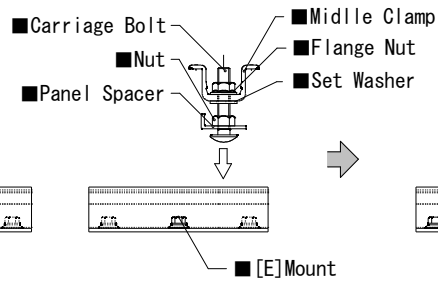


! Attention

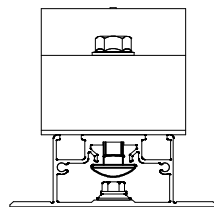
Be aware of the sharp tip of bonding pin at underside of the clamp flange.



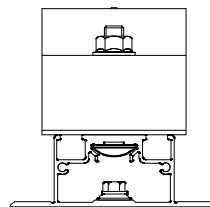
For the first and last columns



For the middle columns



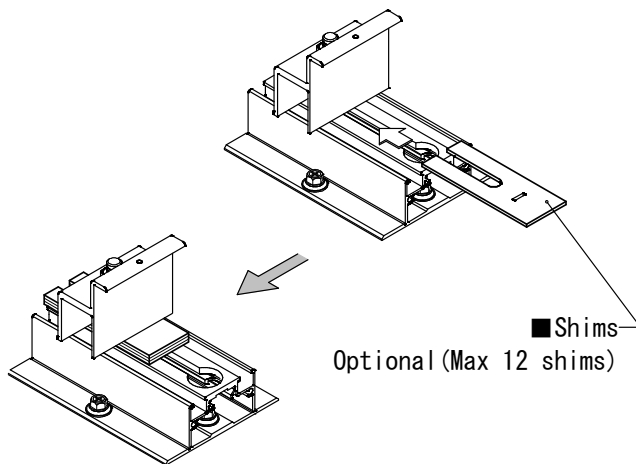
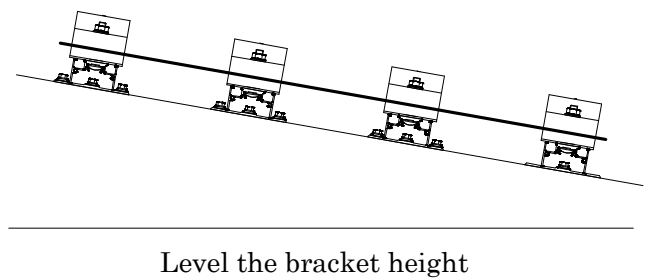
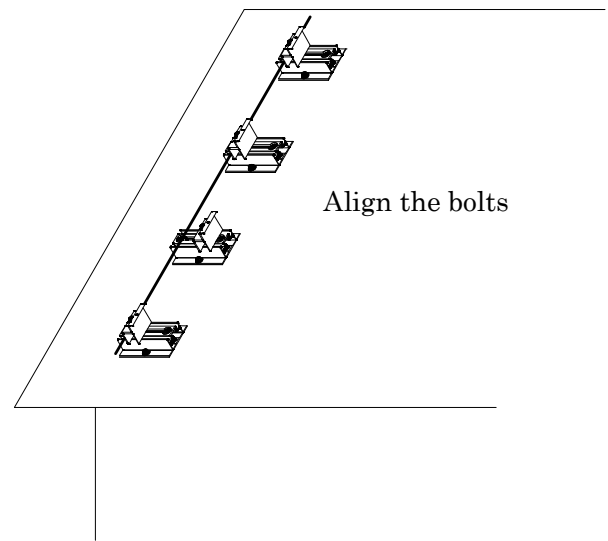
×



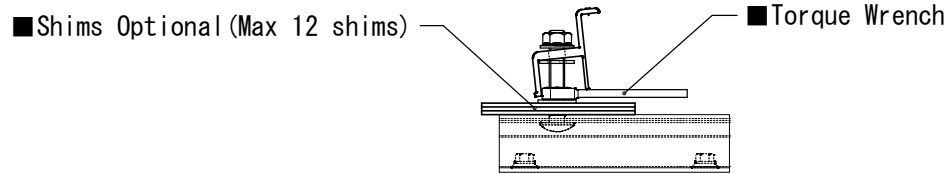
○

PORTRAIT
PANEL INSTALLATION

- ② Stretch a string line tight along the far left T line between the first and last brackets in the first column.
- ③ Align the carriage bolt positions of all the brackets in the column, using the string as a guide.
- ④ Next, level the height of the brackets using max of 12 shims.
- ⑤ If shims are to be used to level the brackets, insert the shims between the Washer/Panel spacer and E Mount/E Mount AIR.



- ⑥ Set the carriage bolt and lower M8 nut to torque 180 in-lbs (20 N·m).

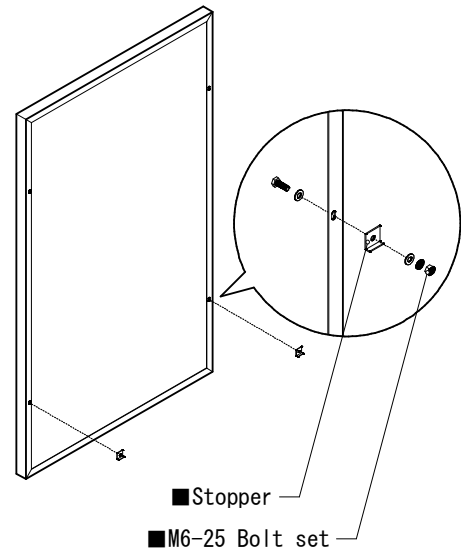
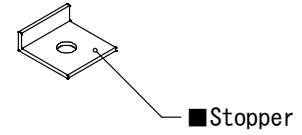
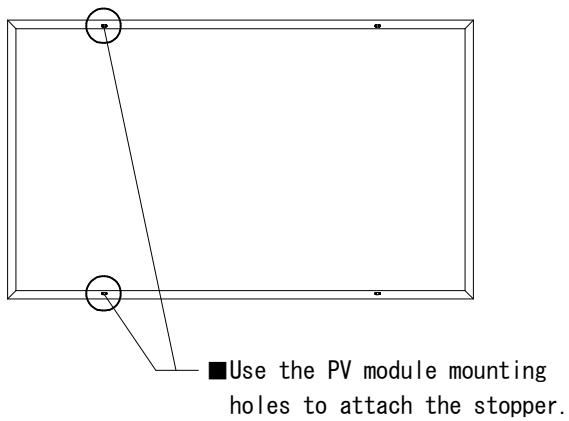


- ⑦ After aligning the first column vertically, follow the same aligning and leveling process horizontally on the first and last rows. Then align each remaining columns of the array (in any order).

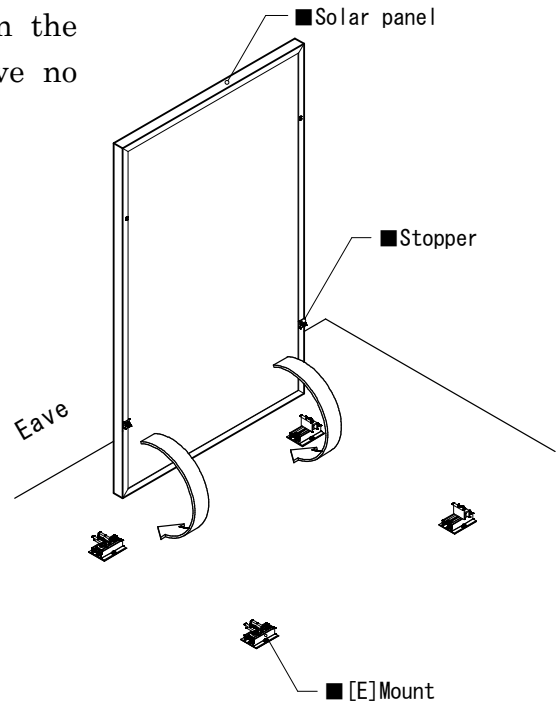
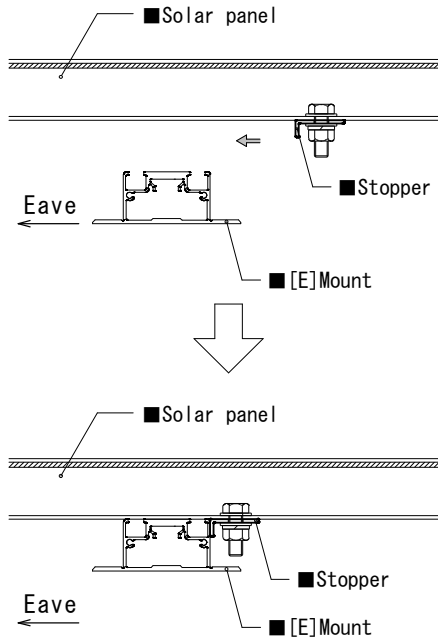
For the columns other than the first one, leave the lower M8 nuts hand-tightened.

