INSTALLATION MANUAL FLEXTRON MODULES

PLEASE READ THIS MANUAL CAREFULLY BEFORE INSTALLING OR USING THE MODULES. PLEASE PASS ALONG THE ATTACHED USER MANUAL TO YOUR CUSTOMER.

1.0 Introduction

The BiPVco FLEXTRON photovoltaic module is a building-applied (BAPV) design. The FLEXTRON modules are intended to adhere to approved roof elements under controlled conditions. This Installation Manual contains essential information for the electrical and mechanical installation that you must know before installing the modules. It also contains general safety information you need to be familiar with before installing any solar photovoltaic (PV) system.

1.1 General Warning

- Before attempting to install, wire, operate and maintain a FLEXTRON module, please ensure you completely understand the information described in this installation manual.
- PV modules produce electricity whenever exposed to sunlight or other light sources, always treat as live.
- Potentially lethal DC voltages can be generated whenever PV Modules are exposed to a light source, therefore, avoid contact with electrically active parts and be sure to isolate live circuits before attempting to make or break any connections.
- When the modules are connected in series, voltage is cumulative. When the modules are connected in parallel, the current is cumulative. As a result, a large-scale PV system can produce a high voltage and current, which could present an increased hazard and may cause serious injury or death.
- In case of snow build-up, snow may slide more easily on the smooth surface of the module than other parts of the roof. Snow may suddenly slide off the roof and hit nearby objects/areas. Take preventive measures (e.g. snow stopper) when there is a possible risk such case would cause an injury or damage.

1.2 General Safety

- Before installing a PV module, contact appropriate authorities to determine permit, installation and inspection requirements that should be followed. Always install PV modules in accordance with applicable rules and regulations (e.g. IEC 62548:2016).
- Roof structures containing integrated PV modules such as FLEXTRON should only be installed by personnel approved by the roof system manufacturer. Electrical connections should only be made by electricians qualified to locally applicable codes. Only such authorised installers or service personnel should have access to the PV module installation site.
- No matter where the PV modules are installed, either roof-mounted construction or any other type of structure above the ground, appropriate safety practices (e.g. scaffolding) should be followed and required safety equipment should be used to avoid possible safety hazards. Note that installing some PV modules on roofs may require the addition of fireproofing, depending on local building/fire codes.
- Do not shade portions of the PV module surface from the sunlight for a long time. A shaded cell may become hot and will cause a drop in generated power and could cause an operation failure of the PV modules.
- Turn off inverters and circuit breakers immediately should a problem occur.
- A defective PV module may generate power even if it is removed from the system. It may be dangerous to handle the module while exposed to sunlight as high voltages may be present. Place any defective PV module in a carton so all the cells are completely shaded.
- In the case of a series connection, the maximum open circuit voltage must not be greater than the specified maximum system voltage.
- This PV module is rated as "Fire safety class C" according to IEC61730-2:2004 or UL790.

1.3 Handling Safety

- Keep the FLEXTRON module packed in the carton until installation.
- Static may be present in the FLEXTRON module, e.g. after friction of the modules over the surfaces (electrostatic loading). This can discharge through the edge of the module. Always handle modules with polymeric gloves (e.g., nitrile or nitrile-coated knitted gloves) to avoid discomfort.
- Do NOT place FLEXTRON modules directly on top of each other.
- The front surface of the FLEXTRON module is susceptible to scratching; avoid scraping with sharp edges.
- Do NOT stand or step on the PV module.
- Do NOT place or allow hard objects to fall onto FLEXTRON modules.
- Do NOT cause the FLEXTRON module or twist excessively. A bending radius of less the 225mm can damage the module.
- Do NOT scratch or hit the back sheet.

1.4 Installation Safety

- Always wear appropriate construction site safety equipment, e.g. protective headgear, gloves and safety shoes.
- FLEXTRON modules can be mounted on rigid roofing elements such as raised seam steel sheets (e.g. TATA Urban). To avoid injury due to sharp edges when handling, the roofing system manufacturer's safety instructions should be closely followed. Recommended personal protective equipment (PPE), as specified by the roofing system manufacturer's installation instructions, should be worn at all times.

- Do NOT touch the junction box and the end of output cables, the cable ends (connectors) with bare hands during installation or under sunlight, regardless of whether the module is connected to or disconnected from the system. If necessary, cover the module with an opaque material to isolate the module from incident light and handle the wires with rubber-gloved hands to avoid electric shock.
- Do NOT install or handle modules when wet or during high wind periods.
- Always use insulated tools.
- Do not drop any object (e.g., PV module or tools) when installing PV modules at height.
- Make sure plug-in connectors are correctly mated.
- Do NOT unplug connectors if the system circuit is connected to a load.
- Do NOT work alone (always work as a team of two or more people).
- Wear a safety belt when working at height.
- Do NOT wear metallic jewellery, which can cause electric shock during installation.
- Do NOT damage the surrounding PV modules or mounting structure when replacing a PV module.
- Cables should be located so that they will not be exposed to direct sunlight after installation to prevent degradation of the cables.
- Do NOT use modules near equipment or in a location where flammable gases may be generated or collected.
- The voltage is proportional to the number of modules in a series. In case of parallel connection, please be sure to take proper measures (e.g. fuse for protection of module and cable from over current, and / or blocking diode for prevention of unbalanced strings voltage) to block the reverse current flow. Modules used in a system must be of the same power and number of cells, each string must be matched for efficiency.
- Under normal conditions, a photovoltaic module will likely 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 module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and size of controls (e.g., inverter) connected to the PV output. The module electrical rating is measured under Standard Test Conditions, 1000W/m2, irradiance with AM 1.5.
- Concentrated sunlight or artificial light must not be directed onto the FLEXTRON module.
- Before installing the PV modules, ensure that the roof construction is suitable. The modules have been certified for a maximum design load of +/-1600 Pa with a test load of +/- 2400Pa with a safety factor of 1.5 from the design load.
- The PV modules have been qualified in an environmental temperature range of -400C to +400C and an altitude limit of up to 2,000 meters in accordance with IEC 61730.
- The modules have been qualified in an environmental condition in accordance with IEC 61701.
- The module is considered to be in compliance with this standard only when the module is mounted in the manner specified by the mounting instructions. A module with exposed conductive parts is considered to be in compliance with this standard only when it is electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017).

