



December 19, 2018

Ms. Mary McClintock, Chair  
Conway Planning Board  
Town of Conway, P.O. Box 240  
Conway, MA 01341

Via: First Class & email: [concomm@townofconway.com](mailto:concomm@townofconway.com)

Reference Application for Site Plan Review  
2394 Main Poland Road  
Conway, Massachusetts  
WDA JN-1212

Dear Ms. McClintock and Members of the Board:

On behalf of Nexamp, LLC. (Applicant), we are submitting herewith an Application for Site Plan Review for the installation of a ground mounted solar array and associated utility connection at 2394 Main Poland Road, with the property located along the west side of the road. This lot is identified on the Town of Conway's Assessors/GIS Map 68, Parcel 415-15.1. This filing has been prepared in accordance with the Town of Conway Zoning Bylaws, Section 64: Site Plan Review and Section 91: Large Scale Solar Facilities Bylaw. This filing contains the following for your reference:

1. Site Plan Review Application (Original & 8 copies)
2. 8.5" x 11" USGS Locus Map
3. List of Abutters within 100'
4. Filing Fee of \$15,188.78 for the Town's share of Notice of Intent
5. Narrative and associated documents for Solar Array prepared by Nexamp (118 pages)
6. Stormwater Management Report, prepared by WDA Design Group., dated May 2018 (2 copies)
7. Site Plans (13 sheets and a cover), prepared by WDA Design Group., dated December 19, 2018 (2 full size copies).
8. CD Rom containing filing materials

### Existing Conditions

The subject property is located along the westerly side of Main Poland Road, approximately 2,000' north of the South Ashfield Road intersection. The property is located in the Rural Residential/Agricultural (RR/A) zoning district. The site has 568.71' of frontage on the west side of Main Poland Road and approximately 3,250' of the westerly property boundary is part of the Ashfield/Conway Town boundary. The entire property is 104 ± acres, although only about half is associated with this filing, and of those 51± acres approximately 2.8 acres are wetland (both jurisdictional bordering wetlands and non-jurisdictional isolated wetlands). Aside from the existing single-family home and gravel drive, the property is wooded. Adjacent property uses are single-family residential to the west and south (some in Ashfield), residential/agricultural to the east/northeast and undeveloped land to the north. Topography is variable, ranging from a high elevation of 1,484 at the top of Abbott Hill in the northern portion of the property to a low elevation of 1,200±

near Main Poland Road in the southeast portion of the site (elevations refer to NAVD 1988) where the driveway enters from Main Poland Road. Several cart paths and interior stone walls traverse the property. Additionally, part of the central and eastern portion the site is subject to a limited tree harvesting. The upland areas are comprised mainly of white pine, hemlock, oak, beech, black and white birch, red maple, black cherry, mountain laurel, hazelnut and ground pine.

WDA Design Group (WDA) flagged the resource areas in April and August 2018, being Bordering Vegetated Wetlands (BVW) and Isolated Wetlands (IW) and the flags were subsequently located during an on-the-ground survey by WDA and are shown on the attached plans. The wetland boundaries as well as intermittent channels were reviewed in the field with the Conservation Commission peer reviewer Ward Smith during the ANRAD review period. The Commission issued an ORAD on September 25, 2018 (DEP #138-0118, recorded FCRD bk. 07266, pg. 52) confirming the on-site resource areas within only that area of the site (51+/- acres) as noted on the plans. Additionally, Bradford Brook, located to the west of South Ashfield Road, is shown as a perennial stream on the USGS maps, and projects a 200' Riverfront Area onto a portion of the site along South Ashfield Road.

No portion of the site contains a Special Flood Hazard Area (aka, Zone A; "100-year flood plain") as depicted on the FEMA flood map 250114 0010 B (dated June 4, 1980). No portion of the site contains an area of priority wildlife or habitat, or certified or potential vernal pools according to the current NHESP Atlas (14<sup>th</sup> Edition, dated August 1, 2017).

The soils mapped on-site by the NRCS are Pillsbury fine sandy loam (map unit 75B-hydric soil) and Millsite-Westminster Complex, rocky (Map unit 116C-F), Millsite-Westminster Complex, very rocky (map unit 120B) and Colrain-Millsite Complex, rocky (map unit 118B).

## Proposed Work

The project involves the installation of a large scale (6 MW DC  $\pm$ ) ground mounted solar photovoltaic installation in the central portion of the site, generally in the flatter "plateau" areas of the site. The fenced area will comprise approximately 25 acres (22 $\pm$  for panels) and the overall cleared area will be approximately 35 acres. The solar panels are mounted to vertical posts that will be driven into the ground to support steel frames to which the modules are affixed. Portions of the site are to be regraded, that is flattened or smoothed to a slope suitable for the installation of the posts and frames. The maximum slope across the array (east/west) is to be 20% (5:1), which as demonstrated on the grading plan is essentially the maximum natural slope of the majority of the site. The area surrounding the array will be loamed and seeded with a New England Restoration Mix where earthwork and/or stumping/grubbing occurs. The panels will be located approximately 3' off the ground at the front (south edge) and 9' off the ground at the back (north edge) of the panels, with 16' between each east/west row and 5' (minimum) between each north/south column. The array will be encircled by an 7' tall chain link security fence with gates for maintenance and emergency access. Given the overall size of the property and natural wooded and slope buffers, the array will be naturally screened.

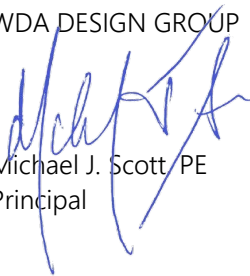
The solar array will be connected to power inverters, small cabinets to be installed as shown on the site plans, via underground conduit and wiring. The power inverters will eventually be connected to Eversource's (NSTAR) 3-phase overhead power system at Main Poland Road. The other residences along Main Poland Road are serviced by the existing power supply and will be unaffected by the solar tie into the 3-phase. The new power will connect via underground conduit and wiring routed to new transformers and new utility poles on site at the point of access. The Applicant has received an interconnection permit from Eversource (NSTAR). The solar array requires no other infrastructure, (i.e. water, sewer) to function.

In summary, proposed work includes clearing, grubbing and regrading portions of the site, installation of the underground conduit, the solar panels, a crushed stone access way (adequate for installation, maintenance and emergency vehicles) and the installation of new transformers, power poles and overhead wires near Main Poland Road.

We thank you in advance for your attention to the enclosed information and look forward to meeting with the Board at your next available public hearing to discuss this Application.