(2) Installation of the First Column

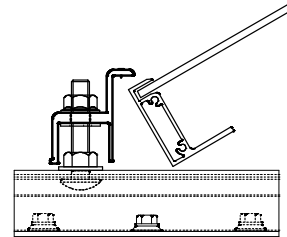
- ① Installation steps for the stopper
(The panel stopper allows the installer to quickly align the array up when the bottom brackets are perfectly lined up.)
Tighten the M8 bolt.



- ② The stopper is to be installed on the panels of the lowest row and have no other panels underneath it.

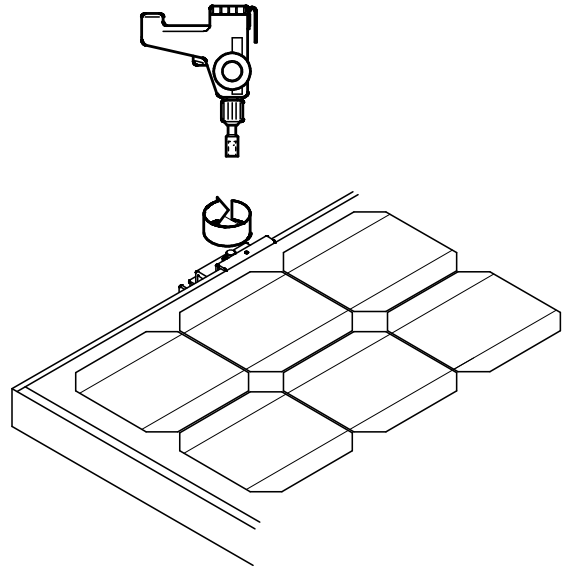


- ③ Place the PV panel on the bracket.



PORTRAIT
PANEL INSTALLATION

- ④ Make any adjustment and tighten the flange nut to 180 in-lbs (20 N·m).
- ⑤ Repeat ③ and ④ for all the first column panels.



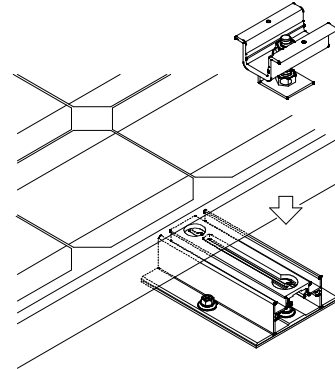
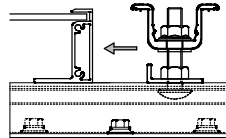
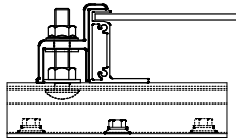
Technical Note:

Stainless hardware is soft and if dry torqued too quickly it may cause the nut and bolt to seize.

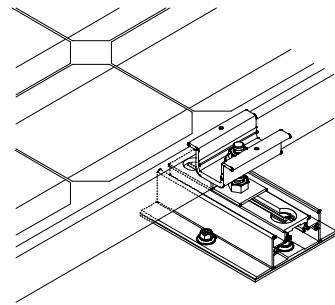
Roof Tech recommends all stainless steel threads should be lubricated before being assembled. This will make it easier to tighten nuts to bolts, avoid galling, and facilitate adjustments before the nut is properly torqued. Therefore, avoid tightening the nut with an impact driver.

(3) Middle Clamp Installation

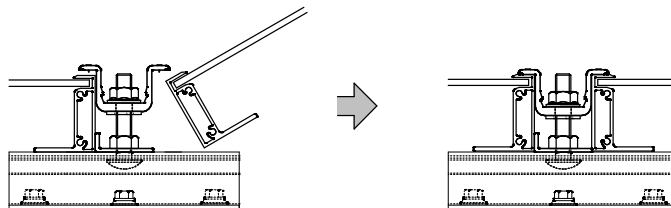
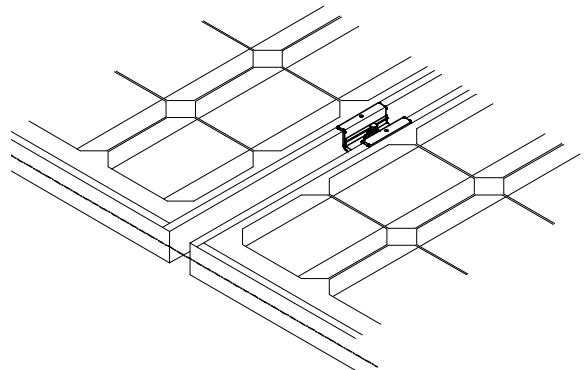
- ① Slide the panel spacer until it is flush to the frame of the panel already installed.



- ② If necessary, add or remove sims for leveling. Then tighten the Panel Spacer (lower M8 nut) to 180 in-lbs (20 N·m)

