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# The Australian Solar Mounting Systems Guide

The resource for Australian solar professionals looking to purchase a solar mounting system

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# Introduction

A solar mounting system – either rooftop or ground-mounted – is an integral feature of any solar installation, particularly for photovoltaic (PV) projects.

Produced by the publishers of **EcoGeneration** – the premier magazine for Australia’s clean energy industry – The Australian Solar Mounting Systems Guide answers the important questions every solar system designer and installer needs to ask before buying a mounting system.

This guide also outlines common mistakes made in relation to mounting systems, and how to avoid them while purchasing the highest-quality products best-suited to your projects.

Click on hyperlinked text and imagery to access extra information online, and to find Australian solar mounting experts who can help ensure your installations have the strongest start possible.



*Image courtesy of SunLock.*

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# Solar mounting systems: the key points

The right solar mounting system, if installed correctly, will provide the structural support a solar system needs, in order to protect it from wind-induced failure and other potential weather hazards. A mounting system can also set the orientation and elevation of a solar system, in order to maximise its energy performance.

Mounting systems can be designed to sit on a separate sub-frame or tilt legs to provide the ideal inclination for a given location.

Usually made from stainless steel or aluminium, most mounting systems are designed for universal application, and can come in a variety of styles including tilt frame, flat roof-mounted or ground-mounted.

They can be customised to meet the size and specifications of a PV installation, as well as the style of roof or installation.

A good mounting system should be easy to install, made from quality, rust-free materials – or materials with sufficient corrosion protection (such as galvanised steel) – and should effectively protect a system's cables.

## SYSTEM TIP:

The mounting system is the base of the solar system – a good base ensures the efficiency of your overall system, and a return on investment.



*Image courtesy of SunLock.*

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## How to check that a mounting system is safe to use

One of the first things to check with a mounting system supplier is that the supplier will provide a structural certificate for its product to your customer (these certificates demonstrate that a mounting system will help prevent damage to a solar installation and safeguard it in the event of a wind-induced failure) – and that the product is accredited to the latest wind code, Australian Standard (AS) 1170.2. At a minimum, installation documents provided by a mounting system supplier will cover certain limits and parameters, and set out the maximum fixing centres and other specifics for a job; these should be carefully followed to ensure obligations are met.

Other project and product parameters to check include:

### ✓ Location

This determines the basic wind speed for the installation. If the site is within 100 km of the coast in Queensland, the Northern Territory or Western Australia, the chances are that it will be in an elevated wind zone. Some mounting systems exclude cyclone regions or other wind zones.

### ✓ Building height

All solar panel mounting systems will have a limit of building height – typically 10 m, but sometimes 20 m. For example, Australian company SunLock supplies a ‘one size fits most’ set of drawings in its installation manual, but can provide extra certification for any building height, panel size or purlin/batten material or thickness.

### ✓ Panel size

Always check the maximum panel size the solar mounting system is rated to.

### ✓ Roof zones

Some wind-induced failures can be due to panels installed too close to the edge or ridge of the roof.

### ✓ Roof frame and fixing specification

The roof frame material, thickness and type of roof screw must be assessed.

### ✓ Testing results

Suppliers of quality framing systems invest in testing for their products. For example, cyclonic regions are exposed to low-high-low (LHL) cyclic loading, where the modules, frame and fixings are exposed to rapidly oscillating up-and-down forces. Centres such as the Cyclone Testing Station at James Cook University conduct LHL testing, and a range of Australian and international testing centres and firms can certify mounting products.

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### How to optimise solar system tilt

Crystalline solar PV panels produce the most power when they are pointed directly at the sun. In Australia, solar modules should face north for maximum electricity production. The orientation of the panels will often have a greater effect on annual energy production than the angle they are tilted at.

The current feed-in tariff structures in Australia result in east-west-facing systems generating an optimal return on investment, especially if the property utilising solar feed-in tariffs has low electricity usage in the middle of the day.

The Clean Energy Council's (CEC) solar guidelines for residential PV recommend a minimum tilt of 10° to ensure self-cleaning by rainfall; and for grid-connected PV systems, CEC recommends positioning panels at the angle of latitude to maximise the amount of energy produced annually.

The best return on investment will be generated for the solar project owner if the system is designed based on the electricity usage pattern of the property on which the project is installed.