1.5 Disclaimer of Liability

This document does not constitute a guarantee, expressed or implied. BiPVco does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with the installation, operation, use or maintenance of the PV modules. BiPVco assumes no responsibility for any infringement of patents or other rights of third parties that may result from using the PV module. BiPVco reserves the right to change the product, specifications or installation manual without prior notice. All the information described in this manual is the intellectual property of BiPVco.

2.0 Attachment Instructions

The FLEXTRON module is a building-applied (BAPV) design. FLEXTRON modules are designed to be adhered to primary metal roof elements. The ability for this product to be adhered to any other roofing material other than that tested must be determined on a site assessment, through local codes and qualified professional engineers.

Please refer to our website *www.bipvco.com* for BiPVco approved roof surfaces as a suitable substrate for adhering FLEXTRON photovoltaic modules.

IMPORTANT: Consult with your BiPVco local agent for prior approval before adhering FLEXTRON modules to any surface not listed on the website. Utilising substrates that are not on the approved list or reapplying FLEXTRON modules that were previously bonded to a roof membrane will void the warranty of the modules.

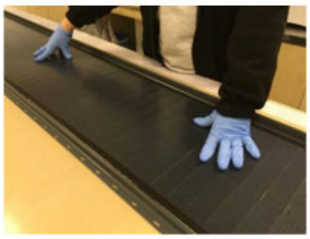
IMPORTANT: It is the responsibility of the roof specifier to ensure that the roof design is fit for purpose and complies with all relevant building codes in force in the jurisdiction where the roof is being installed. It is the contractor's responsibility to ensure that the roof system manufacturer's installation instructions are closely followed. BiPVco takes no responsibility for the design or installation of the roof structure.

- The FLEXTRON module must be bonded to the roof element in a controlled factory environment using the approved methods. Failure to follow the approved methods will invalidate the manufacturers warranty.
- The FLEXTRON module can be installed on-site under controlled conditions but only by an approved BIPVco installer. The ability for this product to be adhered to any soiled roofing surface must be determined on a site assessment, through local codes and qualified professional engineers.

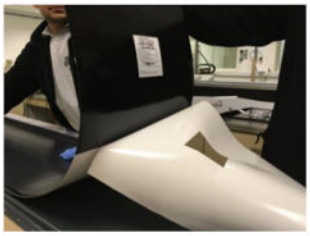
- Metal roof elements must be flat and smooth. Do not bond PV modules directly to corrugate or R-panel metal roof systems.
- The ambient temperature at the time of installation should be between 15°C - 35°C. If the temperature exceeds 35°C, the polymer film release liner may be difficult to remove from the self-adhesive. If the temperature is lower than 15°C, the self-adhesive may not adhere properly to the roof surface.
- Roof materials and components should be stored in the manufacturer's original, unopened, undamaged packaging with identification labels intact.
- Remove any factory-applied protective polymer film from metal roof elements before cleaning.
- The contractor should refer to the roof panel plan for exact PV module placement on each roof element to align the PV module correctly in relation to the ridge cap, ridge trim, middle roof seams and fasteners.
- In order to achieve the required adhesion, clean the roof element surface according to the roof system manufacturer's guidelines.

2.1 Bonding FLEXTRON Modules to an Approved Roof Element

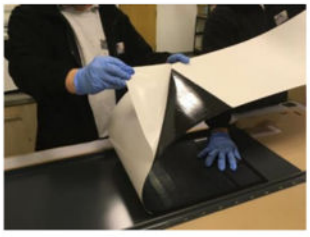
- The roof element should be cleaned with Sika® Aktivator 205 (or equivalent cleaning agent) no more than 30 minutes before bonding the FLEXTRON module.
- Use a clean, lint-free cloth or disposable lint-free wipe for cleaning and allow to dry completely.
- Refer to the roof plan for the precise location of the FLEXTRON module on the roof element.
- Locate and mark the roof element for exact module placement.



- Starting from the junction box end, peel the release paper to expose the Sika® adhesive.



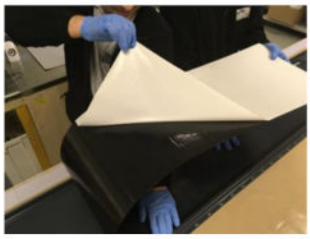
- Press the top surface of the FLEXTRON module to the roof element surface to ensure a good adhesive bond.



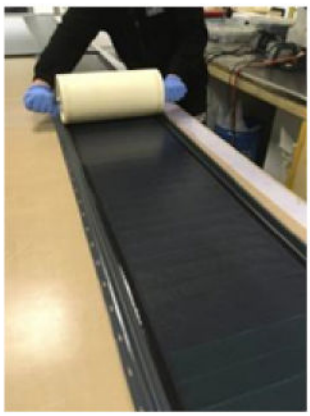
- Take care to maintain the module's alignment.

Note: Once more than 100-150mm of the module is bonded to the surface, do not attempt to remove it.

- One worker should carefully peel back the remainder of the release paper from the FLEXTRON module.



- A second worker should gently press down the exposed adhesive surface onto the roof element surface, taking care to maintain alignment.