Sincerely,

WDA DESIGN GROUP



Michael J. Scott, PE  
Principal



Taylor Smith, EIT  
Civil Designer

cc: Mr. Ethan C. Gyles, PE, Nexamp

G:\common\1212A\Admin\Site Plan Review\JN1212SPltr.docx

# Site Plan Review Application – Conway MA

## Introduction

Site Plan Review establishes criteria for the layout, scale, appearance, safety, and environmental impacts of proposed development projects, in an attempt to "fit" larger projects into the community. Site plan review usually focuses on parking, traffic, drainage, roadway construction, signage, utilities, screening, lighting, and other aspects of the proposal to arrive at the best possible design for the location. **Site plan review can only be used to shape a project;** a project under site plan review can only be denied in rare circumstances, such as when an application is incomplete or inconsistent with the Conway Zoning Bylaws.

### **FEES AND OTHER EXPENSES:**

- SPR Application fee:** \$100.00 **plus** \$10.00 per 1000 square feet of land disturbance
- Abutters Notice mailing fee:** Total cost will vary depending on the number of abutters, and will include the cost/piece for Certified Mail/Return Receipt plus \$2.00 processing costs per piece
- Newspaper publishing fee:** Total cost will vary; to be paid directly to the Town of Conway prior to publication of legal notices.
- Consultant Review fee:** May be required for some projects; fee to be determined by Planning Board and deposited in advance by applicant.

### **CONTACTS:**

- Building Commissioner FCCIP:** 413-774-3167 x113  
FCCIP, Transit Center  
2 Olive St., Greenfield, MA 01301  
Email: [jhawkins@frcog.org](mailto:jhawkins@frcog.org)
- Board of Selectmen's Office  
Planning Board Admin. Staff:** 413-369-4235 x3  
32 Main St., Conway, MA 01341  
Email: [Planningboard@townofconway.com](mailto:Planningboard@townofconway.com)
- Town Clerk:** 413-369-4235 x4  
32 Main St., Conway, MA 01341  
Email: [Clerk@townofconway.com](mailto:Clerk@townofconway.com)
- Registry of Deeds:** 413-772-0239  
Franklin County Courthouse, 425 Main St., Greenfield, MA 01301
- Town Website:** [www.townofconway.com](http://www.townofconway.com)

### **HOURS AND SCHEDULES:**

- Building Commissioner's Office:** 9:00 a.m. to 4:00 p.m. Monday through Friday
- Town Clerk's Office:** 9:00 a.m. to 1:00 p.m. Tuesday & Thursday
- Board of Selectmen's Office:** 9:00 a.m. to 4:00 p.m. Monday through Thursday
- Planning Board Schedule:** Typically meets the first and third Thursday of each month at 6:00 p.m. in Town Office Meeting Room. This schedule or location may change due to holidays, earlier meeting start times, extra meetings in addition to the monthly meetings, etc. Please check with the Selectmen's Office to determine the next scheduled Planning Board meeting.

# Site Plan Review Application

# Town of Conway Planning Board

1. **Name of Applicant:** Conway Solar, LLC c/o Ethan Gyles Phone #: 617-431-1440

Mailing Address: 101 Summer Street, Boston, MA 2110

E-mail Address: egyles@nexamp.com

2. **Property Owner(s)** (If different from above. All entities listed on deed must be included. Please attach additional sheets if necessary.)

**Name:** Robert & Sarah Newman Phone #:

Mailing Address: 2394 Main Poland Road

E-mail Address: onion.and.sarah@gmail.com

3. **Name of Registered Land Surveyor/Engineer:** WDA Design Group

Mailing Address: 31 East Main Street, Westborough, MA 01581

Phone #: 508-366-6552 E-mail Address: msscott@wda-dg.com

4. **Parcel ID: Street Address:** 2394 Main Poland Road

**Map:\*** 68 **Lot/Parcel #:\*** 415-15.1 **Zoning District:\*** RR/A (Rural residential/Agriculture)

*\*This information can be found on your tax bill or can be obtained from the Board of Assessors.*

5. **Deed Reference: Book:** 03639 **Page:** 247

6. **Plan Reference: Book:** 103 **Page:** 96

7. **Parcel Area:** (all figures should be in square feet)

**Total Land Area:** 4,499,414 ± **Area of Disturbed Land:** 1,508,878 ±

**Gross Floor Area** of proposed construction: N/A **Net Floor Area:** N/A

8. **Proposed Use:** (mark all that apply)

- |  |                                       |   |
|--|---------------------------------------|---|
| <input checked="" type="checkbox"/> New Construction | <input type="checkbox"/> Commercial   | <input type="checkbox"/> Parking lot                            |
| <input type="checkbox"/> Alteration/Expansion        | <input type="checkbox"/> Industrial   | <input type="checkbox"/> Outdoor retail                         |
| <input type="checkbox"/> Municipal                   | <input type="checkbox"/> Multi-family | <input checked="" type="checkbox"/> Solar Electric Installation |
| <input type="checkbox"/> Institutional               | <input type="checkbox"/> Mixed Use    | <input type="checkbox"/> Flexible Development                   |
|  |                                       | <input type="checkbox"/> Planned Unit Development               |

**Describe the proposed use in detail, including square footages, where applicable:**

The site is a proposed large scale (6MW DC ±) ground mounted solar photovoltaic installation, with associated tree clearing, electric utility components, and fencing. The overall area to be cleared is approximately 35 acres ± and the array to be enclosed in the fencing is approximately 25 acres ±.

9. Property listed under Chapter 61, 61A, or 61B for tax purposes?  Yes  No
10. Modification of Existing Plan?  Yes  No
11. Special Permit Application Pending?  Yes  No
12. Stormwater Permit Required?  Yes  No
13. List any other Federal, State, and/or Municipal Permits required: NPDES, Stormwater Permit
- 
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14. I hereby certify that the information contained in this application is true and complete:

Applicant's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Owner(s) Signature(s): \_\_\_\_\_ Date: \_\_\_\_\_

(If different from applicant;  
attach additional sheets if necessary) \_\_\_\_\_ Date: \_\_\_\_\_

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**PLEASE ATTACH TWO ORIGINAL 24" x 36" SITE PLANS  
AND THE COMPLETED SITE PLAN REVIEW APPLICATION CHECKLIST**

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15. Building Commissioner Certification: \_\_\_\_\_ Date: \_\_\_\_\_

Comments: \_\_\_\_\_

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16. Town Clerk Certification: \_\_\_\_\_ Date: \_\_\_\_\_

## Town of Conway Planning Board

### Site Plan Review Application Checklist

Reason for Site Plan Review: \_\_\_\_\_

Special Permit application associated with this SPR application?  Yes  No (If yes, please attach copy) **Site Plan Submission Requirements (see Zoning Bylaws Section 64)**

- An original and eight (8) copies of the signed Site Plan Review application
- An original plan prepared by a registered professional engineer, registered architect, registered landscape architect, or registered land surveyor submitted on 24-inch by 36-inch sheets with a minimum scale of 1" = 40' **and**
- A compact disk containing a Standard Digital File (SDF) as defined by Version 2.0 of the MassGIS Standard for Digital Plan Submittals to Municipalities **and**  
 \_\_\_\_\_ a copy of the original CADD file in PDF format **plus**  
 \_\_\_\_\_ accompanying documents in PDF format
- Copies distributed to:
 

|                          |                               |
|--------------------------|-------------------------------|
| _____ Board of Health    | _____ Building Commissioner   |
| _____ Highway Department | _____ Conservation Commission |
| _____ Police Chief       | _____ Board of Selectmen      |
| _____ Fire Chief         | _____ Energy, Historical, ZBA |

