ES-A Series Photovoltaic Panels

Safety, Installation and Operation Manual

This Manual is valid in North America only (ETL listed; conforms to UL Standard 1703)

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ELECTRICAL EQUIPMENT — CHECK WITH YOUR INSTALLER

Evergreen Solar ES-A Series photovoltaic (PV, solar electric) panels are designed to produce DC electrical energy from light. This manual contains important safety, installation and operating information with which you should be familiar before using Evergreen Solar panels.

General Information

- All installation and safety instructions should be understood before attempting to install, wire, operate and maintain the panel.
- When installing, observe all local, regional, national and international statutory regulations, guidelines, norms and code requirements.
- Installation or maintenance should only be performed by licensed and qualified professionals.
- Panels produce voltage even when not connected to an electrical circuit or load. Panels produce nearly full voltage when exposed to as little as 5% of full sunlight, and both electrical current and power increase with light intensity.
- Panels can produce higher output than the rated specifications.
- Industry standard rated specifications are made at conditions of 1000W/m^2 irradiance and 25°C (77°F) solar cell temperature. Colder temperatures can substantially increase voltage and power.
- Ensure that panels are only subjected to ambient temperatures in the range -40 to +80°C (-40 to +176°F).
- Reflection from snow, water or other surfaces can increase light and therefore increase both the current and power generated by the panel.
- Do not artificially concentrate light on the panel.
- Panels are intended for outdoors, land-based applications only. Panels are not intended for use indoor use or application on moving vehicles of any kind.
- Excluded applications also include, but are not limited to, installations where panels come into contact with salt water or where likely to become partially or wholly submerged in fresh or salt water, examples of which include boats, docks and buoys.
- Use only equipment, connectors, wiring and support frames suitable for use in a solar electric system.
- Follow all safety precautions of other used components.
- Each panel is marked with a serial number, including the date of manufacture and the manufacturing location. Example: XXxxYYYYMMDDzzzzzzz

  - XX = country code (49 for Germany, 01 for US)

  - xx = manufacturing building code, can be 01 or higher

  - YYYY = year, MM = month, DD = day

  - zzzzzzz = serial number

Handling Safety

- Do not use the junction box to hold or transport the panel.
- Do not stand or step on the panel.
- Do not drop panel or allow objects to fall on panel.
- Do not damage or scratch the rear surface of the panel.
- Avoid setting the panel down hard on any surface, particularly when placing it on a corner.
- Do not disassemble, modify or adapt the panel or remove any part or labeling installed by Evergreen Solar. Doing so will void the warranty.
- Do not drill holes in the frame or glass of the panel. Doing so will void the warranty.
- Do not apply paint or adhesive to the rear surface of the panel.
- Never leave a panel unsupported or unsecured.
- Panels are constructed with tempered glass, but must still be handled with care.
- A panel with broken glass or torn back-skin cannot be repaired and must not be used since contact with any panel surface or the frame can produce electrical shock.
- Broken or damaged panels must be handled carefully and disposed of properly. Broken glass can be sharp and cause injury if not handled with the appropriate protective equipment.
- Work only under dry conditions, and use only dry tools. Do not handle panels when they are wet unless wearing the appropriate protective equipment.
- When storing unconnected panels outside for any length of time, always cover panels which have the glass facing down to stop water collecting inside the panel and causing damage to exposed connectors.

Installation Safety

- Keep children away from the system and panels when installing.
- Do not carry out installation work when there are strong winds.
- When installing panels above ground, avoid any possible falling or other safety hazards by following appropriate safety practices and using required safety equipment.
- Solar electric panels have no on/off switch. Panels can be rendered inoperative only be removing them from light, or by fully covering their front surface with an opaque material, or by working with panels face down on a smooth, flat surface.

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- When working with panels in light, follow all applicable regulation regarding working with live electrical equipment.
- Do not touch electrical terminals or the ends of any wire while the panel is exposed to light or while installing the panel.
- Do not wear metallic jewelry while performing mechanical or electrical installation.
- Never open electrical connections or unplug connectors while the circuit is under load.
- Contact with electrically active parts of the panels, such as terminals, can result in burns, sparks and lethal shock whether the panel is connected or disconnected.
- Always use insulated tools and rubber gloves that are approved for working on electrical installations.