- Pressure should be applied in a continuous motion across the FLEXTRON module surface width to ensure full surface contact with the roof surface to avoid creating voids and air bubbles under the module, especially along the module perimeter.
- Once the FLEXTRON module is bonded to the metal panel roof surface, roll the module with a maximum pressure of approximately 75 kg per linear meter to ensure full contact with the roof surface, paying careful attention to the module perimeter edge.

3.0 Site Selection

- Do not install the FLEXTRON modules so that the building or other structure, or other systems or components, exert damaging mechanical or electrical influences on the PV modules.
- FLEXTRON modules can be mounted in landscape or portrait orientation.
- Do not install where modules are likely to be shaded. FLEXTRON modules protect themselves from shade-producing hot spots that may damage other modules, but the electrical performance of any PV module can be reduced due to shading obstructions.
- Care should be taken avoid full or partial shading from sources such as rooftop equipment, structural elements of a building and nearby trees, poles, power lines or other nearby buildings to minimise the impact on the power production of the BiPVco FLEXTRON solar array.
- If FLEXTRON modules on the same installation are mounted at different angles or orientations then energy production can normally be optimized by connecting the different orientations to different inverters (or different MPPT if the inverter has more than one MPPT). Refer to the inverter manufacturer's installation instructions for further information.
- Do not install FLEXTRON modules in areas prone to water collection or where they will be continually exposed to water (e.g., under sprinklers or fountains).

- Roofs should have a minimum slope of 3 degrees for positive drainage and avoidance of local ponding of standing water and sediment deposit. The roof should have verifiable positive drainage as per regional guidelines. Refer to the roof system manufacturer for additional requirements. Gutters should be designed and sited in such a way to avoid risk of back flow up the roof slope and flooding of modules and junction boxes.
- PV module installation should not exceed roof system fire rating slope limitations. FLEXTRON modules can be installed on roof slopes with a maximum slope of 45 degrees to the horizontal.
- The FLEXTRON modules have a projected power production service life of +25 years. Roof systems should have a similar projected remaining service life.
- In case the PV modules are used in areas such as: heavy snow areas, extremely cold areas, strong wind areas, installations over water or areas where installations are prone to salt water damage, consult with your BiPVco local agent first to determine an appropriate installation method, or to determine whether the installation is suitable.

4.0 Site Installation

- The contractor shall install the roof element with FLEXTRON modules attached in accordance with roof system manufacturer's written installation specifications.
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- The contractor, before installing modules should contact the appropriate local authority and obtain any required building permits and to determine installation and inspection requirements that apply to the installation site. This includes any local jurisdiction requirements relative to applicable codes.
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- BiPVco recommends a structural engineer should be used to determine project requirements for attachment methods based on the expected wind loads and local building codes.
- The contractor shall determine if the construction or structure (roof, facade, support, etc.) where the PV modules are being installed has enough strength for the installation.
- To maintain the fire rating of the modules do not install within 150 mm of the edge of the roof.
- The fire rating of the FLEXTRON modules is valid only when mounted in the manner specified in the mounting instructions.
- When installed on a roof where local code requirements dictate a minimum fire rating, the roof shall meet the minimum requirements before installation of the PV module to ensure the safety of the building envelope.

5.0 Electrical Installation Instructions

5.1 Module Identification

BiPVco modules are identified by the following numbering system. For example the module below is a FLEXTRON module with a black backsheet, rear mounted junction box and a power of 115 W:

Type	**Width**	**Length**	**J Box**		**Power**			**Colour**	**Version**	**Cell**
Flextron **M**etektron **P**owerPlus	Number of cells wide: **1 - 3**	Meters approx. **0 to 5**	**F**ront **R**ear		40 - 405W; 5W increments			Solid colours **B**lack **W**hite	Version number	Number of cells
F	**1**	**3**	**R**	**-**	**1**	**1**	**5**	**B**	**2**	**(54)**

5.2 Electrical Characteristics

The modules covered by this installation manual are listed in Appendix 1.

5.3 Thermal Characteristics

Operating temperature range	-40°C to +85°C
Temperature coefficient Pmpp	-0.38 % / °C
Temperature coefficient Voc	-0.28 % / °C
Temperature coefficient Isc	0.008 % / °C

The typical efficiency at 200W/M2 in relation to 1000W/M2 (250C AM 1.5) is at least 17% of STC efficiency.

5.4 Class (IEC 61140)

- The FLEXTRON module is classified as "Class II" according to IEC 61730. Modules qualified as Class II are intended for installation where general user access and contact with insulated live parts is anticipated.
- FLEXTRON modules may be connected in systems operating at up to 1000V where general contact or access is anticipated.

5.5 Wiring

- All connections should be performed, by qualified installers, in accordance with the local codes and regulations. (e.g., IEC 62548:2016)
- Modules can be connected in series to increase the operating voltage by plugging the positive plug of one module into the negative socket of the next. Before connecting modules always ensure that the contacts are corrosion free, clean and dry.
- FLEXTRON modules can be irreparably damaged if an array string is connected in reverse polarity to another. Always verify the voltage and polarity of each individual string before making a parallel connection.
- FLEXTRON modules are provided with junction boxes with Staubli / Multi-Contact® MC4 male and female cable couplers. Mated connectors must be of the same type and from the same manufacturer - PV-KBT4-EVO1 female and PV-KST4-EVO1 male by Staubli Electrical Connectors AG.
- For field connections, use at least 4 mm2 copper wires insulated for a minimum of 90°C and sunlight resistance with insulation designated as PV wire.
- The maximum voltage of the system must be less than the maximum certified system voltage and the maximum input voltage of the inverter and of the other electrical devices installed in the system. The maximum system voltage calculation must take into consideration the temperature coefficient for Voc i.e. cold conditions.
- It is recommended that all cables are run in appropriate conduits and sited away from areas prone to water collection.