Most Australian homes have a roof pitch of 20 – 30°, according to the CEC's guidelines; if a roof slope is not ideal, a mounting frame can correct the orientation and elevation of panels. On flat-roof buildings (particularly commercial installations), panel arrays are usually installed on racks at an angle of 15–30°. Some companies typically only install at 15°; this allows for more modules to be placed on a roof, with less wind loads, lower cost, and the same yield. Yield is surprisingly insensitive to inclination.

The installation site, roof material, roof angle, the size and quantity of solar panels and the number of module rows used will determine the dimensions, quantity and layout of framing components required for installation.

Keep in mind that a lower tilt can allow you to fit more panels on the same roof, and also that tilts generate shadows - make sure there's sufficient space between the rows in a solar installation.

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### Tips for ground-mounted systems

Ground-mounted systems are often used for medium- to large-scale solar systems, are occasionally used in smaller systems – such as off-grid projects, or projects where roof space is not suitable.

There are three types of ground-mounted systems:

- Rammed-post (mainly for large-scale projects, as they don't require foundations)
- Foundation-based (for almost all applications)
- Post-mounted (used most often for smaller systems).

All ground-mounted solar systems have to comply with AS 1170.2.

### Tips for ballasted systems

Ballasted systems are mainly deployed on flat concrete roofs. They are suited for this context as they involve no penetration of roof material.

They are designed with a small tilt angle (10° or 15°) with panels in landscape format to limit the wind loading on the array.

Concrete blocks hold the system down, and the amount of weight has to be calculated according to AS 1170.2. Allowable extra 'dead load' for the roof has to be checked as well.

In Australia, due to high wind loads, these systems are limited to Wind Region A.

An example of a ballasted project is the system installed on the roof of the Federal Parliament House in Canberra, which used the SolarMatrix Pro mounting product.



*Image courtesy of SunLock.*

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### How wind region effects mounting system choice

The Building Code of Australia (BCA) and AS 1170.2 provide guidelines for construction within the different wind regions of Australia:

Region A – normal wind speeds

Region B – intermediate wind speeds

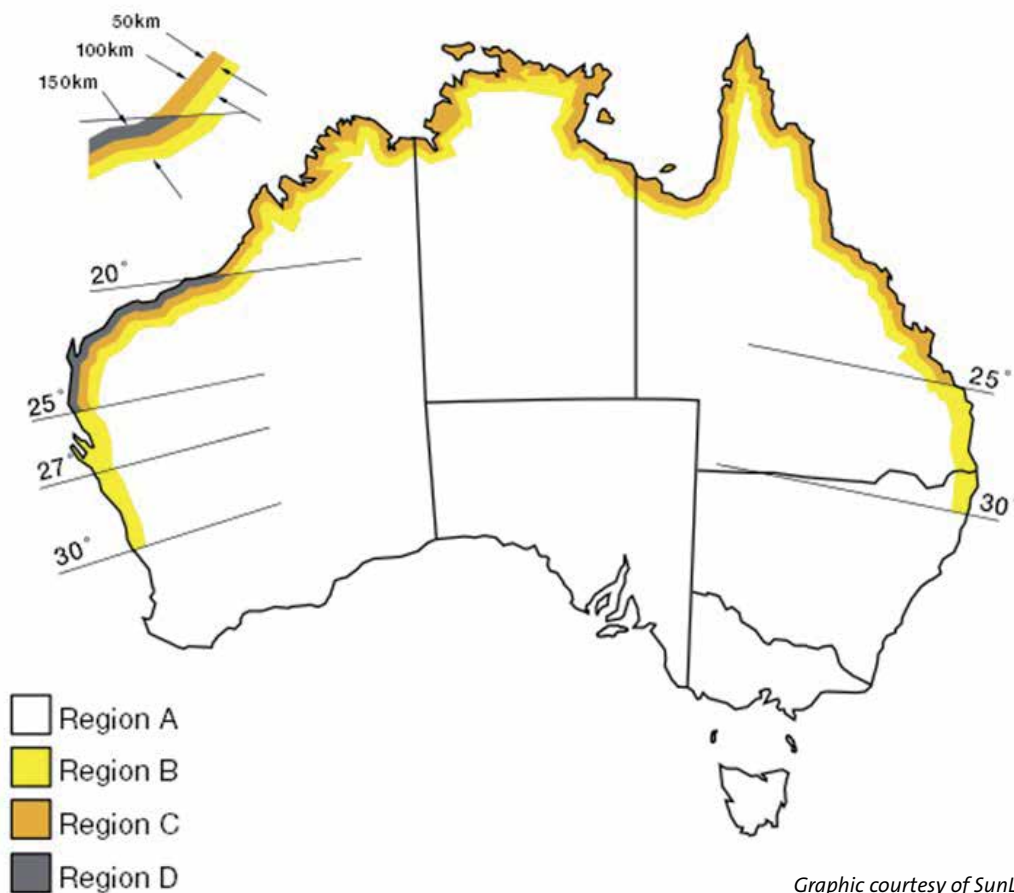
Region C – tropical cyclones

Region D – severe tropical cyclones.

The BCA states that in all wind areas, a structure must have sufficient strength to transfer wind forces to the ground with an adequate safety margin to prevent:

- The collapse of the structure
- The structure being lifted off its foundations
- The structure being slid off its foundations.

### Wind regions of Australia (in accordance with AS 1170.2)



Graphic courtesy of SunLock.

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Read more about the Australian Standards relevant to wind conditions on page 10.



# Misconceptions about mounting systems busted



## All mounting systems are the same

There are differences between mounting systems, particularly when it comes to quality and service. Individual product providers offer different features and benefits in their systems. In purchasing a mounting system product, you generally receive higher quality for a higher price.



## You only need a few roof screws to hold a mounting frame to a roof

You need a lot of roof screws for roof-mounted systems to withstand high winds – especially when installing onto thin metal or timber battens. Like buildings, solar framing needs to be designed for major storm events.

The expected lifetime of a building will affect the interval of a weather event – some mounting systems will be designed for a once-in-100-year event, while others will be designed for once-in-500-year events. Just because it looks strong enough, it doesn't mean that it will be.

Always check the installation manual for a product, for details about the fasteners it requires.



## If a mounting system has an engineering certificate, then I can use it

The suitability of a mounting system for your project will depend on the specific details of the engineering certificate, not just the fact that the certificate exists.



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### SYSTEM TIP:

The quality of an installation manual for a mounting system product is a good indicator of the quality of the product. High-quality, reliable product manufacturers and distributors will provide detailed manuals on their websites to guide you through system design and installation.

# The importance of industry standards for mounting systems



Adherence to Australian standards is not only a benefit, it's also a requirement. The mounting system is part of the solar system, but it is also part of a building in the case of roof-mounted projects. If the mounting system you install doesn't comply with relevant standards, you run the risk of losing the system and your investment, and this can result in third-party damages.

A mounting system complies with a standard only if it is installed according to the product's installation guide and/or accreditation letter. If that is the case, you can sign off on the documents for a PV system knowing that the system is safe. It is important to comply with **CEC guidelines** and provide a maintenance plan when installing mounting systems according to Australian Standards. It is also important to pay attention to the specifics – such as fasteners to be used, applicable panel sizes, etc. – of the accreditation letter.

## RELEVANT AUSTRALIAN STANDARDS FOR THE DESIGN AND INSTALLATION OF SOLAR PV SYSTEMS:

- AS 4509 Stand-alone power systems
- AS 4086 Secondary batteries for stand-alone power systems
- AS 5033 Installation of PV arrays
- AS 3000 Electrical wiring rules
- AS 1768 Lightning protection
- AS 1170.2 Wind loads
- AS 1664.1 Aluminium structures
- AS 4600 Cold-formed steel structures
- AS4777 Grid connections of energy systems via inverters.

If you're a CEC-accredited installer, you must have and use a copy of each of these standards – they can be purchased from Standards Australia.

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### Wind loading

One of the key benefits of buying a mounting system that adheres to AS 1170.2 for wind loading is confidence that you won't have to revisit a bunch of jobs on the day after a storm event. Mounting products must meet this standard in order to comply with CEC guidelines.

### Installation of PV arrays

CEC guidelines state that it is the responsibility of all accredited installers to advise the owner of a system if it does not comply with the current standards; this could be as a result of weathering, damage or an upgrade to the standards themselves. Therefore, it's important that the mounting system you purchase adheres to both AS 1170.2 and other relevant standards.