Fire Safety

- Refer to your local authority for guidelines and requirements for building or structural fire safety.
- The roof construction and installation may affect the fire safety of a building; improper installation may contribute to hazards in the event of fire.
- For roof application, the panels should be mounted over a fire resistant covering rated for the application.
- It may be necessary to use components such as earth ground fault circuit breakers, fuses and circuit breakers.
- Do not use panels near equipment or locations where flammable gases can be generated or can collect.

Electrical Installation

- Avoid all electrical hazards when installing, wiring, operating and maintaining a panel.
- If the total DC system voltage exceeds 100V, the system must be installed, commissioned and maintained by a licensed electrician unless local electrical codes determine otherwise.
- Contact with a DC voltage 30V or more is potentially hazardous.
- Do not use panels of different electrical or physical configurations in the same system.
- The maximum open circuit voltage of the system must not be greater than the specified maximum system voltage for the panel.
- All Evergreen Solar panels are equipped with factory-installed wires and quick connectors. Panels have been designed to be easily interconnected in series.
- Evergreen Solar ES-A series panels are equipped with Multi-Contact® Type 4 clickable connectors. In order to comply with the 2008 National Electric code for accessible arrays, the plug connection must be secured with the UL approved, pluggable safety lock clip (PV-SSH4) supplied by Multi-Contact®.
- The PV-SSH4 clip is not provided by Evergreen Solar and must be purchased separately. Once the clip is installed, the PV plug connection can only be unlocked with the use of the PV-MS tool, also supplied by Multi-Contact®.
- Evergreen Solar ES-A series panels are equipped with 10AWG, UL4703 certified PV-WIRE which enables the panels to be used in electrically ungrounded systems with transformer-less inverters.
- Use system wiring with suitable cross-sectional areas and connectors that are approved for use at the maximum short-circuit current of the panel.
- Match the polarities of cables and terminals when making the connections; failure to do so may result in damage to the panel.
- When reverse currents can exceed the value of the maximum protective fuse marked on the back of the panel, a properly rated and certified over-current device (fuse or circuit breaker) must be connected in series with each panel or string of panels.
- The rating of the over-current device shall not exceed the value of the maximum protective fuse marked on the back of the panel.
- The panel contains factory installed bypass diodes located inside the junction box.
- The junction box is not designed or certified to be field accessible or maintainable and should under no circumstances be opened. Opening the junction box may void the warranty.
- Panels with a suspected electrical problem should be returned to Evergreen Solar for inspection and possible repair or replacement as per the warranty conditions provided by Evergreen Solar.

Grounding

- Panel frames should be connected to an earth ground for safety and protection from lightning
- The panel frame is provided with grounding holes that accommodate self-tapping screws. A #10-32 stainless steel thread cutting screw is required.
- Evergreen panels can also be grounded using third party grounding washers or clip devices provided the devices are listed and identified for grounding the metallic frames of PV panels and the devices are installed in accordance with the manufacturers specified instructions.

Mechanical Installation

- Panels should be mounted to maximize direct exposure to sunlight and to eliminate or minimize shadowing.
- Even partial shadowing can substantially reduce panel and system output.
- Panels must be securely fastened using support frames or mounting kits specialized for PV applications.
- Panels may be mounted at any angle from vertical to horizontal orientation.
- Care must be taken to avoid low tilt angles which may cause dirt to build-up on the glass against the frame edge.
- Dirt build-up on the surface of the panel can cause active solar cells to be shaded and electrical performance to be impaired.
- Contact Evergreen Solar for more information regarding minimum recommended tilt angles for specific panel products.
- For roof mounted systems, provide adequate rear ventilation under a panel for cooling (100mm: 4 in. gap minimum).
- Clearance of 7mm: ¼ in or more between panels is required to allow for thermal expansion of the frames.
- Always keep the back surface of the panel free from any foreign objects or structural elements which could come into contact with the panel, especially when the panel is under mechanical load.