5.6 System Configuration

- FLEXTRON modules can be connected in either a series or parallel configurations.
- FLEXTRON modules must not be connected is series so as to give and output voltage higher than they certified system voltage of 1000V
- The maximum number of modules in series can be calculated by dividing 1000V by (Voc x 1.25) value of the module. The variation of Voc under different temperatures should be taken take into consideration when making this calculation (i.e. the Voc of the modules will be higher when the temperature drops).
- The safety factor of 1.25 for the minimum voltage rating of the components can be modified during the design of a system according to the minimum temperature of the location of the installation and the temperature coefficient for VOC. ISC can be adjusted based on maximal temperature, irradiance and orientation of the module. To this end a full simulation for the specific location is required using long-term weather data.
- Strings of series connected FLEXTRON modules can be connected in parallel. Each string should have similar voltage to avoid reverse currents.
- No more than 2 (TWO) strings of FLEXTRON modules can be connected in parallel.
- When connected in parallel reverse current protection (e.g., blocking diodes) should be installed in accordance with IEC 62548:2016.

5.7 Fusing

- When fuses are fitted they should be rated for the maximum DC voltage and connected in each pole of the array.
- The maximum rating of a fuse connected in series with an array string is 10A but the actual module specific rating can be found on the product label and in the product datasheet.

5.8 Grounding / Earthing Identification

- FLEXTRON modules do not have a metallic frame and therefore do not require grounding. If the FLEXTRON modules are applied to a metallic roof element, grounding maybe required to comply with locally applicable wiring regulations.

6.0 Maintenance

- The modules are designed for long life and require very little maintenance. If the angle of the PV module is 5 degrees or more, normal rainfall is sufficient to keep the module glass surface clean under most weather conditions. If dirt/sand build-up becomes excessive, clean the top surface only with a soft cloth using water. Do not use a jet wash or a high-powered water hose.
- Do not clean the module surface with aggressive chemicals.
- In order to ensure the correct operation of the system, the condition of the connectors and wiring should be inspected periodically.
- FLEXTRON modules do not contain any user serviceable parts. If malfunction is suspected contact your installer or BiPVco local agent immediately.
- In order to ensure the correct operation of the system, the conditions of the connectors and wiring should be inspected periodically and any debris cleared.

Appendix 1

Electrical Characteristics

The modules covered by this installation manual are listed below:

Where x = “F” or “B”, yyy = output power and z = “B” or “W”								
Model	**Maximum System Voltage, (Vdc)**	**Maximum Series Fuse, (A)**	**Class (IEC 61140)**	**Pmax (W)**	**Voc (V)**	**Isc (A)**	**Vmpp (V)**	**Impp (A)**
				± 5%	**± 10%**	**± 10%**		
F11x-yyyz2 (18), F31x-yyyz2 (18)	1000	10	II	40	12.54	4.39	10.12	3.93
				45	12.76	4.49	10.49	4.12
F11x-yyyz2 (20), F21x-yyyz2 (20)	1000	10	II	40	13.76	4.35	10.98	3.8
				45	13.98	4.41	11.32	3.96
				50	14.18	4.49	11.66	4.12
F11x-yyyz2 (22)	1000	10	II	45	15.19	4.35	12.18	3.83
				50	15.41	4.42	12.5	3.99
				55	15.6	4.49	12.83	4.12
F11x-yyyz2 (24), F21x-yyyz2 (24), F31x-yyyz2 (24)	1000	10	II	50	16.57	4.35	13.28	3.83
				55	16.82	4.42	13.64	3.99
				60	17.02	4.49	13.99	4.12
F11x-yyyz2 (26)	1000	10	II	55	18.02	4.37	14.47	3.86
				60	18.31	4.45	14.95	4.06
F11x-yyyz2 (28), F21x-yyyz2 (28)	1000	10	II	60	19.4	4.37	15.59	3.86
				65	19.72	4.45	16.1	4.06
F11x-yyyz2 (30), F31x-yyyz2 (30)	1000	10	II	65	20.79	4.37	16.7	3.86
				70	21.13	4.45	17.25	4.06
F12x-yyyz2 (32), F21x-yyyz2 (32)	1000	10	II	65	22.02	4.35	17.57	3.8
				70	22.26	4.38	17.94	3.89
				75	22.54	4.45	18.4	4.06
F12x-yyyz2 (34)	1000	10	II	70	23.39	4.35	18.67	3.8
				75	23.71	4.39	19.15	3.92
				80	24	4.47	19.65	4.09
F12x-yyyz2 (36), F21x-yyyz2 (36), F31x-yyyz2 (36)	1000	10	II	75	24.86	4.35	19.93	3.83
				80	25.18	4.41	20.38	3.95
				85	25.42	4.47	20.81	4.09
F12x-yyyz2 (38)	1000	10	II	80	26.24	4.35	21.03	3.83
				85	26.58	4.41	21.51	3.95
				90	26.83	4.47	21.96	4.09
F12x-yyyz2 (40), F21x-yyyz2 (40)	1000	10	II	85	27.62	4.35	22.14	3.83
				90	27.98	4.41	22.64	3.95
				95	28.24	4.47	23.12	4.09
F12x-yyyz2 (42), F31x-yyyz2 (42)	1000	10	II	90	29	4.35	23.25	3.83
				95	29.38	4.41	23.77	3.95
				100	29.65	4.47	24.28	4.09
F12x-yyyz2 (44), F21x-yyyz2 (44)	1000	10	II	90	30.27	4.35	24.16	3.8
				95	30.6	4.38	24.66	3.89
				100	30.89	4.44	25.12	4.02
				105	31.2	4.49	25.65	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