### Making standards stronger

There has been a strengthening of the standards applicable to PV array installations since a new version of AS 5033 was released in July 2012, including the following changes relevant to mounting systems:

- PV module and mounting frame earth connections are to be a purpose-made fitting, providing earthing or bonding connections or purpose-made penetrating washers or equivalent between the PV modules and mounting frame for the connection of dissimilar metals purpose-made fittings are installed to manufacturer's instructions
- Cable lugs, earthing termination and bonding cables are to be fixed by stainless steel bolts, washers and penetrating washers to aluminium frames
- Earthing or bonding connections must be arranged so that the removal of a single module earth connection will not affect the continuity of the earthing or bonding connections to any other module
- Self-tapping screws cannot be used for earth connections to the PV array framework
- Connection to earth is at a single point, connected to the main earthing terminal of the electrical installation; this connection point is between the PV array disconnection device and the PCE and as close as possible to or located inside the PCE the PV system functional earthing conductor has the same rating as the earth fault interrupter EFI
- On an earth fault, the EFI interrupts the earth fault, shuts the PV system down and provides a fault indication and an external fault alarm
- Plastic cable ties cannot be used as primary fixing for PV cables.

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For further information on Australian Standards relevant to mounting products.

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# Important questions to ask a supplier about solar mounting systems

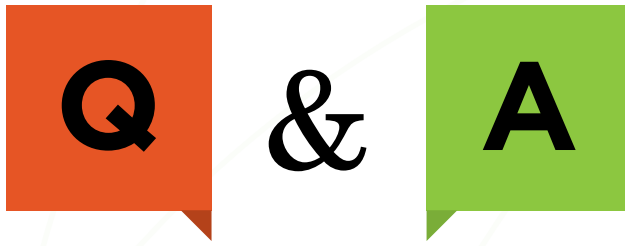
- 1 Is the product accredited for Australian conditions, to the latest standards and accompanied by a genuine structural engineering certificate signed off by an accredited structural engineer in Australia?
- 2 Does your installation manual include engineering installation drawings prepared by an Australian registered structural engineer?
- 3 Does your installation manual clearly state what thickness and material of battens/ purlins the spacing tables are valid for?
- 4 Has the product been tested under LHL cyclic conditions?
- 5 Is there a bill of materials calculator available for the product?
- 6 Is the product stocked in Australia or available from a local distributor?
- 7 Is the product and its warranty backed by a local technical support team?

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**Q What are the hardest parts of the decision-making process in finding the right mounting system?**

**A** Determining the lowest total cost of installation can be difficult. This cost is learnt by experience, and includes:

- Design cost for custom or tricky jobs
- Parts cost
- Warehousing costs, which can be reduced by using a supplier that holds less stock and gets weekly or on-demand deliveries
- Time cost for installation
- Auditing or compliance cost
- Repair or warranty cost.

**Q What are the individual requirements to keep in mind for different mounting system applications?**

**A** Installing on a roof will always be cheaper than mounting on a ground-mounted frame. Flush-mounted roof frames will always be cheaper than tilt-mounted roof frames, as there is less material required.

*Roof-mounted considerations include:*

- Roof material
- Batten/purlin material and thickness (purlins are more common fixing elements than rafters)
- Batten/purlin spacing
- Waterproofing/penetration versus no penetration
- Edge zones.

*Ground-mounted considerations include:*

- Soil conditions
- Required ground clearance (such as for flooding).

**Q What is the importance of a warranty for system performance?**

The warranty is an indicator of the quality of the product. It is of most relevance with a company that is still going to be around to honour the warranty in ten years' time, so it's worth choosing a supplier with industry credentials and a proven track record. While a mounting system warranty won't have an impact on solar system performance to the same degree as one for a solar panel, a warranty for structural integrity is a 'must-have' to ensure safety and to keep a client happy. Choosing a high-quality mounting system with the right tilt will have a higher impact on system performance, which will add to customer benefits.

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# Common mistakes made when purchasing solar mounting systems – and how to avoid them

## Mistakes:

- ✗ Deciding purely on parts costs alone, and not taking into consideration installation costs
- ✗ Buying on price, and regretting later when complaints about quality come through or local support and stock is unsatisfactory
- ✗ Thinking that all mounting systems are the same
- ✗ Thinking that the mounting system is the least important part of the system.