35 day deadline for comments: \_\_\_\_\_

 **Contents of Plan (see Zoning Bylaws Section 64)**

- Identification of Applicant, Property Owner (if different), and Site Plan Preparer (incl. e-mail addresses)
- Property Description
- Applicant and Property Owner(s) signatures
- Town signatures: \_\_\_\_\_ Town Clerk and \_\_\_\_\_ Building Commissioner
- Certified list of abutters from Board of Assessors (+ 2 sets of mailing labels)
- All boundary line information pertaining to the land sufficient to permit location of same on ground with existing and proposed topography at 2 foot contour intervals and the location of wetlands, streams, water bodies, drainage swales, areas subject to flooding and unique natural features
- Existing and proposed buildings and structures, including fences, loading areas, accessory buildings, signs, waste disposal areas, and storage areas, with proposed building elevations or renderings; utilities and snow disposal methods
- Water provision, including fire protection measures
- Sanitary sewerage
- Storm drainage, including means of ultimate disposal and calculations to support maintenance of the requirements in the Zoning Bylaws
- Parking, walkways, driveways, and other access and egress provisions
- Existing trees 10" caliper or better and existing tree/shrub masses; proposed planting, landscaping, and screening
- Existing and proposed exterior lighting
- Signage

**For Office Use Only**

- Base Fee paid:** \$ \_\_\_\_\_ Date: \_\_\_\_\_ Town Clerk stamp: \_\_\_\_\_  
 Fee = \$100.00 **plus** \$10.00 per 1000 square feet of land disturbance  
 Calculation: Land disturbance = \_\_\_\_\_ sq. ft./1000 = \_\_\_\_\_ x \$10.00 = \$ \_\_\_\_\_
- Abutters list fee paid:** \$ \_\_\_\_\_ Date: \_\_\_\_\_ Assessor's initials: \_\_\_\_\_  
 Fee = Cost as determined by the Conway Assessor's Office + cost of 2 sets of mailing labels
- Mailing fee paid:** \$ \_\_\_\_\_ Date: \_\_\_\_\_ Town Clerk stamp: \_\_\_\_\_  
 Fee = cost/piece for Certified Mail/Return Receipt plus \$2.00 processing costs per piece

- Consultant Peer Review** requested by Planning Board: \_\_\_\_ Yes \_\_\_\_ No (If yes, complete below)
  - Date plans forwarded to reviewer(s): \_\_\_\_\_ List: \_\_\_\_\_
  - Date project-specific account established: \_\_\_\_\_ Town Accountant's initials: \_\_\_\_\_  
 (per MGL Ch. 44, §53g) Acct. #: \_\_\_\_\_
  - Consultant fee paid:** \$ \_\_\_\_\_ Date: \_\_\_\_\_ Town Clerk stamp: \_\_\_\_\_
    - Funds deposited into account: \_\_\_\_\_ Date: \_\_\_\_\_ Treasurer's initials: \_\_\_\_\_
    - Additional funds deposited: \$ \_\_\_\_\_ Date: \_\_\_\_\_ Treasurer's initials: \_\_\_\_\_
    - Unused funds returned: \$ \_\_\_\_\_ Date: \_\_\_\_\_ Treasurer's initials: \_\_\_\_\_  
 (with interest)

- FRCOG Review** requested by Planning Board: \_\_\_\_ Yes \_\_\_\_ No
  - Date plans forwarded to FRCOG: \_\_\_\_\_

- Date Site Plan rejected by Planning Board and sent back as incomplete: \_\_\_\_\_ (if applicable)
- Effective Date** of application (signed by Town Clerk): \_\_\_\_\_
- Decision Deadline:**  
 60 days from effective date: \_\_\_\_\_ **OR** 90 days: \_\_\_\_\_ (if PB also reviewing SP)
- Continuation request form filed with Town Clerk (if applicable) **Revised Decision Deadline:** \_\_\_\_\_

- Public Hearing Date:** \_\_\_\_\_ (Notice and postings pursuant to M.G.L. Ch. 40A, Sec. 11)  
 Date notice sent to newspaper: \_\_\_\_\_  
 Date confirmation of payment received: \_\_\_\_\_  
 Date of **first** legal notice in newspaper: \_\_\_\_\_ (not less than 14 days prior to hearing)  
 Date of **second** legal notice in newspaper: \_\_\_\_\_ (at least 7 days prior to hearing)  
 Date of certified mailing of notice to abutters: \_\_\_\_\_ (to be done by Administrative Staff)  
 Date posted in Town Hall, Town Office \_\_\_\_\_ (period not less than 14 days prior to hearing)  
 Date notice mailed to abutting Towns: \_\_\_\_\_

- Date Site Plan Approved:**
- Date Site Plan Review decision mailed to applicant: \_\_\_\_\_
- Date Site Plan Review decision filed with Town Clerk: \_\_\_\_\_

- NO APPEAL** has been filed with the Conway Town Clerk after 20 days Town Clerk stamp: \_\_\_\_\_