ere x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F12x-yyyz2 (46)	1000	10	II	95	31.65	4.35	25.25	3.8
				100	31.99	4.38	25.78	3.89
				105	32.29	4.44	26.27	4.02
				110	32.61	4.49	26.82	4.12
F12x-yyyz2 (48), F21x-yyyz2 (48), F31x-yyyz2 (48)	1000	10	II	100	33.02	4.35	26.35	3.8
				105	33.38	4.38	26.9	3.89
				110	33.7	4.44	27.41	4.02
				115	34.03	4.49	27.98	4.12
F12x-yyyz2 (50)	1000	10	II	105	34.4	4.35	27.45	3.8
				110	34.78	4.38	28.03	3.89
				115	35.1	4.44	28.55	4.02
				120	35.45	4.49	29.15	4.12
F12x-yyyz2 (52), F21x-yyyz2 (52)	1000	10	II	110	35.91	4.35	28.78	3.83
				115	36.3	4.39	29.28	3.92
				120	36.5	4.44	29.69	4.02
				125	36.87	4.49	30.32	4.12
F13x-yyyz2 (54), F31x-yyyz2 (54)	1000	10	II	115	37.29	4.35	29.89	3.83
				120	37.77	4.41	30.56	3.95
				125	37.96	4.46	30.94	4.06
				130	38.29	4.49	31.48	4.12
F13x-yyyz2 (56), F21x-yyyz2 (56)	1000	10	II	115	38.53	4.35	30.74	3.8
				120	38.81	4.36	31.25	3.86
				125	39.17	4.41	31.7	3.95
				130	39.37	4.46	32.09	4.06
				135	39.7	4.49	32.65	4.12
F13x-yyyz2 (58)	1000	10	II	120	39.9	4.35	31.84	3.8
				125	40.19	4.36	32.36	3.86
				130	40.57	4.41	32.83	3.95
				135	40.77	4.46	33.23	4.06
				140	41.12	4.49	33.81	4.12
F13x-yyyz2 (60), F21x-yyyz2 (60), F31x-yyyz2 (60)	1000	10	II	125	41.28	4.35	32.94	3.8
				130	41.73	4.38	33.63	3.89
				135	42.06	4.42	34.14	3.99
				140	42.18	4.46	34.38	4.06
				145	42.54	4.49	34.98	4.12
F13x-yyyz2 (62)	1000	10	II	130	42.66	4.35	34.04	3.8
				135	43.12	4.38	34.75	3.89
				140	43.46	4.42	35.28	3.99
				145	43.59	4.46	35.53	4.06
				150	43.96	4.49	36.15	4.12

Standard test conditions (STC): 1000W/m^2, 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F13x-yyyz2 (64), F22x-yyyz2 (64)	1000	10	II	135	44.03	4.35	35.14	3.8
				140	44.51	4.38	35.87	3.89
				145	44.86	4.42	36.42	3.99
				150	44.99	4.46	36.67	4.06
				155	45.38	4.49	37.31	4.12
F13x-yyyz2 (66), F31x-yyyz2 (66)	1000	10	II	140	45.57	4.35	36.53	3.83
				145	46.07	4.39	37.16	3.92
				150	46.27	4.42	37.55	3.99
				155	46.4	4.46	37.82	4.06
				160	46.79	4.49	38.48	4.12
F13x-yyyz2 (68), F22x-yyyz2 (68)	1000	10	II	140	46.78	4.35	37.33	3.8
				145	47.12	4.36	37.94	3.86
				150	47.46	4.39	38.28	3.92
				155	47.67	4.42	38.69	3.99
				160	47.8	4.46	38.96	4.06
				165	48.21	4.49	39.64	4.12
F13x-yyyz2 (70)	1000	10	II	145	48.16	4.35	38.43	3.8
				150	48.51	4.36	39.06	3.86
				155	48.86	4.39	39.41	3.92
				160	49.07	4.42	39.83	3.99
				165	49.21	4.46	40.11	4.06
				170	49.63	4.49	40.81	4.12
F13x-yyyz2 (72), F22x-yyyz2 (72), F31x-yyyz2 (72)	1000	10	II	150	49.54	4.35	39.53	3.8
				155	49.9	4.36	40.18	3.86
				160	50.26	4.39	40.54	3.92
				165	50.54	4.44	41.11	4.02
				170	50.8	4.46	41.54	4.07
				175	51.05	4.49	41.98	4.12
F13x-yyyz2 (74	1000	10	II	155	50.91	4.35	40.63	3.8
				160	51.28	4.36	41.29	3.86
				165	51.65	4.39	41.66	3.92
				170	51.95	4.44	42.25	4.02
				175	52.21	4.46	42.7	4.07
				180	52.47	4.49	43.14	4.12
F14x-yyyz2 (76), F22x-yyyz2 (76)	1000	10	II	160	52.29	4.35	41.72	3.8
				165	52.67	4.36	42.41	3.86
				170	53.16	4.41	43.02	3.95
				175	53.43	4.46	43.55	4.06
				180	53.66	4.47	43.93	4.09
				185	53.88	4.49	44.31	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F14x-yyyz2 (78), F31x-yyyz2 (78)	1000	10	II	165	53.66	4.35	42.82	3.8
				170	54.25	4.38	43.72	3.89
				175	54.68	4.42	44.38	3.99
				180	54.83	4.46	44.69	4.06
				185	55.3	4.49	45.47	4.12
F14x-yyyz2 (80), F22x-yyyz2 (80)	1000	10	II	165	55.04	4.35	43.92	3.8
				170	55.44	4.36	44.64	3.86
				175	55.84	4.39	45.04	3.92
				180	56.08	4.42	45.52	3.99
				185	56.24	4.46	45.84	4.06
				190	56.72	4.49	46.64	4.12
F14x-yyyz2 (82)	1000	10	II	170	56.42	4.35	45.02	3.8
				175	56.83	4.36	45.76	3.86
				180	57.24	4.39	46.17	3.92
				185	57.48	4.42	46.66	3.99
				190	57.65	4.46	46.99	4.06
				195	58.14	4.49	47.81	4.12
F14x-yyyz2 (84), F22x-yyyz2 (84), F31x-yyyz2 (84)	1000	10	II	175	57.79	4.35	46.12	3.8
				180	58.21	4.36	46.87	3.86
				185	58.63	4.39	47.29	3.92
				190	58.88	4.42	47.8	3.99
				195	59.05	4.46	48.13	4.06
				200	59.56	4.49	48.97	4.12
F14x-yyyz2 (86)	1000	10	II	180	59.17	4.35	47.21	3.8
				185	59.6	4.36	47.99	3.86
				190	60.03	4.39	48.42	3.92
				195	60.29	4.42	48.93	3.99
				200	60.46	4.46	49.28	4.06
				205	60.97	4.49	50.14	4.12
F14x-yyyz2 (88), F22x-yyyz2 (88)	1000	10	II	185	60.54	4.35	48.31	3.8
				190	60.98	4.36	49.1	3.86
				195	61.42	4.39	49.54	3.92
				200	61.69	4.42	50.07	3.99
				205	61.86	4.46	50.42	4.06
				210	62.39	4.49	51.3	4.12
F14x-yyyz2 (90), F31x-yyyz2 (90)	1000	10	II	190	61.92	4.35	49.41	3.8
				195	62.37	4.36	50.22	3.86
				200	62.82	4.39	50.67	3.92
				205	63.09	4.42	51.21	3.99
				210	63.27	4.46	51.57	4.06
				215	63.81	4.49	52.47	4.12