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- Ensure panels are not subjected to wind or snow loads in excess of the maximum permissible loads and are not subjected to excessive forces due to thermal expansion of the support structure.
- Evergreen Solar permits several different mounting methods. The permissible mounting methods and maximum permissible wind and snow loads are detailed in the Mounting Guide available from Evergreen Solar (ETL listed version).
- For permission to use mounting methods not described in the Mounting Guide (ETL listed version), please consult Evergreen Solar. Failure to do so will void the warranty and panel certification.
- Always follow the mounting equipment vendors' installation instructions in addition to the instructions found in the Mounting Guide (ETL listed version). In cases where the vendors' instructions are more stringent than those detailed in the Mounting Guide (ETL listed version), the vendors' instructions shall apply.
- In cases where the maximum permissible loading determined by the mounting equipment vendor is less than the maximum permissible load stated in the Mounting Guide (ETL listed version), the maximum loads determined by the vendor should always be used.
- The maximum permissible loads apply to uniformly distributed wind or snow loading. Care should be taken to avoid mounting panels in areas that are prone to drifting snow, icicle and/or ice dam formation.

Operation and Maintenance

- No routine maintenance is required. However it is advisable to perform periodic inspection of the panels for damage to glass, back-skin, frame, junction box or external electrical connections.
- Check electrical connections for loose connections and corrosion.
- PV panels can operate effectively without ever being washed, although removal of dirt from the front glass can increase output.
- Evergreen Solar panels use front glass with a wear resistant and durable anti-reflection treatment designed to improve electrical performance.
- Water can be used for regular washing or rinsing of the treated front glass to remove dust, dirt or other deposits.
- To remove ingrained dirt, the treated glass can be washed with a micro-fiber cloth and ethanol or a conventional glass cleanser.
- No aggressive and abrasive cleansers or chemicals should ever be used on the treated front glass. No alkali based chemicals should be used, including ammonia based solutions.
- Always wear rubber gloves for electrical insulation whilst maintaining, washing or cleaning panels.

Underwriters Laboratories and Canadian Standards ULC/ORD-C1703-01 Information

- Under normal conditions, a photovoltaic panel is likely to experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of Isc and Voc marked on this panel should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes, and size of controls connected to the PV output.
- Refer to section 690-8 of the National Electric Code (NEC) for additional multiplying factors of 125% (80% de-rating) which may be applicable.
- Conductor recommendations: single conductor cable, type USE-2 (non-conduit), 10 AWG minimum (6mm^2 minimum).
- For compliance with Canadian Standards ULC/ORD-C1703-1, the installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

Disclaimer of Liability

Since the use of this Safety, Installation and Operation Manual and the conditions or methods of installation, operation, use and maintenance of the panel are beyond Evergreen Solar control, Evergreen Solar does not assume responsibility and expressly disclaims liability for loss, damage, injury or expense arising out of or in any connected with such installation, operation, use or maintenance of the panel.

Evergreen Solar assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the panel. No license is granted by implication or otherwise under any patent or patent rights.

The information in this Manual is based on Evergreen Solar knowledge and experience and is believed to be reliable; but such information including product specifications (without limitations) and suggestions do not constitute a warranty, expressed or implied. Evergreen Solar reserves the right to make changes to the product, specifications or this Manual without prior notice.

Note: This document may be provided in multiple languages. If there is a conflict among versions, the English language version dominates.