**SECTION 64: Site Plan Review** *(Added 11 May 2015)*

- a) **Purpose.** The purpose of Site Plan Review is to ensure that new development is designed in a manner which reasonably protects the environmental and scenic qualities of the neighborhood and the Town.
- b) **Site Plan Review Process.** The Site Plan Review process will be conducted by the Planning Board.
- c) **Applicability.** Site Plan Review shall be required for Large-scale Ground-Mounted Solar Facilities (Article 9), Light Industrial expansion, and other Non-Residential Uses.
- d) **Procedures.** An applicant for Site Plan Review shall file a completed application with the Town Clerk. The Town Clerk shall acknowledge receipt of the plans by signing and dating the application form. The application submitted to the Town Clerk shall include nine (9) copies each of an application form and any narrative documents as outlined in the submittal requirements. Upon receipt of the application, the Town Clerk shall transmit copies of the application to the Planning Board, Zoning Board of Appeals, Conservation Commission, Board of Health, the Highway Superintendent, Historical Commission, Energy Committee, the Fire Chief and the Police Chief. These Town Boards and municipal officials shall have 45 days from the date the completed application is received by the Town Clerk to report to the Planning Board their findings and recommendations, and they can attend the public hearing(s). No building permits for projects requiring Site Plan Review shall be issued until the Planning Board has approved the Site Plan or unless the required time period for taking action on a Site Plan has lapsed without action from the Planning Board. The applicant is also responsible for obtaining all applicable permits or approvals that may be required for the development from other Town Boards or municipal officials.
- e) **Public Hearing.** The Planning Board shall hold a public hearing within 65 days after the filing of a completed application and shall take final action on an application for Site Plan Review within 90 days of the close of the public hearing. Notice and posting of the public hearing shall comply with the provisions of M.G.L. Chapter 40A, Section 11, regarding notice for public hearings.
- f) **Required Contents of a Site Plan.** All Site Plans shall be prepared by a registered architect, registered land surveyor, registered landscape architect, or registered professional engineer. A locus map at a scale of 1" = 100 feet shall be provided showing parcels and roads within 300 feet of the property line. The Site Plans shall be on standard sheets of 24 inches by 36 inches and prepared at a scale of 1"=40 feet or finer. The Site Plan and accompanying narrative shall contain the following:
  - 1. Name of project, boundaries, locus map(s) showing site's location in Town, date, north arrow and scale of plan;
  - 2. Name(s), address(es), and phone number(s) of the owner(s) of the land, the developer (if applicable), and/or their designee;
  - 3. Name, title, address, and phone number of person(s) who prepared the plan;
  - 4. Names and addresses of all owners of record of abutting lots and those within 300 feet of the property line;
  - 5. All existing lot lines, easements and rights of way;
  - 6. Location and use of buildings and structures within 300 feet of the site;
  - 7. Location and use of all existing and proposed buildings and structures, including approximate height and floor area;
  - 8. Location and size in acres of wetlands on the site reviewed and approved by the Conway Conservation Commission;
  - 9. The location and a description of all proposed sewage disposal systems, sewer connections, water supplies, storm drainage systems, utilities and other waste-disposal methods;
  - 10. Location and date of all registered "perc" tests on the site;

11. Location of all proposed new lot lines;
12. Existing and proposed topography at a two-foot contour interval for the proposed grading and landscape plan;
13. Location of existing public ways and proposed private ways on the site;
14. Location and size of proposed parking and loading areas, driveways, walkways, access and egress points;
15. The location and a description of proposed open space or recreation areas;
16. The location of existing farmland and agricultural soils classified as prime farmland or soils of state and local importance;
17. Size and location of existing and proposed sign(s);
18. Surface drainage strategy that prevents increased drainage off-site or pollution;
19. Existing vegetation that will be left undisturbed and proposed landscape features, including the location and a description of screening, fencing and plantings using non-invasive species;
20. Design features which will integrate the proposed development into the existing landscape, maintain neighborhood character, and screen objectionable features from neighbors and roadways;
21. Estimated average daily and peak-hour vehicle trips to be generated by the site and traffic flow patterns for both vehicles and pedestrians, showing adequate access to and from the site and adequate circulation within the site; and
22. Other reasonable information the Planning Board may request in order to make a decision.

g) **Decision.** The Planning Board's action shall consist of either:

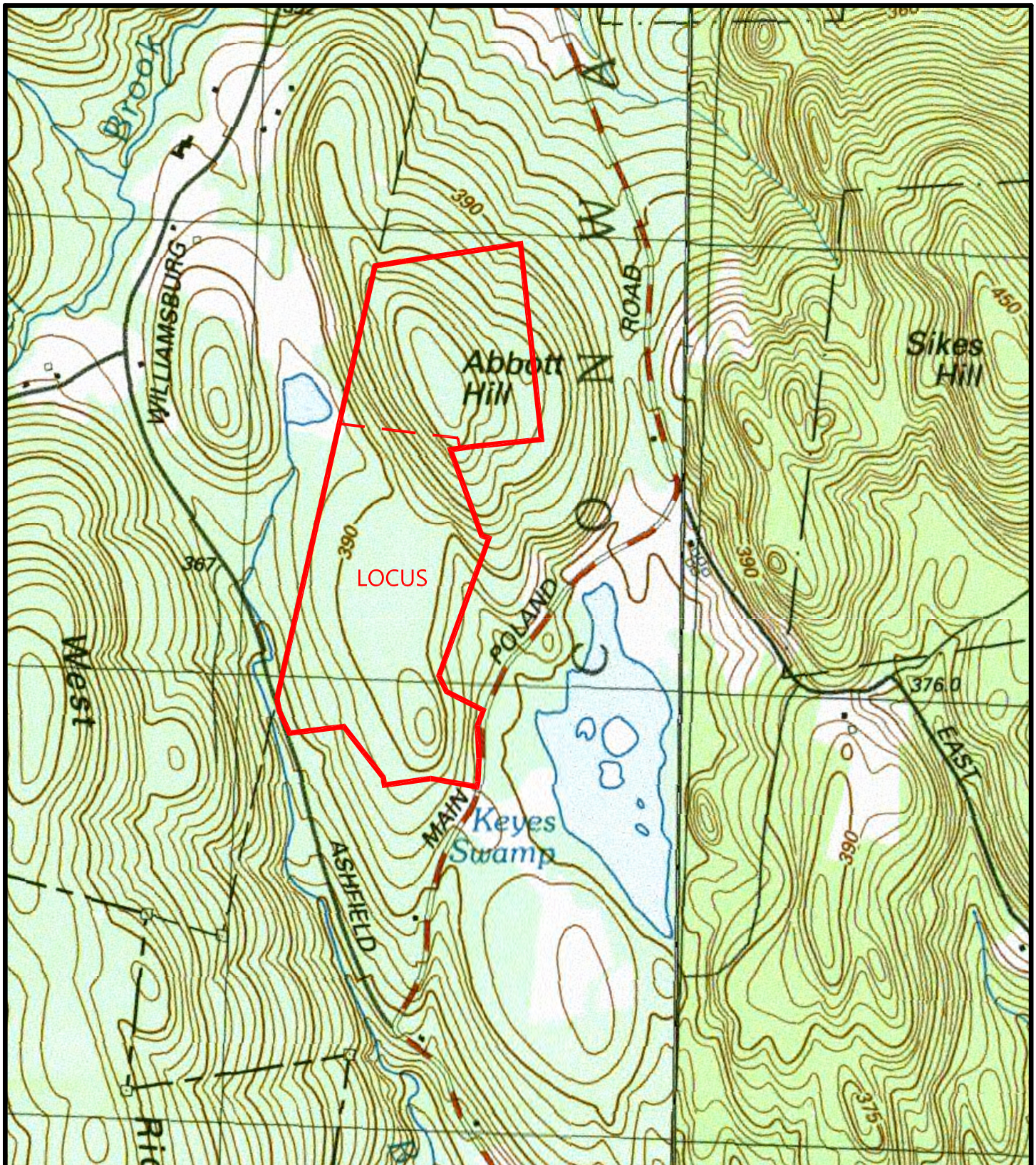
1. Approval of the Site Plan based upon the determination that the proposed project is in compliance and consistent with the criteria set forth in this Bylaw;
2. Approval of the Site Plan subject to conditions, modifications, and restrictions as the Planning Board may deem necessary; or
3. Denial of the Site Plan based upon specific findings such as a determination that there was insufficient information submitted with the proposal to adequately review it or that the project is inconsistent with the requirements of these Zoning Bylaws.