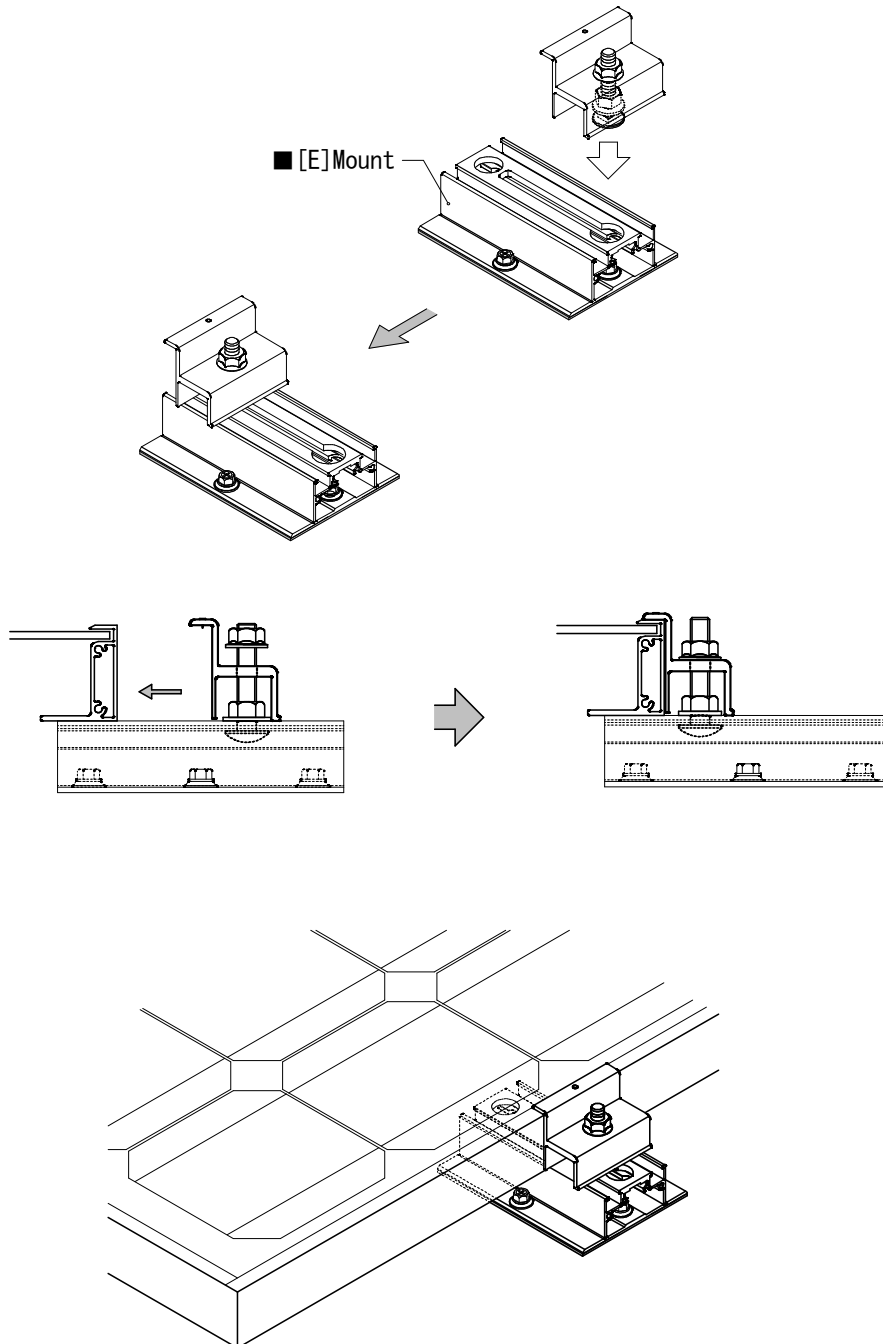


- ③ Set the next Panel in place and make any adjustment. Once the panel is at the correct and final position, set the flange M8 nut to 180 in-lbs (20 N·m) torque.



(4) End Clamp Installation

- ① Make the End Clamp to touch the PV Panel. Tighten the lower M8 nut, then the flange M8 nut to 180 in·lbs (20 N·m).



PART D Electrical Setup

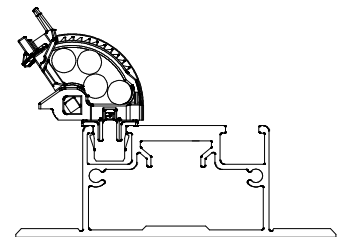
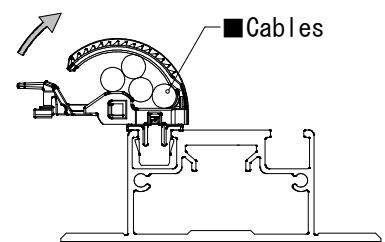
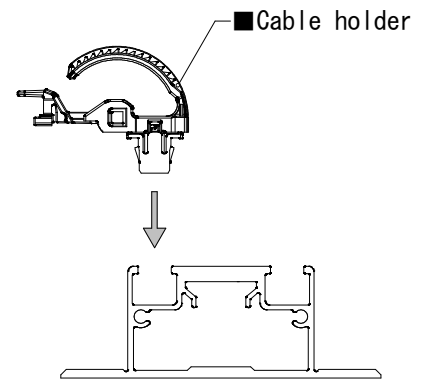
1. Cable Management Options

- ① Cable holder can fit into the brackets as it is shown in the picture.
- ② Place the cables into the holding area and close the clamp. You can hear a click when it is secured.

Note : If the cable holder need to be opened, simply pinch and pull by hand.
Also, it can be easily removed from the bracket simply slide it out.

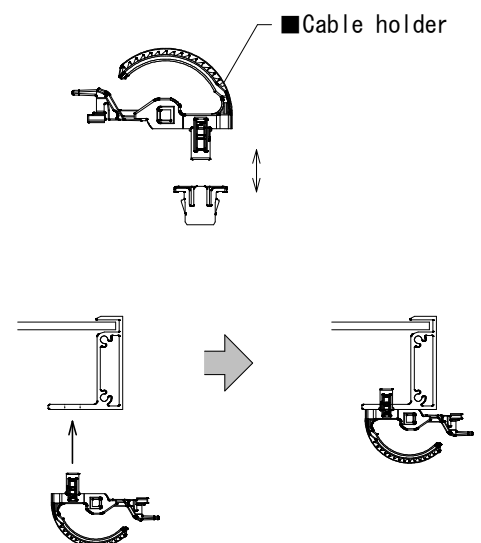
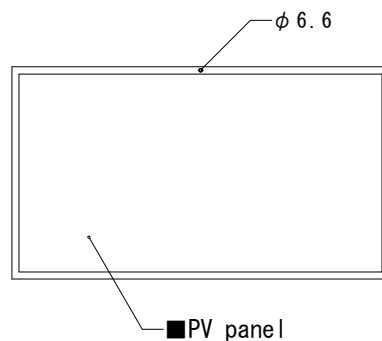
Note : Cable holder can hold 3 to 4 cables depend on the thickness of the cables.

AWG size	Number of Cables to be hosted
8, 10	2
12	3
14	4



2. Mounting on the Module Frame

- ① Cable holder can fit through a ϕ 6.6 mm hole on a panel frame. Cable holder can be separated at the bottom part (grommet).

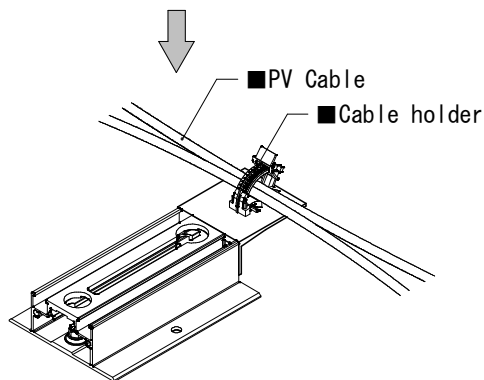
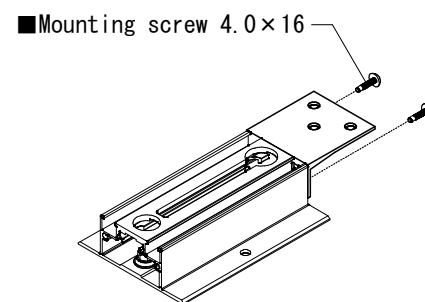
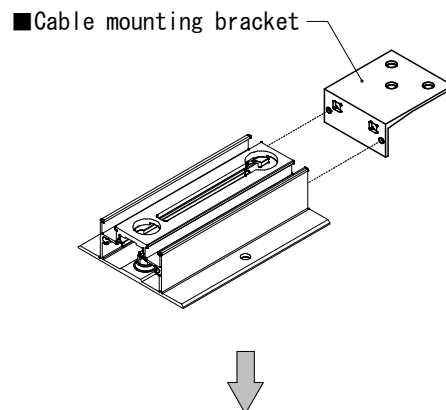
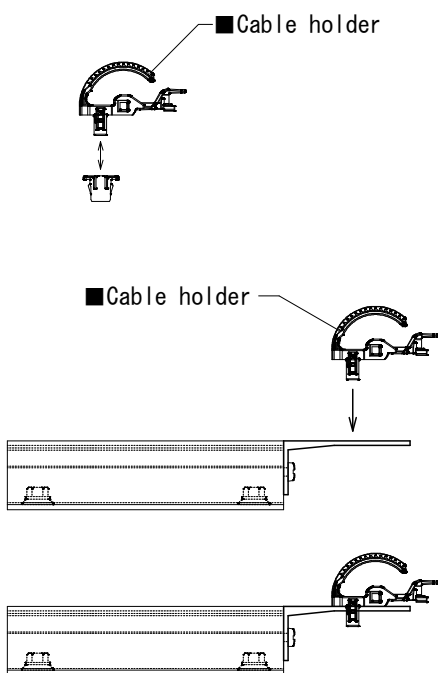
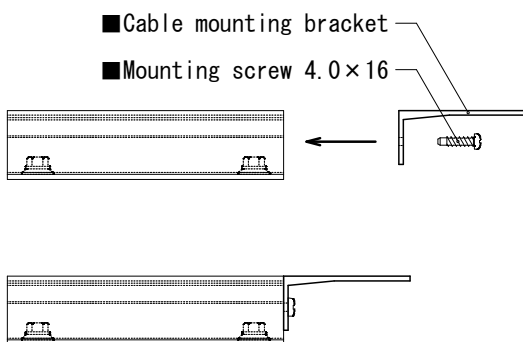
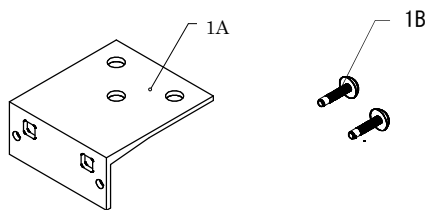


3. Cable Mounting Bracket (Optional)

Optional

① Cable mounting bracket

	Item
1A	Cable mounting bracket
1B	Mounting screw 4.0×16



Note: The Cable mounting bracket is electrically bonded to the RT-[E] Mount and E-Mount AIR base through the 4×16 mm mounting screws.