Standard test conditions (STC): 1000W/m^2, 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F14x-yyyz2 (92), F22x-yyyz2 (92)	1000	10	II	190	63.3	4.35	50.51	3.8
				195	63.53	4.35	50.92	3.83
				200	63.76	4.36	51.34	3.86
				205	64.22	4.39	51.8	3.92
				210	64.49	4.42	52.35	3.99
				215	64.68	4.46	52.72	4.06
				220	65.23	4.49	53.64	4.12
F14x-yyyz2 (94)	1000	10	II	195	64.67	4.35	51.61	3.8
				200	65.14	4.36	52.45	3.86
				205	65.61	4.39	52.92	3.92
				210	65.75	4.41	53.2	3.95
				215	65.89	4.42	53.49	3.99
				220	66.08	4.46	53.86	4.06
				225	66.65	4.49	54.8	4.12
F14x-yyyz2 (96), F22x-yyyz2 (96), F32x-yyyz2 (96)	1000	10	II	200	66.05	4.35	52.7	3.8
				205	66.53	4.36	53.57	3.86
				210	67.01	4.39	54.05	3.92
				215	67.15	4.41	54.34	3.95
				220	67.3	4.42	54.62	3.99
				225	67.49	4.46	55.01	4.06
				230	68.06	4.49	55.97	4.12
F14x-yyyz2 (98)	1000	10	II	205	67.42	4.35	53.8	3.8
				210	67.91	4.36	54.68	3.86
				215	68.4	4.39	55.17	3.92
				220	68.7	4.42	55.76	3.99
				225	68.8	4.44	55.96	4.02
				230	68.89	4.46	56.15	4.06
				235	69.48	4.49	57.13	4.12
F15x-yyyz2 (100), F22x-yyyz2 (100)	1000	10	II	210	68.8	4.35	54.9	3.8
				215	69.3	4.36	55.8	3.86
				220	69.8	4.39	56.3	3.92
				225	70.1	4.42	56.9	3.99
				230	70.2	4.44	57.1	4.02
				235	70.3	4.46	57.3	4.06
				240	70.9	4.49	58.3	4.12
F15x-yyyz2 (102), F32x-yyyz2 (102)	1000	10	II	215	70.18	4.35	56	3.8
				220	70.69	4.36	56.92	3.86
				225	71.2	4.39	57.43	3.92
				230	71.5	4.42	58.04	3.99
				235	71.71	4.46	58.45	4.06
				240	72.01	4.47	58.96	4.09
				245	72.32	4.49	59.47	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F15x-yyyz2 (104), F22x-yyyz2 (104)	1000	10	II	215	71.55	4.35	57.1	3.8
				220	71.81	4.35	57.56	3.83
				225	72.07	4.36	58.03	3.86
				230	72.59	4.39	58.55	3.92
				235	72.9	4.42	59.18	3.99
				240	73.11	4.46	59.59	4.06
				245	73.42	4.47	60.11	4.09
				250	73.74	4.49	60.63	4.12
F15x-yyyz2 (106)	1000	10	II	220	72.93	4.35	58.19	3.8
				225	73.19	4.35	58.67	3.83
				230	73.46	4.36	59.15	3.86
				235	73.99	4.39	59.68	3.92
				240	74.31	4.42	60.31	3.99
				245	74.52	4.46	60.74	4.06
				250	74.84	4.47	61.27	4.09
				255	75.15	4.49	61.8	4.12
F15x-yyyz2 (108), F23x-yyyz2 (108), F32x-yyyz2 (108)	1000	10	II	225	74.3	4.35	59.29	3.8
				230	74.84	4.36	60.26	3.86
				235	75.11	4.38	60.53	3.89
				240	75.38	4.39	60.8	3.92
				245	75.71	4.42	61.45	3.99
				250	75.92	4.46	61.88	4.06
				255	76.25	4.47	62.42	4.09
				260	76.57	4.49	62.96	4.12
F15x-yyyz2 (110)	1000	10	II	230	75.68	4.35	60.39	3.8
				235	76.23	4.36	61.38	3.86
				240	76.51	4.38	61.66	3.89
				245	76.78	4.39	61.93	3.92
				250	77.11	4.42	62.59	3.99
				255	77.33	4.46	63.03	4.06
				260	77.66	4.47	63.58	4.09
				265	77.99	4.49	64.13	4.12
F15x-yyyz2 (112), F23x-yyyz2 (112)	1000	10	II	235	77.06	4.35	61.49	3.8
				240	77.62	4.36	62.5	3.86
				245	78.18	4.39	63.06	3.92
				250	78.34	4.41	63.39	3.95
				255	78.51	4.42	63.73	3.99
				260	78.74	4.46	64.18	4.06
				265	79.07	4.47	64.74	4.09
				270	79.41	4.49	65.3	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F32x-yyyz2 (114)	1000	10	II	240	78.43	4.35	62.59	3.8
				245	79	4.36	63.61	3.86
				250	79.57	4.39	64.18	3.92
				255	79.74	4.41	64.52	3.95
				260	79.91	4.42	64.87	3.99
				265	80.14	4.46	65.32	4.06
				270	80.48	4.47	65.89	4.09
				275	80.83	4.49	66.46	4.12
F23x-yyyz2 (116)	1000	10	II	240	79.81	4.35	63.68	3.8
				245	80.1	4.35	64.21	3.83
				250	80.39	4.36	64.73	3.86
				255	80.97	4.39	65.31	3.92
				260	81.14	4.41	65.66	3.95
				265	81.32	4.42	66	3.99
				270	81.55	4.46	66.47	4.06
				275	81.9	4.47	67.05	4.09
				280	82.24	4.49	67.63	4.12
F23x-yyyz2 (120), F32x-yyyz2 (120)	1000	10	II	250	82.56	4.35	65.88	3.8
				255	82.86	4.35	66.42	3.83
				260	83.16	4.36	66.96	3.86
				265	83.76	4.39	67.56	3.92
				270	84.12	4.42	68.28	3.99
				275	84.24	4.44	68.52	4.02
				280	84.36	4.46	68.76	4.06
				285	84.72	4.47	69.36	4.09
				290	85.08	4.49	69.96	4.12
F23x-yyyz2 (124)	1000	10	II	260	85.31	4.35	68.08	3.8
				265	85.93	4.36	69.19	3.86
				270	86.24	4.38	69.5	3.89
				275	86.55	4.39	69.81	3.92
				280	86.92	4.42	70.56	3.99
				285	87.05	4.44	70.8	4.02
				290	87.17	4.46	71.05	4.06
				295	87.54	4.47	71.67	4.09
				300	87.92	4.49	72.29	4.12
F32x-yyyz2 (126)	1000	10	II	265	86.69	4.35	69.17	3.8
				270	87.32	4.36	70.31	3.86
				275	87.63	4.38	70.62	3.89
				280	87.95	4.39	70.94	3.92
				285	88.33	4.42	71.69	3.99
				290	88.45	4.44	71.95	4.02
				295	88.58	4.46	72.2	4.06
				300	88.96	4.47	72.83	4.09
				305	89.33	4.49	73.46	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F23x-yyyz2 (128)	1000	10	II	265	88.06	4.35	70.27	3.8
				270	88.38	4.35	70.85	3.83
				275	88.7	4.36	71.42	3.86
				280	89.34	4.39	72.06	3.92
				285	89.54	4.41	72.45	3.95
				290	89.73	4.42	72.83	3.99
				295	89.86	4.44	73.09	4.02
				300	89.98	4.46	73.34	4.06
				305	90.75	4.49	74.62	4.12
F23x-yyyz2 (132), F32x-yyyz2 (132)	1000	10	II	275	90.82	4.35	72.47	3.8
				280	91.15	4.35	73.06	3.83
				285	91.48	4.36	73.66	3.86
				290	92.14	4.39	74.32	3.92
				295	92.33	4.41	74.71	3.95
				300	92.53	4.42	75.11	3.99
				305	92.8	4.46	75.64	4.06
				310	93.19	4.47	76.3	4.09
				315	93.59	4.49	76.96	4.12
F23x-yyyz2 (136)	1000	10	II	285	93.57	4.35	74.66	3.8
				290	93.91	4.35	75.28	3.83
				295	94.25	4.36	75.89	3.86
				300	94.93	4.39	76.57	3.92
				305	95.13	4.41	76.98	3.95
				310	95.34	4.42	77.38	3.99
				315	95.61	4.46	77.93	4.06
				320	96.02	4.47	78.61	4.09
				325	96.42	4.49	79.29	4.12
F32x-yyyz2 (138)	1000	10	II	290	94.94	4.35	75.76	3.8
				295	95.63	4.36	77	3.86
				300	95.98	4.38	77.35	3.89
				305	96.32	4.39	77.69	3.92
				310	96.53	4.41	78.11	3.95
				315	96.74	4.42	78.52	3.99
				320	97.01	4.46	79.07	4.06
				325	97.43	4.47	79.76	4.09
				330	97.84	4.49	80.45	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F23x-yyyz2 (140)	1000	10	II	290	96.32	4.35	76.86	3.8
				295	96.67	4.35	77.49	3.83
				300	97.02	4.36	78.12	3.86
				305	97.37	4.38	78.47	3.89
				310	97.72	4.39	78.82	3.92
				315	98.14	4.42	79.66	3.99
				320	98.28	4.44	79.94	4.02
				325	98.42	4.46	80.22	4.06
				330	98.84	4.47	80.92	4.09
				335	99.26	4.49	81.62	4.12
F23x-yyyz2 (144), F32x-yyyz2 (144)	1000	10	II	300	99.07	4.35	79.06	3.8
				305	99.43	4.35	79.7	3.83
				310	99.79	4.36	80.35	3.86
				315	100.15	4.38	80.71	3.89
				320	100.51	4.39	81.07	3.92
				325	100.94	4.42	81.94	3.99
				330	101.09	4.44	82.22	4.02
				335	101.23	4.46	82.51	4.06
				340	101.66	4.47	83.23	4.09
				345	102.1	4.49	83.95	4.12
F23x-yyyz2 (148)	1000	10	II	310	101.82	4.35	81.25	3.8
				315	102.19	4.35	81.92	3.83
				320	102.56	4.36	82.58	3.86
				325	103.3	4.39	83.32	3.92
				330	103.53	4.41	83.77	3.95
				335	103.75	4.42	84.21	3.99
				340	103.9	4.44	84.51	4.02
				345	104.04	4.46	84.8	4.06
				350	104.49	4.47	85.54	4.09
				355	104.93	4.49	86.28	4.12
F32x-yyyz2 (150)	1000	10	II	315	103.2	4.35	82.35	3.8
				320	103.58	4.35	83.03	3.83
				325	103.95	4.36	83.7	3.86
				330	104.7	4.39	84.45	3.92
				335	104.93	4.41	84.9	3.95
				340	105.15	4.42	85.35	3.99
				345	105.3	4.44	85.65	4.02
				350	105.45	4.46	85.95	4.06
				355	105.9	4.47	86.7	4.09
				360	106.35	4.49	87.45	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”