The decision of the Planning Board shall be filed with the Town Clerk within 90 days of the close of the Public Hearing. The written record of the Planning Board's decision including any approved Site Plan shall be filed with the Town Clerk within 14 days of the final vote or sooner to meet the 90 day maximum time frame. A copy of any approved Site Plan and the decision of the Planning Board shall be sent by the Town Clerk to the Building Inspector and the applicant. The Site Plan shall be recorded at the Registry of Deeds by the applicant with confirmation of such recording sent to the Town Clerk.

h) **Administration, Waivers and Appeals.** The Planning Board may adopt and from time to time amend regulations for the submission and approval of Site Plans. The Planning Board may waive any of the requirements for Site Plan Review submittals and approval if the simplicity or scale of the project warrants such action. The Planning Board may also request any additional information it should need to render a decision. For large or complex projects, the Planning Board shall have the right to retain a registered professional engineer, planner, designer or other professional to advise the Board regarding any or all aspects of the Site Plan. The applicant shall be responsible for the costs of such advice. Appeals of the decision by the Planning Board on the Site Plan may be submitted to the Zoning Board of Appeals.

i) **Compliance with Other Bylaws.** The Site Plan shall comply with any zoning bylaws for parking, loading, dimensions, environmental controls and all other provisions of the Zoning Bylaw. Before approval of a Site Plan, the Planning Board may request that the applicant make modifications in the proposed design of the project to ensure that the above criteria are met.

- j) **Review Criteria.** The Planning Board's evaluation of the proposed Site Plan shall include, as appropriate, the following:
1. Adequacy and arrangement of vehicular traffic access and circulation, including intersections, road widths, pavement surfaces, dividers and traffic controls;
  2. Adequacy and arrangement of pedestrian traffic access and circulation, pedestrian walkways, control of intersections with vehicular traffic and overall pedestrian safety and convenience;
  3. Location, arrangement, appearance and sufficiency of off-street parking and loading;
  4. Location, arrangement, size, design and general site compatibility of structures, buildings, lighting and signs in relation to the terrain and to the use, scale, and proportions of existing and proposed buildings in the vicinity;
  5. Location of structures and buildings to provide a solar and wind orientation or other construction methods that encourage energy conservation;
  6. Adequacy of stormwater and drainage facilities;
  7. Adequacy of landscaping and other screening to minimize the visual impact of the development from public ways or abutting properties; and
  8. Protection of farmland and forestry resources.



PREPARED BY:



31 EAST MAIN STREET WESTBOROUGH, MA | 508.366.6552  
7 CENTRAL STREET, PROVIDENCE, RI | 401.274.1360  
WDA-DB.COM

TITLE: USGS LOCUS PLAN  
2394 Main Poland Road  
Conway, MA

PREPARED FOR: NEXAMP, INC.  
101 Summer Street  
Boston, MA

SOURCE: USGS TOPOGRAPHIC MAP

DATE: 04/25/18 JOB NO.: 1212.00

DRAWN BY: BPW FILE NO.: 1212001

REV. NO.: -  
REV DATE: -





# 100 foot Abutters List Report

Ashfield, MA  
December 11, 2018

14-0-09 ✓

Caleb Ward ✓

1307 Williamsburg Rd

± 300 FOOT

Subject Property: 2394 MAIN POLAND RD - CONWAY

Parcel Number: 14-0-12  
CAMA Number: 14-0-12  
Property Address: 1401 WILLIAMSBURG RD

Mailing Address: NICHOLLS ESTATE HOWARD R  
NICHOLLS GLORIA H  
PO BOX 15  
WILLIAMSBURG, MA 01096-0015 ✓

## Abutters:

Parcel Number: 14-0-10  
CAMA Number: 14-0-10  
Property Address: 1327 WILLIAMSBURG RD

Mailing Address: MAZNICK MICHELLE D.  
1327 WILLIAMSBURG RD ✓  
WILLIAMSBURG, MA 01096

Parcel Number: 14-0-11  
CAMA Number: 14-0-11  
Property Address: 1359 WILLIAMSBURG RD

Mailing Address: CHIAMIS DANNY DELUCA MARIE  
P O BOX 66  
WILLIAMSBURG, MA 01096

Parcel Number: 14-0-15  
CAMA Number: 14-0-15  
Property Address: 1531 WILLIAMSBURG RD

Mailing Address: CRANSON RICHARD D  
P O BOX 63  
ASHFIELD, MA 01330

Parcel Number: 14-0-16  
CAMA Number: 14-0-16  
Property Address: 1344 WILLIAMSBURG RD

Mailing Address: SCHAEFER ROBERT YOELENE  
P O BOX 2010  
ASHFIELD, MA 01330

Parcel Number: 14-0-19  
CAMA Number: 14-0-19  
Property Address: 62 LUDWIG RD

Mailing Address: GARDNER BRUCE GARNER, WAYNE  
LIFE ESTATE  
62 LUDWIG RD  
WILLIAMSBURG, MA 01096

Parcel Number: 14-0-22  
CAMA Number: 14-0-22  
Property Address: WILLIAMSBURG RD

Mailing Address: DANELSKI CARL  
45 WHITESTONE LANE ✓  
LANCASTER, NY 14086

Parcel Number: 14-0-23  
CAMA Number: 14-0-23  
Property Address: WILLIAMSBURG RD

Mailing Address: BACON ROBERT J DANIEL F BACON,  
JOHN E BACON ✓  
20 HAWTHORNE TER  
FLORENCE, MA 01062-9766

Parcel Number: 14-0-68  
CAMA Number: 14-0-68  
Property Address: 1467 WILLIAMSBURG RD

Mailing Address: GOUGEON EDWARD CORRINE I  
1467 WILLIAMSBURG RD  
WILLIAMSBURG, MA 01096

Parcel Number: 14-0-75  
CAMA Number: 14-0-75  
Property Address: WILLIAMSBURG RD

Mailing Address: MONGEAU JOHN  
187 WEST STREET, APT 4  
WEST HATFIELD, MA 01088

14-0-24

Paul Bouchard

1668 Williamsburg Rd



www.cai-tech.com

Data shown on this report is provided for planning and informational purposes only. The municipality and CAI Technologies are not responsible for any use for other purposes or misuse or misrepresentation of this report.