4. Grounding Setup

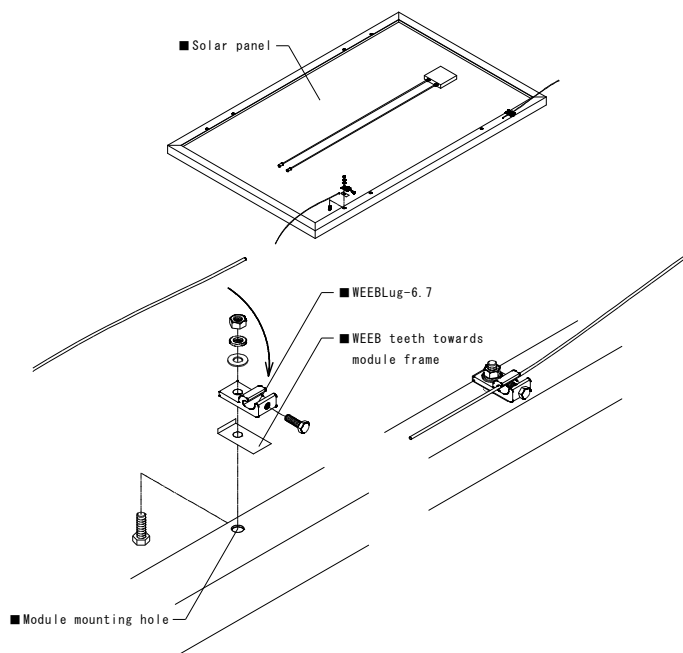
All electrical installation and procedures should be conducted by skilled, licensed and bonded electricians. Installer is responsible for and shall provide an appropriate method of direct-to-earth grounding in accordance with the latest edition of the Canadian Electrical Code Part 1, CSA 22.1 Safety Standard for Electrical Installations or the National Building Code, including NEC 250: Grounding and Bonding, and NEC 690: Solar Photovoltaic Systems.

Please refer to your local Building and Electrical Codes.

[E]Mount and E Mount AIR hardware are classified to UL 2703 and it is to be used with UL 1703 listed PV modules.

We recommend the use of either the Weeb-6.7 or Ilsco SGB-4 Grounding lug with a minimum 10 AWG solid copper grounding conductor. Alternate Grounding lugs shall be installed per PV manufacturers' instructions, using the hardware and/or requirements provided by the PV manufacturer.

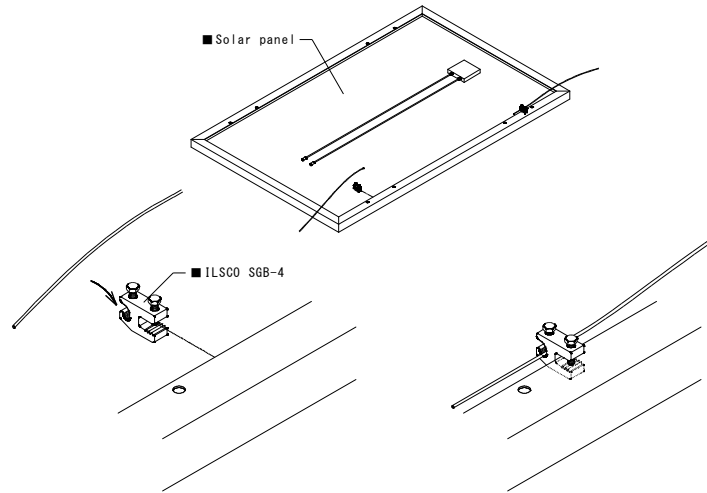
Example ①



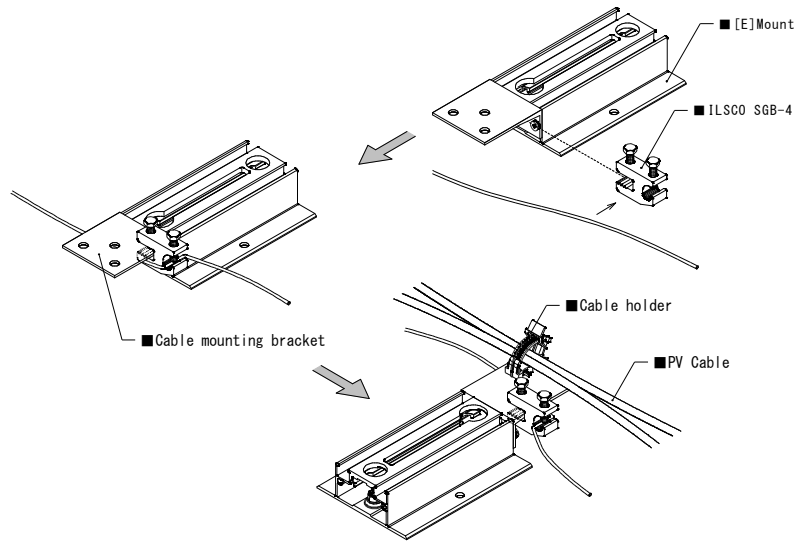
! Attention

When bare copper cable is employed, be careful to avoid direct contact between the cable and aluminum and/or galvanized steel

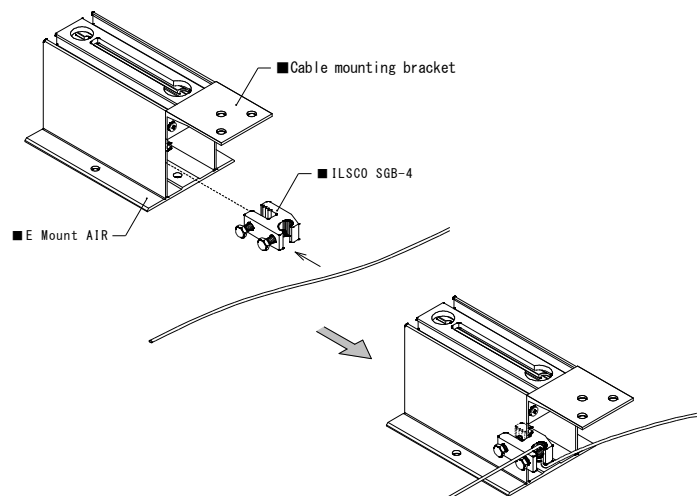
Example ②



Example ③

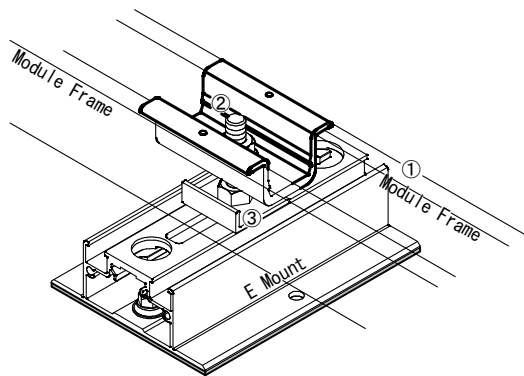


Example ④ (E Mount AIR only)



5. Bonding Path Diagrams

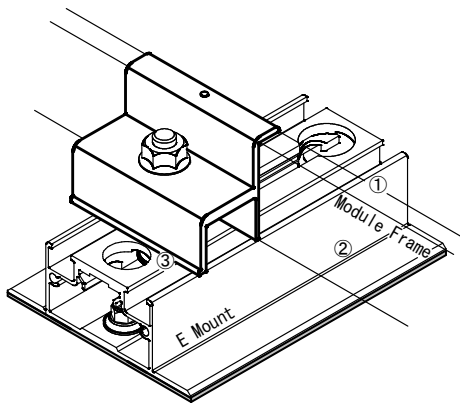
A: Bonding Middle Clamp



A

- ① Stainless steel Bonding Teeth integrated in the Middle Clamp pierce module frame anodization to bond module to module through clamp.
- ② Serrated flange nut bonds aluminum Middle Clamp to stainless steel Carriage Bolt, removing Clamp anodization.
- ③ Carriage Bolt seating surface contact with Mounting Bracket reverse surface to bond Bolt to Bracket.