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Electrical Specifications at STC*

		ES-A-190 -fa2	ES-A-195 -fa2	ES-A-200 -fa2	ES-A-205 -fa2	ES-A-210 -fa2
P_{mp}	(W)	190	195	200	205	210
P_{ptc}**	(W)	171.3	175.9	180.6	185.2	189.8
V_{mp}	(V)	17.4	17.8	18.1	18.4	18.7
I_{mp}	(A)	10.92	10.96	11.05	11.15	11.23
V_{oc}	(V)	22.0	22.3	22.5	22.8	23.1
I_{sc}	(A)	11.80	11.90	12.00	12.10	12.20

Number of Cells	114
Bypass Diodes	2x Type Schottky UCQS30A04, 45 V, 30 A
Max. Series Fuse/ Max. Reverse Current	20A
UL Rated System Voltage	600V DC Maximum

Electrical Specifications at NOCT***

P_{mp}	(W)	139.1	142.7	146.4	150.1	153.7
V_{mp}	(V)	16.3	16.5	16.7	16.8	17.0
I_{mp}	(A)	8.54	8.65	8.76	8.93	9.04
V_{oc}	(V)	20.0	20.3	20.5	20.7	21.0
I_{sc}	(A)	9.44	9.52	9.60	9.68	9.76
T_{noct}	(°C)	44.8	44.8	44.8	44.8	44.8

Temperature Coefficients

αP_{mp}	-0.45	(%/°C)
αV_{mp}	-0.43	(%/°C)
αI_{mp}	-0.02	(%/°C)
αV_{oc}	-0.32	(%/°C)
αI_{sc}	-0.003	(%/°C)

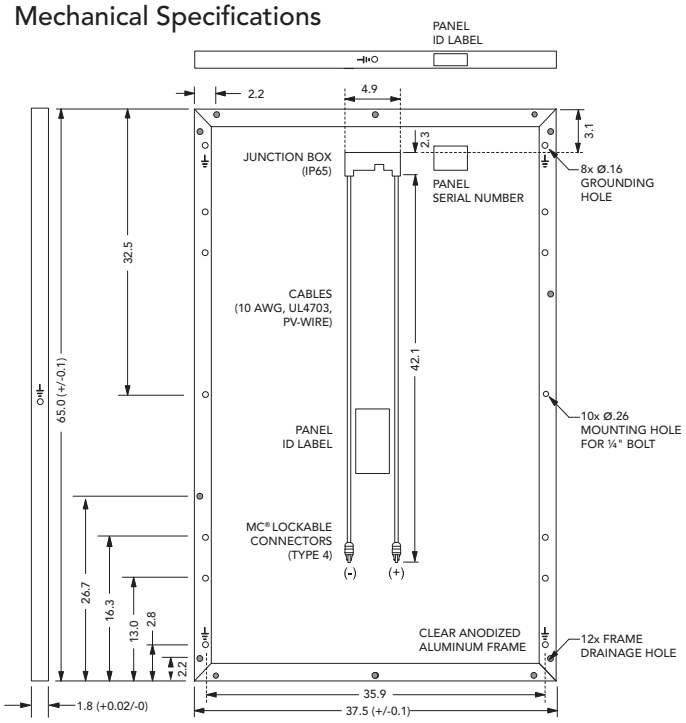
*At Standard Test Conditions: 1000 W/m², 25°C cell temperature, AM 1.5 spectrum. Minimum specified power rating is 0% below P_{mp} for all products; other specifications are +/-10 % of measured values per ASTM E 892. Specifications subject to change without notice. Warranty details available on request.

**At PCT (PV-USA Test Conditions): 1000 W/m², 20°C ambient temperature, 1 m/s wind speed

*** At Nominal Operating Cell Temperature Conditions: 800 W/m², 20°C ambient temperature, wind velocity 1 m/s, AM 1.5 spectrum.

The relative reduction of panel efficiency at 200W/m² irradiance in relation to 1000W/m² both at 25°C cell temperature and spectrum AM 1.5 is 0%.

Mechanical Specifications



ES-A-190, 195, 200, 205, 210

All dimensions in inches; Weight 41 lbs. (18.6 kg)

Worldwide Headquarters
Evergreen Solar Inc.
138 Bartlett Street
Marlboro, MA 01752 USA
T: +1 508.357.2221
F: +1 508.229.0747
info@evergreensolar.com

Customer Service - Americas and Asia
Evergreen Solar Inc.
138 Bartlett Street
Marlboro, MA 01752 USA
T: +1 508.357.2221
F: +1 508.229.0747
sales@evergreensolar.com

www.evergreensolar.com

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