Model	Maximum System Voltage, (Vdc)	Maximum Series Fuse, (A)	Class (IEC 61140)	Pmax (W)	Voc (V)	Isc (A)	Vmpp (V)	Impp (A)
				± 5%	± 10%	± 10%		
F24x-yyyz2 (152)	1000	10	II	315	104.58	4.35	83.45	3.8
				320	104.96	4.35	84.13	3.83
				325	105.34	4.36	84.82	3.86
				330	105.72	4.38	85.2	3.89
				335	106.1	4.39	85.58	3.92
				340	106.32	4.41	86.03	3.95
				345	106.55	4.42	86.49	3.99
				350	106.7	4.44	86.79	4.02
				355	106.86	4.46	87.1	4.06
				360	107.31	4.47	87.86	4.09
				365	107.77	4.49	88.62	4.12
F24x-yyyz2 (156), F32x-yyyz2 (156)	1000	10	II	325	107.33	4.35	85.64	3.8
				330	107.72	4.35	86.35	3.83
				335	108.11	4.36	87.05	3.86
				340	108.5	4.38	87.44	3.89
				345	108.89	4.39	87.83	3.92
				350	109.12	4.41	88.3	3.95
				355	109.36	4.42	88.76	3.99
				360	109.51	4.44	89.08	4.02
				365	109.67	4.46	89.39	4.06
				370	110.14	4.47	90.17	4.09
				375	110.6	4.49	90.95	4.12
F24x-yyyz2 (160)	1000	10	II	335	110.08	4.35	87.84	3.8
				340	110.48	4.35	88.56	3.83
				345	110.88	4.36	89.28	3.86
				350	111.28	4.38	89.68	3.89
				355	111.68	4.39	90.08	3.92
				360	111.92	4.41	90.56	3.95
				365	112.16	4.42	91.04	3.99
				370	112.48	4.46	91.68	4.06
				375	112.8	4.47	92.21	4.08
				380	113.12	4.48	92.75	4.1
				385	113.44	4.49	93.28	4.12