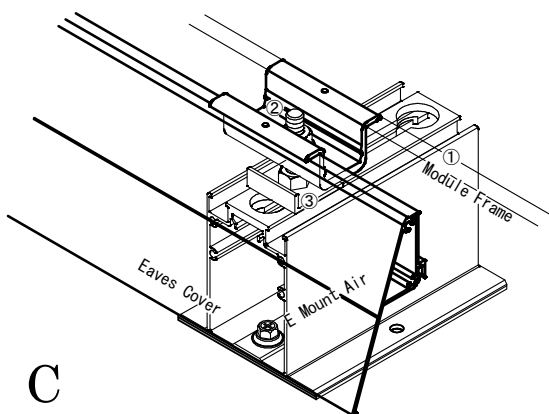
B: Bonding End Clamp



B

- ① Stainless steel Bonding Tooth integrated in the End Clamp pierce module frame anodization to bond module to clamp.
- ② Serrated flange nut bonds aluminum End Clamp to stainless steel Carriage Bolt, removing Clamp anodization.
- ③ Carriage Bolt seating surface contact with Mounting Bracket reverse surface to bond Bolt to Bracket.

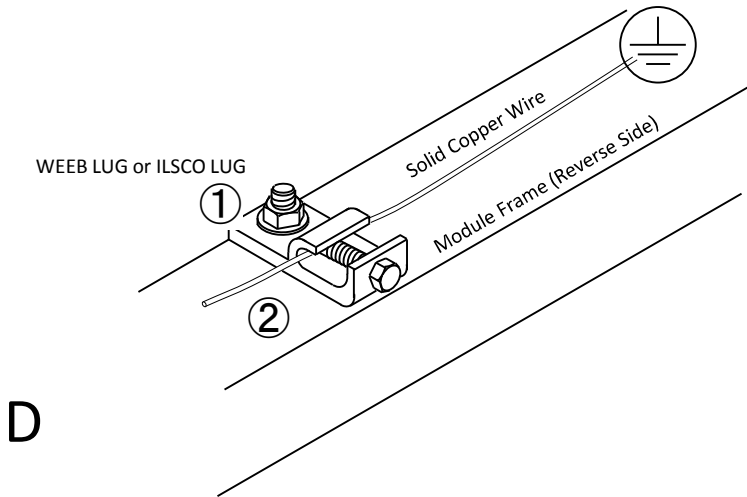
C: Eaves Cover



C

- ①&② Stainless steel Bonding Teeth integrated in the Middle Clamp pierce the anodization layer of the module frame and the Eaves Cover to bond frame to Eaves Cover.
- ② Serrated flange nut bonds aluminum Middle Clamp to stainless steel Carriage Bolt, removing Clamp anodization.
- ③ Carriage Bolt seating surface contact with Mounting Bracket reverse surface to bond Bolt to Bracket.

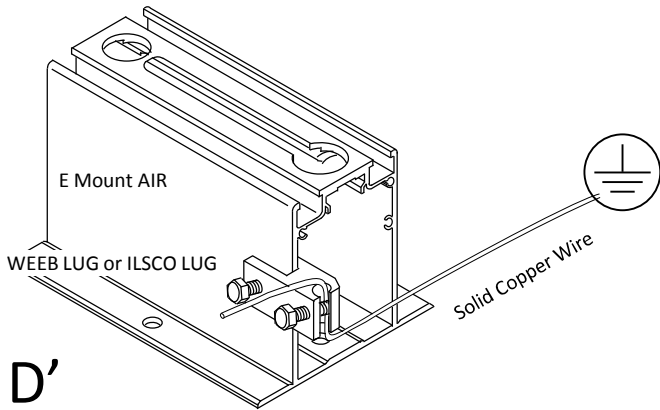
C: WEEB Lug or ILSCO Lug



- ① WEEB washer dimples or ILSCO Lug teeth pierce anodized module frame to bond frame to Lug.
- ② Solid copper wire connected to lug is routed to provide final system ground connection.

D

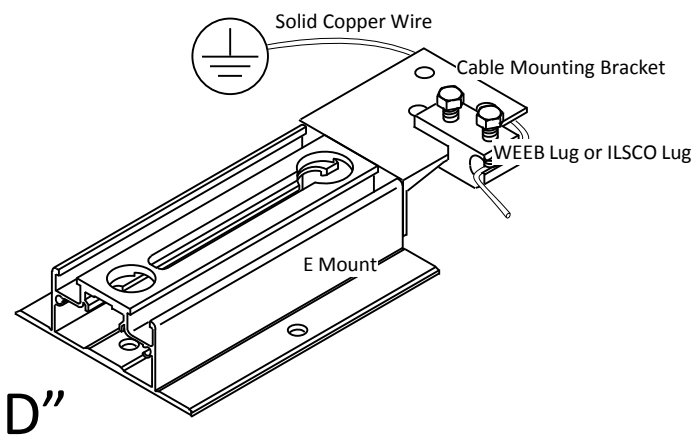
D': WEEB or ILSCO Lug attached to the AIR base



- ① WEEB washer dimples or ILSCO Lug teeth pierces the anodized E Mount AIR bracket to bond the bracket to Lug.
- ② Solid copper wire connected to Lug is routed to provide final system ground connection.

D'

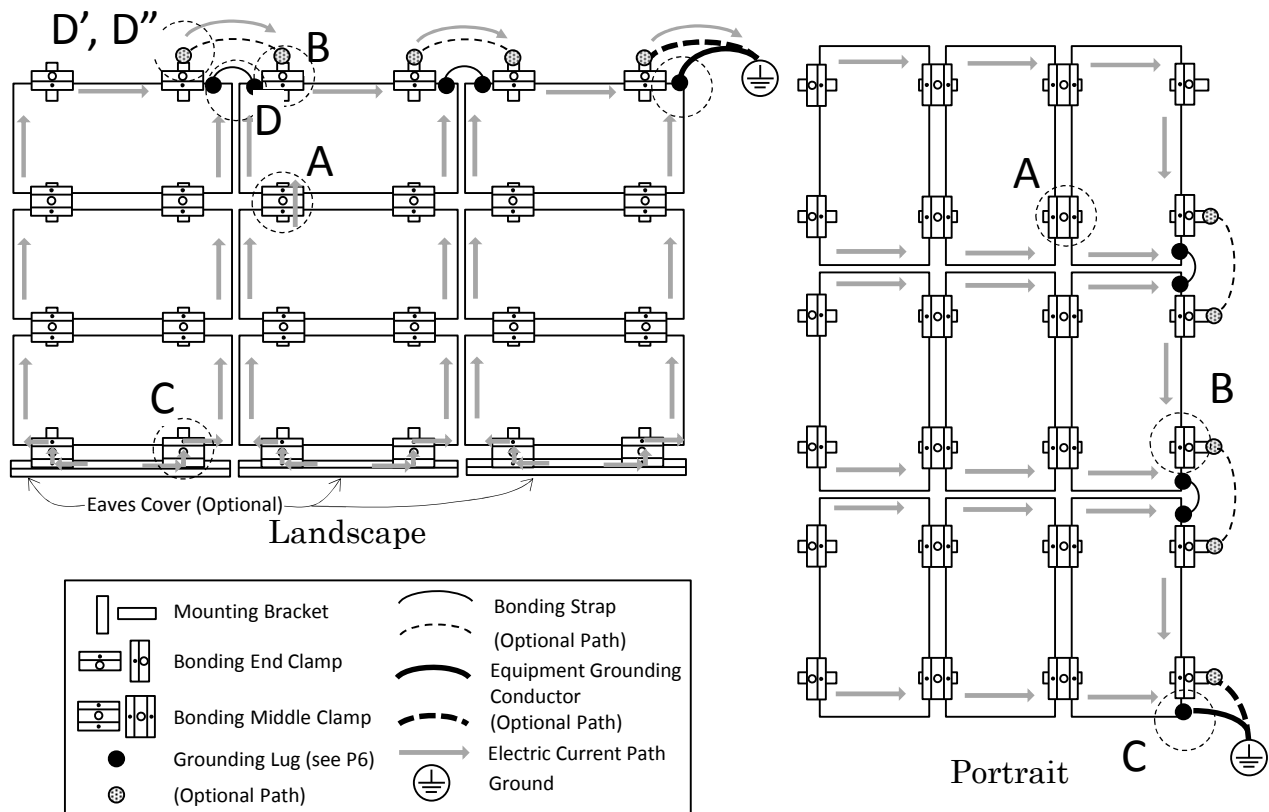
D'': WEEB or ILSCO Lug attached to the cable holding bracket