12/11/2018

Page 1 of 1





# 300 foot Abutters List Report

Conway, MA

December 11, 2018

Parcel Number: 415-018-000  
CAMA Number: 415-018-000  
Property Address: 2262 MAIN POLAND RD

Mailing Address: Contact Town For Info

Parcel Number: 415-019-000  
CAMA Number: 415-019-000  
Property Address: 46 EAST GUINEA RD

Mailing Address: Contact Town For Info

Parcel Number: 415-021-000  
CAMA Number: 415-021-000  
Property Address: 0 MAIN POLAND RD

Mailing Address: Contact Town For Info

Parcel Number: 415-022-000  
CAMA Number: 415-022-000  
Property Address: 1870 MAIN POLAND RD

Mailing Address: Contact Town For Info



[www.cai-tech.com](http://www.cai-tech.com)

12/11/2018

Data shown on this report is provided for planning and informational purposes only. The municipality and CAI Technologies are not responsible for any use for other purposes or misuse or misrepresentation of this report.

Page 2 of 2

**To: Conway, MA Planning Board**

**Date: December 2018**

## **Decommissioning Surety Memorandum**

### **Introduction**

Nexamp has prepared this Decommissioning Plan (Plan) for the Conway Solar, LLC Photovoltaic Facility (Facility) off Main Poland Road, Conway, Massachusetts. This Plan was prepared to fulfill the requirements of the local bylaws and zoning ordinances and assumes that the Facility will be constructed in accordance with permits and conditions issued by the Planning Board and Conservation Commission.

### **Facility Description**

The proposed solar system Facility will consist of a new approximately **6 Megawatt MW (DC)** capacity solar power-generating operation secured within a chain-link fence surrounding the solar panels and equipment and accessed via a locked CLF gate. The Facility will include the following site features:

- An approximately 25-acre array of photovoltaic (PV) modules (panels) and mounting system;
- Screw driven piles supporting the photovoltaic modules;
- Up to two (2) transformers (filled with biodegradable vegetable oil);
- Underground conduit;
- A seven (7)-foot chain-link security fence;
- Underground conduit and wires;
- Up to six (6) aboveground wooden utility poles;
- Overhead wires; and,
- A gravel access road.

### **Decommissioning Plan**

The Facility will be decommissioned by completing the following major steps: Dismantlement and Demolition, Disposal or Recycle, and Site Stabilization as further described below.

Dismantlement, Demolition, and Disposal or Recycle



A significant amount of the components of the photovoltaic system at the Facility will include recyclable or re-saleable components, including copper, aluminum, galvanized steel, and modules. Due to their re-sale monetary value, these components will be dismantled and disassembled rather than being demolished and disposed of.

Following coordination with Eversource regarding timing and required procedures for disconnecting the Facility from the private utility, all electrical connections to the system will be disconnected and all connections will be tested locally to confirm that no electric current is running through them before proceeding. All electrical connections to the panels will be cut at the panel and then removed from their framework by cutting or dismantling the connections to the supports. Each panel will be individually lifted from its support (likely using a small crane and synthetic rigging straps), wrapped in sheet plastic and taped before being removed. They will then be stacked and cushioned on pallets, plastic wrapped, and transferred to a flat-bed truck for transfer to the purchaser or recycler. The exterior glass of the solar panels is commercial-grade and tempered, designed to significantly reduce a complete fracture. However, in the event of a total fracture, the interior materials are silicon-based and are not considered to be hazardous materials. Disposal of these materials at a landfill will be permissible.

The PV mounting system framework will be dismantled and recycled. The metal screw piles will be removed from their approximated depth of eight feet and recycled for salvage value.

Finally, all associated structures will be demolished and removed from the site for recycling or disposal as required in the bylaws for Conway. This will include the site fence and gates, which will likely be reclaimed or recycled. Grade slabs will be broken and removed to a depth of one foot below grade, and clean concrete will be crushed and disposed of off-site or recycled (reused either on- or off-site).

Sanitary facilities will be provided on-site for the workers conducting the decommissioning of the Facility.

Aboveground utility poles owned by Conway Solar, LLC will be completely removed and disposed of off-site in accordance with utility best practices. Overhead wires will be removed from the area of the solar modules and terminated at the utility-owned (Eversource) utility poles located on Main Poland Road. The access road will remain in place and Eversource will be responsible for dismantling those overhead wires and poles under its ownership. Coordination with Eversource personnel will be conducted to facilitate Eversource's removal of their aboveground poles and overhead wires located on the site.

A final site walkthrough will be conducted to remove debris and/or trash generated within the site during the decommissioning process and will include removal and proper disposal of any

debris that may have been wind-blown to areas outside the immediate footprint of the facility being removed.

### Site Stabilization

The areas of the Facility that are disturbed (during decommissioning) will be stabilized with the ground treatment approved by the Planning Board during the Special Permit Review process, including application of a drought-tolerant grass seed mix to surfaces disturbed during the decommissioning process. The gravel access road from Main Poland Road, including the portion within the perimeter fence surrounding the photovoltaic modules, will remain intact and shall be not removed.

### **Permitting Requirements**

Given the size and location of the Facility, several approvals are required prior to initiation of ground-disturbing activity. Table 1 provides a summary of the expected approvals if the decommissioning were to take place in January 2019. Noting, however, that because the decommissioning is expected to occur at a later date, the permitting requirements listed in the table below will be reviewed and updated based on current local, state, and federal regulations at the time.

### **Schedule and Cost**

The decommissioning process is estimated to take approximately six to eight (6-8) weeks (but no longer than six (6) months) and is intended to occur outside of the winter season.

Nexamp had solicited a specific construction estimate for decommissioning of this project (attached) along with assembling five separate bids regarding the salvage value of the raw materials intended for recycling.

**Table 1. Current Permitting Requirements for Decommissioning**

| <b>Permit</b>  | <b>Agency</b>                        | <b>Threshold/Trigger</b>  |
|--|--------------------------------------|---|
| National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges from Construction Activity | U.S. Environmental Protection Agency | Ground disturbance of greater than 1 acre with discharge to wetlands or water bodies. Requires preparation of a Stormwater Pollution Prevention Plan, including erosion and sedimentation controls.     |
| Special Permit Approval  | Town of Conway Planning Board        | Anticipated decommissioning requirements listed in the Special Permit Approval conditions of approval.  |
| Building Permit  | Town of Conway Building Departments  | A building permit is required to construct the facility. A building permit must also be obtained for any construction, alteration, repair, demolition, or change to the use or occupancy of a building. |

Permitting Requirement Assumptions:

1. The access road will remain in place throughout the Facility.
2. All ground disturbance, including temporary laydown areas if required within areas subject to the Massachusetts Wetlands Protection Act will obtain the appropriate approval from the Conway Conservation Commission (Assuming a negative determination from a RDA)

**Surety Proposal/ Decommissioning Cost Estimate**

Consistent with the approach it has taken in surrounding communities, and pursuant to the Town of Conway Zoning Ordinance, Nexamp, Inc., the parent company of Conway Solar, LLC, proposes to provide a decommissioning surety bond, to be posted prior to the beginning of operations (COD) and the final Conway Certificate of Compliance, in the amount of **\$76,000.00**, for decommissioning in the unlikely event that Nexamp is unable to meet its contractual obligations for solar project removal and restoration.