Standard test conditions (STC): 1000W/m², 25°C, AM 1.5 Spectrum.

Where x = “F” or “B”, yyy = output power and z = “B” or “W”								
Model	**Maximum System Voltage, (Vdc)**	**Maximum Series Fuse, (A)**	**Class (IEC 61140)**	**Pmax (W)**	**Voc (V)**	**Isc (A)**	**Vmpp (V)**	**Impp (A)**
				± 5%	**± 10%**	**± 10%**		
F33x-yyyz2 (162)	1000	10	II	340	111.46	4.35	88.94	3.8
				345	111.86	4.35	89.67	3.83
				350	112.27	4.36	90.4	3.86
				355	112.67	4.38	90.8	3.89
				360	113.08	4.39	91.21	3.92
				365	113.56	4.42	92.18	3.99
				370	113.72	4.44	92.5	4.02
				375	113.89	4.46	92.83	4.06
				380	114.21	4.47	93.37	4.08
				385	114.53	4.48	93.91	4.1
				390	114.86	4.49	94.45	4.12
F24x-yyyz2 (164)	1000	10	II	340	112.83	4.35	90.04	3.8
				345	113.11	4.35	90.53	3.82
				350	113.38	4.36	91.02	3.84
				355	113.65	4.36	91.51	3.86
				360	114.47	4.39	92.33	3.92
				365	114.72	4.41	92.82	3.95
				370	114.96	4.42	93.32	3.99
				375	115.13	4.44	93.64	4.02
				380	115.29	4.46	93.97	4.06
				385	115.62	4.47	94.52	4.08
				390	115.95	4.48	95.07	4.1
				395	116.28	4.49	95.61	4.12
F24x-yyyz2 (168), F33x-yyyz2 (168)	1000	10	II	350	115.58	4.35	92.23	3.8
				355	116	4.35	92.99	3.83
				360	116.42	4.36	93.74	3.86
				365	116.84	4.38	94.16	3.89
				370	117.26	4.39	94.58	3.92
				375	117.52	4.41	95.09	3.95
				380	117.77	4.42	95.59	3.99
				385	117.94	4.44	95.93	4.02
				390	118.1	4.46	96.26	4.06
				395	118.44	4.47	96.82	4.08
				400	118.78	4.48	97.38	4.1
				405	119.11	4.49	97.94	4.12

Standard test conditions (STC): 1000W/m^2, 25°C, AM 1.5 Spectrum.

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