- ① WEEB washer dimples or ILSCO Lug teeth pierces the anodized cable holding bracket, which is bonded to E Mount through mounting screw, to bond the bracket to Lug.
- ② Solid copper wire connected to Lug is routed to provide final system ground connection.

D''

Example of Bonding Path



In order to properly ground the PV modules and the brackets to the equipment ground, a grounding lug or lay-in lug must be attached to the PV module or the E Mount base at the end of each row. Notice that the PV frame is part of the bonding path.

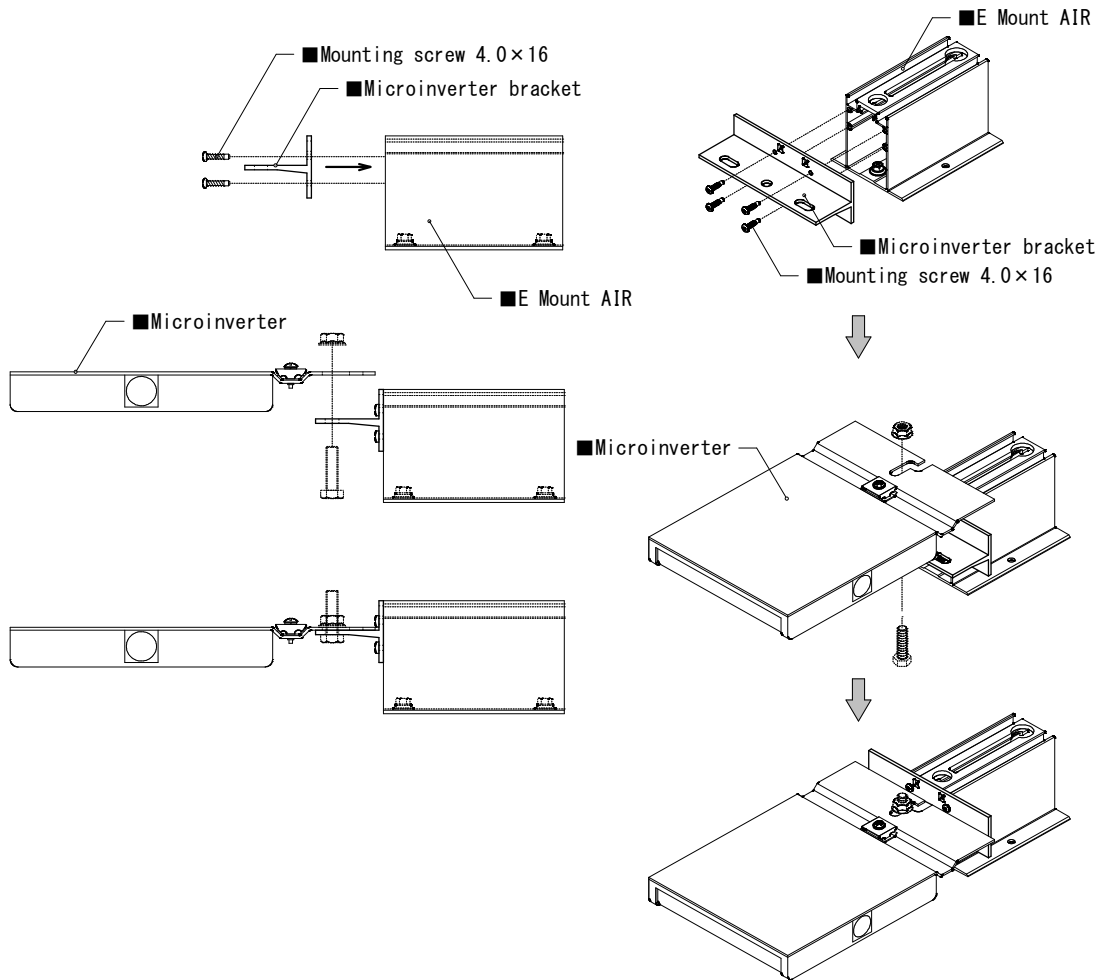
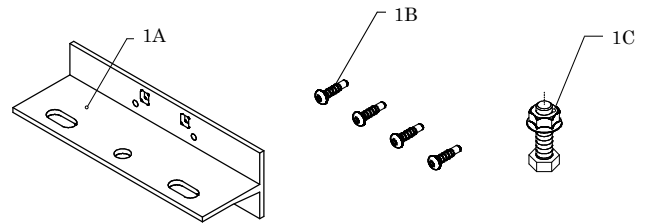
Note: Grounding, Bonding lugs and Straps are not provided by Roof Tech Inc.
(See page 7)

6. Micro-inverter Bracket (Optional, E Mount AIR only)

Optional

① Micro-inverter bracket

	Item
1A	Micro-inverter bracket
1B	Mounting screw 4.0×16
1C	M8 Bolt Set



Note: The Micro-inverter bracket is electrically bonded to the E-Mount AIR base through the 4×16 mm mounting screws.

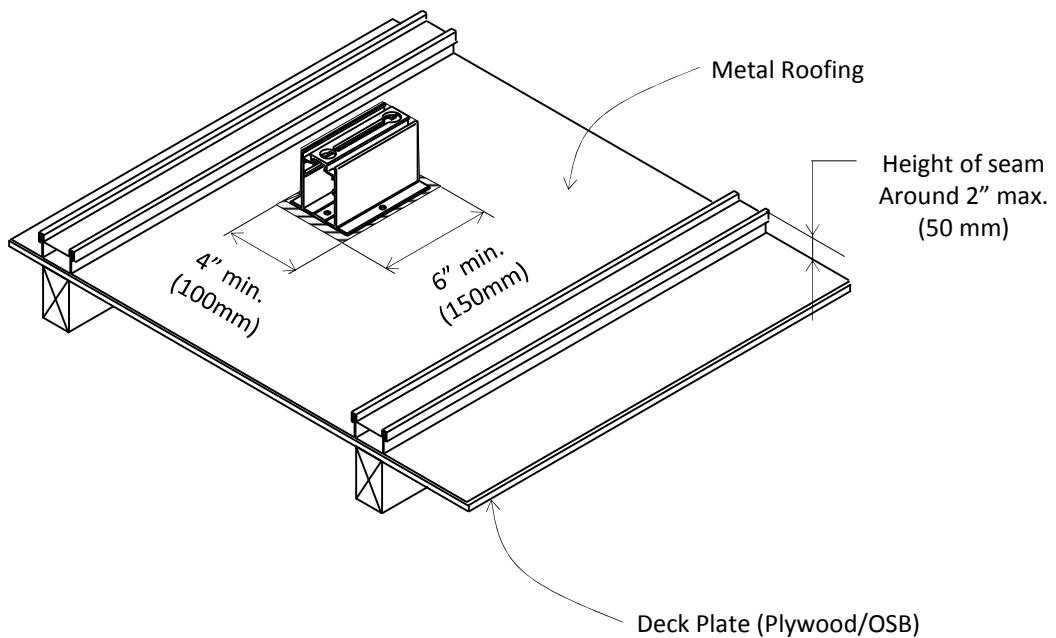
The M8 bolt set will bond a mill finish metal chassis to the Micro-inverter bracket once 106 in-lbs(12 Nm)torque is applied to the set.