In developing the decommissioning surety bond, Nexamp utilized a recent decommissioning cost estimates from J & J Construction, one of the region’s largest site development contractors, specifically for this site. Nexamp also utilized recent 2018 salvage value estimates

from five recycling facilities in New England based on the assumption of recycling the solar modules, racking and associated project components as raw materials. In addition to the decommissioning cost, Nexamp included a 5% contingency and allowance for associated legal costs.

Below is a summary of the analysis:

| <b>Project Size (Megawatts DC)</b>   | <b>6 MW (DC)</b>                |
|--|---------------------------------|
| <b><u>Decommissioning Cost, No Salvage Value</u></b>                               |                                 |
| Decommissioning 6.2MW Example (\$206,800)  | \$33,355 /MW                    |
| 5% Contingency   | \$1,668 /MW                     |
| 3% Legal Services Estimate   | \$1,001 /MW                     |
| Total Decommissioning Cost, No Salvage Value                                       | <b><u>\$36,024 /MW</u></b>      |
| <b><u>Salvage Value</u></b>  |                                 |
| Market Based Salvage Estimate/ MW<br>(Average of 5 Bids-2018)                      | \$23,476/MW                     |
| Total Avg. Salvage Value:  | <b><u>\$23,476 /MW</u></b>      |
| <b><u>Decomm. Cost Estimate, Net Salvage Value</u></b>                             |                                 |
| Decommissioning Estimate   | \$36,024 / MW                   |
| Minus Salvage Value  | (\$23,476)/ MW                  |
| Decommissioning Cost, Net Salvage (\$)/MW:   | <b><u>\$12,548 /MW (DC)</u></b> |
| <b><u>Proposed Total Decommissioning Cost<br/>for the 6 MW Solar Project :</u></b> | <b><u>\$76,000.00</u></b>       |

The following attachments are included:

- J & J Construction Corporation Decommissioning Cost Estimate for the Example 6.2 MW (DC) Nexamp project
- Salvage Value Summary, (letters provided upon request)

Sincerely,

A handwritten signature in black ink, appearing to read "Chris Clark". The signature is fluid and cursive, with the first name "Chris" and the last name "Clark" clearly distinguishable.

---

Chris Clark; Conway Solar, LLC, c/o Nexamp, Inc.;

SVP Business Development



# J&J CONTRACTORS, INC.

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November 12, 2018

Alan L. Clapp, P.E.  
Spring Street Renewables, LLC

c/o Nexamp, Inc  
101 Summer Street  
Boston, MA 02110

Re: Spring Street, Franklin: Solar Decommissioning Cost Estimate

Dear Mr. Clapp,

J&J Contractors is pleased to provide you with the following decommissioning cost estimate for the 6.2 MW DC project in Franklin.

- Remove all solar infrastructures and return the site to a meadow condition
- Removal and disposal of non-recycled materials
- Removal and delivery to a recycling facility of the remaining materials (expecting most of the materials can be recycled)
- Dismantle panels, racking system, screw foundations, transformer/inverters, remove all wiring, R&D Nexamp utility poles (3)
- Slight regrading (smoothing of ruts) and reseedling of the area
  - i Removal of concrete pads.
  - i Labor and equipment cost for infrastructure \$29,000.00/mw. For a total cost of \$179,800.
  - i Labor and material cost for slight regrading and seeding \$ 21,000.00.
  - i Labor and material cost for concrete removal \$6,000.00

**Total cost for above work \$ 206,800.00**

If you have any question, please feel free to call me.

Sincerely,

Kamlesh Patel  
CEO

J&J Contractors, Inc.  
KamP@JJContractor.com

---

Phone 978.452.9898  
Fax 978.452.3796

101 Billerica Avenue, Bldg. 5, Suite 205  
North Billerica, MA 01862

[www.JJContractor.com](http://www.JJContractor.com)