## How to avoid them:

- ✓ Apply long-term thinking, and sustainable business models in the process
- ✓ Treat the mounting system as an important part of the installation; consider it as the base for the entire project
- ✓ Look for local expertise and experience
- ✓ Go through the specification, accreditation and installation guide carefully to make sure that it suits the purpose of the project
- ✓ Beware of thin anodising on poor-quality aluminium, which won't last.

Aluminium comes in different alloys. A construction or structural alloy is an aluminium alloy designed for building structures, such as in the rails of a mounting system – examples of this type are 6005-T5 or 6106-T6.

Lower-grade aluminium like AL 6063 is most commonly used to build office partitions or window framing; it is not as strong, and you should be wary of a mounting system rail constructed using this material.

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# Important considerations for your next solar mounting system: a checklist

- The product complies with all relevant Australian Standards
- The price of the mounting system meets your budget
- The product manufacturer provides design, compliance and audit support
- The product manufacturer ensures availability and security of supply in stock levels and delivery times
- The product is durable and made of high-quality components
- The product is suitable for your project

## How to ensure a product is right for your project

Different projects can require different products, and a mounting system supplier can help you determine which mounting material is best-suited to a particular job.

For example, a supplier can help you ascertain if certain screws are suitable for the type of batten (steel or wood) on your rooftop project – or, in cases where screws aren't ideal and a clamp would be better, Klip Lok-style roofs can be recommended.

If you're installing on a concealed roof such as Klip Lok, check if the bracket is accredited and tested for the particular roofing sheet you are using it on.

For ground-mounted projects, check that the soil is suitable for a product type – such as by ascertaining whether a rammed-post structure, concrete foundation earth screws would be most ideal.

If you are planning a ballasted system, check if the roof is going to be able to handle the additional load, or whether you should look at penetrating the roof with a mounting system.

Your mounting system supplier can help you answer these questions and more.

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SunLock mounting systems are Australian-made with a mill finish and 25-year service life, as certified by corrosion engineering consultants CMET (Aust) Pty Ltd. SunLock products are fully certified for all wind regions in Australia – both cyclonic and non-cyclonic – and are fully certified for all areas of a roof – including edge zones. SunLock provides engineering installation drawings in its installation manual, in addition to full engineering support for customers.

Product feature	SunLock	GroundLock	PoleLock
<b>System type (flat-roof, pitched-roof or ground-mounted)</b>	For pitched or flat roofs	Ground-mounted	Ground-mounted
<b>Warranty (in years)</b>	10	10	10
<b>Industry certifications received</b>	Certified by Partridge Structural/Dome Consulting AS 1170.2:2011/Amdt 2:2012 AS 1664.1:1997 AS 1720.1:2012 AS 4600:2005	Certified by Partridge Structural/Wallbridge & Gilbert Consulting Engineers AS 1170.2:2011	Certified by Partridge Structural AS 1170.2:2011
<b>Roof types it is suitable for (if applicable) e.g. tin, tile, slate etc.</b>	Tin/tile (timber battens, steel purlins and concrete slab)	Ground	Ground
<b>Type of roof attachment (if applicable)</b>	L-foot/tile brackets and tilt legs (via timber/tek-screws/dynabolts)	N/A	N/A
<b>Slope of roof (maximum, in degrees)</b>	Up to 30°; up to 90° with extra certification	N/A	N/A
<b>Wind load specification</b>	Wind Regions A, B, C and D (all of Australia – cyclonic/non cyclonic regions)	Wind Region A and C (most of Australia – cyclonic/non cyclonic regions)	Wind Region A and B (most of Australia – non cyclonic regions)
<b>Material(s) used</b>	6106-T6 aluminium extrusions	6106-T6 aluminium extrusions Cold formed galvanised steel	6106-T6 aluminium extrusions Hot dipped galvanised steel
<b>Delivery time for product</b>	2–5 days (<300 km of 14 branches) 5–10 days (<1,000 km of 14 branches)	2–21 days (<300 km of 14 branches) 5–21 days (<1,000 km of 14 branches)	2–21 days (<300 km of 14 branches) 5–21 days (<1,000 km of 14 branches)
<b>Solar PV modules it is compatible with</b>	All major PV panels sold in Australia	All major PV panels sold in Australia	All major PV panels sold in Australia
<b>Maximum module width/maximum module length (in millimetres)</b>	Up to 1,680 long x 1,000 mm wide (30 mm – 58 mm high)	Up to 1,680 long x 1,000 mm wide (30 mm – 58 mm high)	Up to 1,680 long x 1,000 mm wide (30 mm – 58 mm high)
<b>PV module tilt (angle, in degrees, minimum to maximum)</b>	0–40° degrees	20–40° degrees	25–35°
<b>PV module orientation (portrait or landscape)</b>	Both	Landscape	Both