ADDENDUM
Installation Instruction for Metal Roofing

Installation on a Metal Roofing

1. Requirement

- Applicable to maximum 20 gage metal decking.
- The roof should have sheathing (deck) board and the metal roofing should be flat and flush against the sheathing board at least 4" by 6" area at the bracket mounting location.



2. Marking on the Roof

(1) Landscape Layout

- ① For the first (lowest) row, mark at 13 mm from the intersection of the R/M Line and Y0 Line (Top of the first row bracket) on the R/M Line. Put another marking at 94 mm from the first marking.

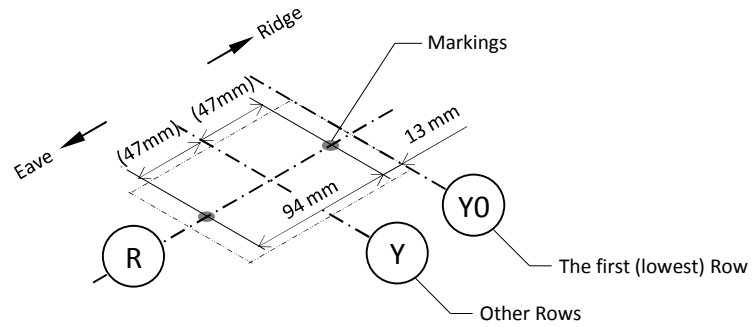
(See illustrations.)

- ② For the other rows, mark at ± 47 mm from the intersection of the R/M Line and Y Line.

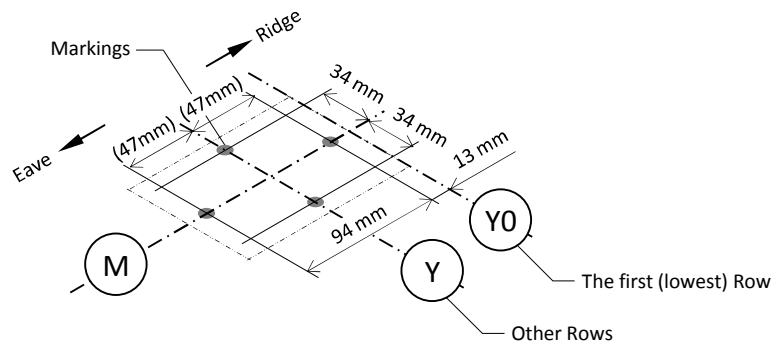
- ③ In case of Deck Installation, add two markings at ± 34 mm from the intersection of the R/M Line and Y Line on the Y Line.

(2) Portrait Layout (Deck only)

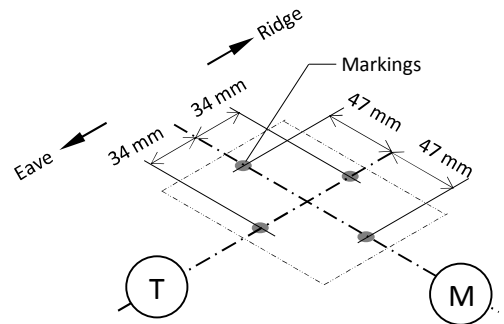
- ① Mark at ± 34 mm on the T Line and ± 47 mm on the M Line from the intersection of the T Line and M Line.



Rafter Installation (Landscape)



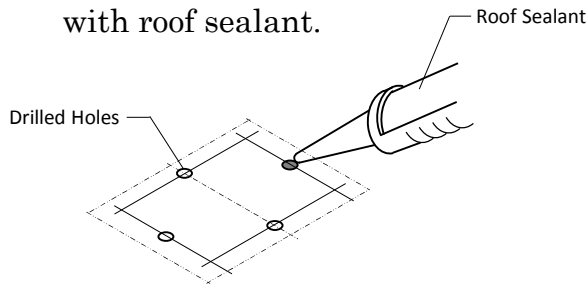
Deck Installation (Landscape)



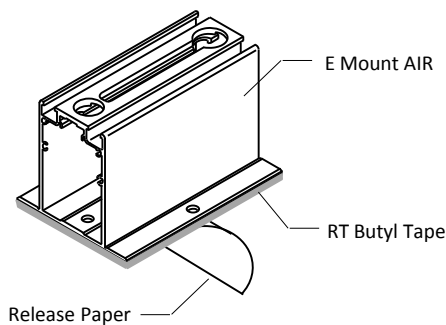
Deck Installation (Portrait)

3. Bracket Installation

- ① Drill the roofing metal sheet with a $\phi 1/8''$ ($\phi 3$ mm) drill bit at the markings.
- ② Clean up the drilled chips and fill the drilled hole with roof sealant.



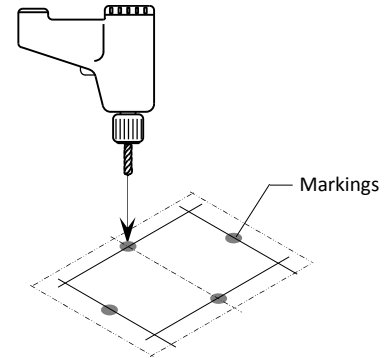
- ③ Peel off the release paper from the RT butyl tape.



- ④ Place the brackets at the specified location with RT butyl tape and make sure the RT butyl attaches well to the roofing surface.

Set the bracket with 2 ea. (for RAFTER), or 4 ea. (for Roof DECK), of 5.0×60 mm stainless wood screw using 8 mm×L110 mm socket.

After completing process, make sure the brackets are securely fixed.

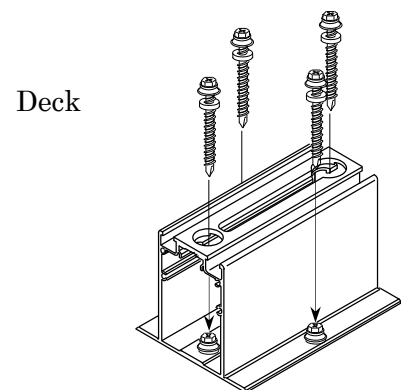
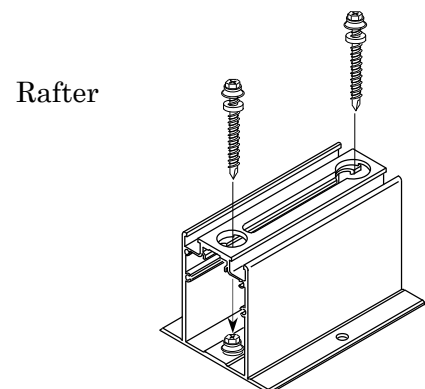


! Attention

Be careful to minimize the intrusion of the drill bit into the sheathing board.

! Attention

Do not leave any release paper on the surface of the RT butyl tape, it can cause an improper seal and may allow water intrusion under the bracket.



APPENDIX

List of PV Modules compatible with this racking system.

The Roof Tech RT-[E] Mount & E Mount AIR rail-less PV mounting system is certified to UL 2703 and may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. Unless otherwise noted, “xxx” refers to the module power rating and both black and silver frames are included in the certification. The following list of PV modules have been evaluated to UL 2703 Ed.1.