# Featured product:

## Commercial roof brackets for large Australian commercial buildings

**Commercial roof brackets, available from SunLock**, are an Australian-designed and manufactured solar panel framing system for typical large Australian commercial buildings.

The brackets form a simple, fast framing system for steel-framed roofs; solar PV modules are mounted in landscape format at either 5° or 15° above the roof sheet, using brackets on a SunLock channel. The channel forms a conduit for cabling.

The brackets are backed by a 10-year warranty.

### Product features:

- Supports PV modules with dimensions up to 1,680 x 1,000 mm
- Available with clamps to suit almost all PV module thicknesses
- 5° or 15° inclination
- Light-weight
- High durability and corrosion resistance
- Complies with AS 1172.2.

**The SunLock channel, able to act as a cable conduit, is held to the roof frame with channel feet and potable-grade EPDM washer and is supporting the commercial roof brackets. Fixed-end clamps securely hold the modules to the brackets.**



*Image courtesy of SunLock.*

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### Product benefits:

- **Fast installation** – you can lay the channel feet, channel, commercial roof brackets and then the PV modules; cables can be laid in the channel and protected with a channel lid. Few parts makes the product easy to lift and install
- **Compliant** – a signed engineering installation drawing is provided by Partridge Structural, who are registered structural engineers; and is supplied as part of the technical bulletin for the product
- **Durable** – SunLock uses 6000 series aluminium (predominantly 6106-T6) which has a 25+ year service life under Australian conditions, even without anodising
- **Earthed** – EarthLock washers and bonding terminals are fast to install and ensure that systems using transformerless inverters are properly earthed according to CEC guidelines
- **Edge zones** – the installation drawing for this product includes spacing tables for edge zones; this is critical, as commercial clients often wish to make full use of available roof space.

### Why install with commercial roof brackets?

This product can help provide a lowest total cost for installation, owing to the reduced time you spend on the roof when installing the brackets.

### Tips on installing commercial roof brackets

SunLock brackets are supplied as a kit (one front bracket and one rear bracket) including fixed-end clamps and channel nuts for fixing to a SunLock channel. For a standard two-channel installation, two kits are required to fix each module.

The kits are available in 5° or 15° versions, and can be supplied with various heights of fixed-end clamps. The brackets suit modules with a width of ~1 m, such as a typical 60 cell module using polycrystalline cells.

PV modules can be earthed by placing an EarthLock washer on each front bracket, underneath the frame of the PV module. The mill-finish aluminium components form a conductive path, and an earth cable can be attached to the end of each SunLock channel.

**To learn more about SunLock's commercial roof brackets**

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# Need more information?

We hope this guide has assisted you in the process of purchasing a solar mounting system.

**Interested in any of the featured products, or want to know more about solar mounting systems?**



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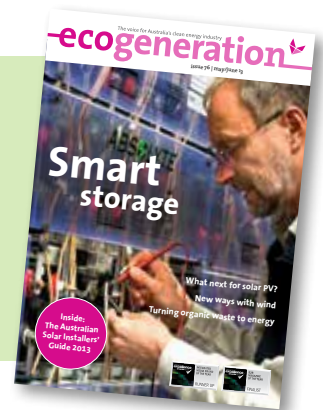
**Phone:** 1300 855 484

**Fax:** +61 3 9697 1919

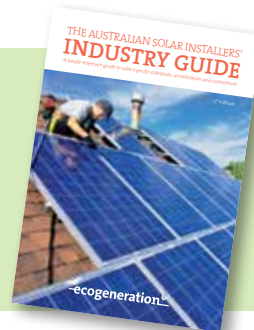
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