Manufacture	Model	P/N
AXITEC	AXI black	AC-xxxP/156-60S
	AXI black premium	AC-xxxM/156-60S
	AXI plus SE black	AC-xxxP/156-60S
	AXI power	AC-xxxP/156-60S
		AC-xxxP/156-72S
	AXI power Blk	AC-xxxP/156-60S
AXI premium	AC-xxxM/156-60S	
BOVIET	60 Cell Mono xxx-xxxW	BVM6610M
	60 Cell Poly xxx-xxx(4BB)	BVM6610P
	72 Cell Mono xxx-xxx(4BB)	BVM6612M
	72 Cell Poly xxx-xxx(4BB)	BVM6612P
CANADIAN	CS6K, Clear and Black	CS6K-xxx,P-SD,P,M,M-AB, CS6K-xxxP
	MaxPower	CS6X-xxxP
	Smart Module	CS6P-xxx-xxx P-SD
ET SOLAR	ET Elite Monocrystalline 60 cells	ET-M660xxxWB/WW/BB
	ET Elite Monocrystalline 72 cells	ET-M672xxxWB/WW
	ET Elite Polycrystalline 60 cells	ET-P660xxxWB/WW/BB
	ET Elite Polycrystalline 72 cells	ET-P672xxxWB/WW
GCL	GCL-M6/60	GCL-M6/60 285-300 Watt
	GCL-M6/72	GCL-M6/72 355-370 Watt
	GCL-P6/60	GCL-P6/60 275-290 Watt
	GCL-P6/72	GCL-P6/72 310-330 Watt
	GCL-P6/72H	GCL-P6/72H 325-350 Watt
Hanwha Q Cells	B.LINE PLUS BFR G4.1 (262-292)	B.LINE PLUS BFR G4.1 xxx
	B.LINE PLUS L G4.2 (310-347)	B.LINE PLUS L G4.2 xxx
	B.LINE PRO BFR G4.1 (247-277)	B.LINE PRO BFR G4.1 xxx
	B.LINE PRO L G4.1 (307-337)	B.LINE PRO L G4.1 xxx
	B.LINE PRO L G4.2 (307-337)	B.LINE PRO L G4.2 xxx
	Q.PLUS BFR G4.1 (270-280)	Q. PLUS BFR G4.1 xxx
	Q.PLUS G4 (270-280)	Q.PLUS G4 xxx
	Q.PLUS L G4.1 (330-340)	Q.PLUS L G4.1 xxx
	Q.PLUS L G4.2 (330-335)	Q.PLUS L G4.2 xxx
	Q.PRO BFR G4 (255-265)	Q.PRO BFR G4 xxx
	Q.PRO BFR G4.1 (260-270)	Q.PRO BFR G4.1 xxx
	Q.PRO BFR G4.3 (260-265)	Q.PRO BFR G4.3 xxx
	Q.PRO L G4 (310-320)	Q.PRO L G4 xxx
	Q.PRO L G4.1 (310-320)	Q.PRO L G4.1 xxx
Q.PRO L G4.2 (310-320)	Q.PRO L G4.2 xxx	
HELIENE	Heliene 60P	60P
Hyundai	RG Series	HIS-MxxxRG
		HIS-SxxxRG
	RI Series	HIS-MxxxRI
		HIS-SxxxRI

APPENDIX

Manufacture	Model	P/N
Itek Energy	SE 60 Cell Module	295-315 SE (in the increment of 5 watts)
	SE 72 Cell Module	350-370 SE (in the increment of 5 watts)
Japan Solar	JPS285/290M-60	JPS285/290M-60
	JS-260U-RJ160	JS-xxxU-RJ160
	JS-280M-TC160	JS-xxxM-TC160
	Mono PV Module	JS-xxxM-LI60
		JS-xxxM-LI72
	Poly PV Module	JS-xxxU-LI60
JS-xxxU-LI72		
Jinko Solar	Eagle JKM275PP-60	JKMxxxPP-60
	Eagle JKM280PP-60-J4	JKMxxxPP-J4
	Eagle JKM330PP-72	JKMxxxPP-72
	Eagle PERC 280-300	JKMxxxM
	Smart MX 255-320	JKMSxxxP
Kyocera	KD 200-60 F Series	KD 260GX-LFB2, KD265GX-LFB2
	KU-60 1000V	KU265-6MCA
LG	LG Mono X Neon 72 cell	LGxxxN2W-B3, LGxxxN2W-G4
	LG Mono X Plus 60 cell	LGxxxS1C-G4
	LG Neon 2 60 cell	LGxxxN1C-G4, LGxxxS1C-L4, LGxxxS2W-G4
	LG Neon 2 Blk 60 cell	LGxxxN1K-G4
Longi	LR6-60PH	LR6-60PH 290-310M
	LR6-72HV	LR6-72HV 330-350M
	LR6-72PH	LR6-72PH 360-380M
MITSUBISHI	MJE SERIES DIAMOND PRO	PV-MJExxxFB
		PV-MJExxxFB-B
	MLE SERIES DIAMOND PREMI	PV-MLExxxHD2
PANASONIC	N240	VBHN240SA11
	N325	VBHN325SA16 and 16B
	N330	VBHN330SA16 and 16B
PEIMAR	Commercial Line	SG325/330P
	Full Black Line	SG290/300M (FB)
	High Efficiency Line	SG300/310M (FB)
	High-Power Line	SG360M
	Residential Line	SG270/280P
PHONO SOLAR	Poly/Mono Onyx/Diamond	PS-xxx-60
		PS-xxx-72
REC	REC Peak Energy BLK2 Series	REC2xxPEBLK2
	REC Peak Energy Series	REC2xxPE
	REC TwinPeak Series	REC2xxTP
Seraphim	SRP-6MA	SRP-6MA 340-360W
	SRP-6MB-BB	SRP-6MB-BB 290-310W
	SRP-6PA	SRP-6PA 315-330W
SilFab	Polycrystalline	SLA-P xxx
		SLG-P xxx
	Silfab Monocrystalline	SLA-M xxx
		SLG-M xxx
	Smart Modules Monocrystalline	SSA-M
		SSG-M
	Smart Modules Polycrystalline	SSA-P xxx
		SSG-P xxx
Ultra-High-Efficiency	SLA-X	
	SLG-X	

APPENDIX

Manufacture	Model	P/N
Solaria	Solaria Power XT	XT-325R-BX
		XT-330R-PX
		XT-345R-BD
		XT-350R-PD
SolarWorld	sunmodule pro-series	SW xxx POLY (33mm black frame)
	sunmodule protect	SW 275-280 MONO BLACK (33mm frame)
	sunmodule xl mono	SW xxx-xxx XL MONO (33mm frame)
	sunmodule-plus-mono	SW xxx-xxx MONO (33mm frame)
	sunmodule-plus-mono-5-buster	SW xxx-xxx MONO (33mm frame, 5 buster)
	sunmodule-plus-mono-black	SW xxx-xxx MONO BLACK (33mm frame)
Sonali	SS 230 to 265 Series	SS 230 - 265
SUNIVA	Optimus Series	OPT xxx-60-4-100
		OPT xxx-60-4-1B0
		OPT xxx-72-4-100
TRINA SOLAR	Allmax Module	TSM-PD05, TSM-PD05.05, TSM-PD05.08, TSM-PE05A, TSM-PE05A.08
	Honey M Plus Module	TSM-DD05A(II), TSM-DD05A.05(II), TSM-DD05A.08(II)
	Tallmax M Plus Module	TSM-DD14A(II), TSM-DD14A.05(II), TSM-DD14A.08(II), TSM-PD14.002
	Tallmax Module	TSM-PD14, TSM-PE14A, TSM-PE14A.08
	TrinaPeak Mudule	TSM-PD05.08C, TSM-PD05.08D
	Trinasmart Module	TSM-DD05A.052(II), TSM-DD05A.082(II), TSM-PD05.052, TSM-PD05.082
	Trinaswitch Module	TSM-DD05A.08S(II), TSM-DD05A.05S(II), TSM-PD05.08S
Winaico	WSP-M6 Mono	WSP-xxxM6 PERC
	WSP-M6 Mono Triple Black	WSP-xxxM6
	WST-P6 Poly	WST-xxxP6BF, WST-xxxP6SF
Yingli	YGE 60 cell series	YL xxxP-29b
	YGE 72 cell series	YL xxxP-35b
	YLM 60 cell 40mm Series	YLxxxD-30b(xxx=Pmax)
	YLM 72 cell 40mm Series	YLxxxD-36b(xxx=Pmax)

NOTE

Customer Support

If you need assistance at any point of your installation or have suggestions on how can we improve your experience, call Roof-Tech customer support.

(619) 551-7029

<http://roof-tech.us/>