### Salvage Values for Components of a 2.6 MW DC Solar Project

| Components of Typical 2.6MW DC Solar Site:                 | TOTAL WEIGHT | Primary Constituent Material | Anestis Metal Corp (\$/lb) | Stis Metal Corp Valuation | Salitsky Alloys inc (\$/lb) | Salitsky's Valuation | Green Recycling Industries (\$/lb) | Metals Green's Valuation | Mid City Scrap (\$/lb) | Mid City's Valuation | Kane Scrap      | Kane Scrap (\$/lb) |
|--|--------------|------------------------------|----------------------------|---------------------------|-----------------------------|----------------------|------------------------------------|--------------------------|------------------------|----------------------|-----------------|--------------------|
|  |              |                              | SCRAP RATE / lb            |                           | SCRAP RATE / lb             |                      | SCRAP RATE / lb                    |                          | SCRAP RATE / lb        |                      | SCRAP RATE / lb |                    |
| <b>Steel Components</b>                                    |              |                              |                            |                           |                             |                      |                                    |                          |                        |                      |                 |                    |
| CFS Cee Section - 363.38"                                  | 227,184      | Prepared Steel               | \$0.09                     | \$21,298.45               | \$0.08                      | \$18,002.26          | \$0.10                             | \$22,718.35              | \$0.10                 | \$21,805.56          | \$0.09          | \$21,298.45        |
| External Lateral Brace Tube - 2.360"x0.095"x22.000"        | 6,270        | Prepared Steel               | \$0.09                     | \$587.82                  | \$0.08                      | \$496.85             | \$0.10                             | \$627.01                 | \$0.10                 | \$601.82             | \$0.09          | \$587.82           |
| Internal Lateral Brace Tube -80                            | 11,438       | Prepared Steel               | \$0.09                     | \$1,072.34                | \$0.08                      | \$906.38             | \$0.10                             | \$1,143.82               | \$0.10                 | \$1,097.87           | \$0.09          | \$1,072.34         |
| Internal Lateral Brace Tube -81                            | 11,539       | Prepared Steel               | \$0.09                     | \$1,081.79                | \$0.08                      | \$914.37             | \$0.10                             | \$1,153.91               | \$0.10                 | \$1,107.55           | \$0.09          | \$1,081.79         |
| Internal Lateral Brace Tube - 82                           | 21,762       | Prepared Steel               | \$0.09                     | \$2,040.16                | \$0.08                      | \$1,724.42           | \$0.10                             | \$2,176.17               | \$0.10                 | \$2,088.73           | \$0.09          | \$2,040.16         |
| Complete HDG South Leg Assembly - 36.000"                  | 9,801        | Prepared Steel               | \$0.09                     | \$918.83                  | \$0.08                      | \$776.63             | \$0.10                             | \$980.09                 | \$0.10                 | \$940.71             | \$0.09          | \$918.83           |
| Complete HDG North Leg Assembly - 99.000"                  | 24,219       | Prepared Steel               | \$0.09                     | \$2,270.53                | \$0.08                      | \$1,919.14           | \$0.10                             | \$2,421.90               | \$0.10                 | \$2,324.59           | \$0.09          | \$2,270.53         |
| Inverter Posts - 96.000"                                   | 965          | Prepared Steel               | \$0.09                     | \$90.48                   | \$0.08                      | \$76.48              | \$0.10                             | \$96.51                  | \$0.10                 | \$92.63              | \$0.09          | \$90.48            |
| Rafter Beam - 134.760"                                     | 27,150       | Prepared Steel               | \$0.09                     | \$2,545.29                | \$0.08                      | \$2,151.38           | \$0.10                             | \$2,714.98               | \$0.10                 | \$2,605.89           | \$0.09          | \$2,545.29         |
| Galvanized Z-Purlin- 4ZS2 x 16 GA x 201.500"               | 46,276       | Prepared Steel               | \$0.09                     | \$4,338.34                | \$0.08                      | \$3,666.93           | \$0.10                             | \$4,627.56               | \$0.10                 | \$4,441.63           | \$0.09          | \$4,338.34         |
| Rafter Beam - 134.760"                                     | 26,053       | Prepared Steel               | \$0.09                     | \$2,442.45                | \$0.08                      | \$2,064.45           | \$0.10                             | \$2,605.28               | \$0.10                 | \$2,500.60           | \$0.09          | \$2,442.45         |
| Foundation KSF G 76x2100-3xm16                             | 51,200       | Prepared Steel               | \$0.09                     | \$4,057.00                | \$0.08                      | \$4,057.14           | \$0.10                             | \$5,120.00               | \$0.10                 | \$4,914.29           | \$0.09          | \$4,800.00         |
| Cross Brace Assembly - 219"                                | 1,643        | Prepared Steel               | \$0.09                     | \$154.05                  | \$0.08                      | \$130.21             | \$0.10                             | \$164.32                 | \$0.10                 | \$157.72             | \$0.09          | \$154.05           |
| Cross Brace Assembly - 203"                                | 72           | Prepared Steel               | \$0.09                     | \$6.75                    | \$0.08                      | \$5.71               | \$0.10                             | \$7.20                   | \$0.10                 | \$6.91               | \$0.09          | \$6.75             |
| M8 - 1.25 Hex Bolt x 20mm w/ M8 External Tooth Lock Washer | 7,702        | Prepared Steel               | \$0.09                     | \$722.10                  | \$0.08                      | \$610.34             | \$0.10                             | \$770.24                 | \$0.10                 | \$739.29             | \$0.09          | \$722.10           |
| 1/4 Flatwasher 18.8 ss                                     | 57           | Prepared Steel               | \$0.09                     | \$5.33                    | \$0.08                      | \$4.51               | \$0.10                             | \$5.69                   | \$0.10                 | \$5.46               | \$0.09          | \$5.33             |
| 1/4 Mid Split Lockwasher 18.8                              | 51           | Prepared Steel               | \$0.09                     | \$4.78                    | \$0.08                      | \$4.04               | \$0.10                             | \$5.10                   | \$0.10                 | \$4.90               | \$0.09          | \$4.78             |
| M8 - 1.25 Hex Nut  | 4,263        | Prepared Steel               | \$0.09                     | \$399.68                  | \$0.08                      | \$337.83             | \$0.10                             | \$426.33                 | \$0.10                 | \$409.20             | \$0.09          | \$399.68           |
| 1/4 Ext. Tooth Lock Washer                                 | 23           | Prepared Steel               | \$0.09                     | \$2.17                    | \$0.08                      | \$1.83               | \$0.10                             | \$2.32                   | \$0.10                 | \$2.22               | \$0.09          | \$2.17             |
| M6 External - Tooth LockWasher                             | 62           | Prepared Steel               | \$0.09                     | \$5.79                    | \$0.08                      | \$4.90               | \$0.10                             | \$6.18                   | \$0.10                 | \$5.93               | \$0.09          | \$5.79             |
| M16-2.0 x 40 Socket Set Screw Cone Pt HDG                  | 445          | Prepared Steel               | \$0.09                     | \$41.74                   | \$0.08                      | \$35.28              | \$0.10                             | \$44.53                  | \$0.10                 | \$42.74              | \$0.09          | \$41.74            |
| M16-2.0 Hex Jam Nut Gr. 2 HDG                              | 198          | Prepared Steel               | \$0.09                     | \$18.57                   | \$0.08                      | \$15.70              | \$0.10                             | \$19.81                  | \$0.10                 | \$19.02              | \$0.09          | \$18.57            |
| 3/8-16 x 3" Hex Bolt                                       | 148          | Prepared Steel               | \$0.09                     | \$13.84                   | \$0.08                      | \$11.70              | \$0.10                             | \$14.76                  | \$0.10                 | \$14.17              | \$0.09          | \$13.84            |
| 3/8-16 x 1-1/2 Brace Clamp Carriage Bolt                   | 278          | Prepared Steel               | \$0.09                     | \$26.08                   | \$0.08                      | \$22.04              | \$0.10                             | \$27.82                  | \$0.10                 | \$26.70              | \$0.09          | \$26.08            |
| 3/8-16 Serrated Flange Nut                                 | 101          | Prepared Steel               | \$0.09                     | \$9.47                    | \$0.08                      | \$8.01               | \$0.10                             | \$10.11                  | \$0.10                 | \$9.70               | \$0.09          | \$9.47             |
| 1/2 - 13 x 1-1/2 Serrated Flange Hex Bolt                  | 916          | Prepared Steel               | \$0.09                     | \$85.86                   | \$0.08                      | \$72.57              | \$0.10                             | \$91.58                  | \$0.10                 | \$87.90              | \$0.09          | \$85.86            |
| 1/2 - 13 x 3-1/2 Serrated Flange Hex Bolt                  | 387          | Prepared Steel               | \$0.09                     | \$36.27                   | \$0.08                      | \$30.65              | \$0.10                             | \$38.69                  | \$0.10                 | \$37.13              | \$0.09          | \$36.27            |
| 1/2 - 13 Serrated Flange Nut                               | 208          | Prepared Steel               | \$0.09                     | \$19.54                   | \$0.08                      | \$16.52              | \$0.10                             | \$20.84                  | \$0.10                 | \$20.01              | \$0.09          | \$19.54            |
| Interlocking Brace Clamp - HDG                             | 5,092        | Prepared Steel               | \$0.09                     | \$477.40                  | \$0.08                      | \$403.52             | \$0.10                             | \$509.23                 | \$0.10                 | \$488.77             | \$0.09          | \$477.40           |
| L 5x5x1/2 Finished L-Bracket                               | 10,137       | Prepared Steel               | \$0.09                     | \$950.36                  | \$0.08                      | \$803.28             | \$0.10                             | \$1,013.72               | \$0.10                 | \$972.99             | \$0.09          | \$950.36           |
|  | 495,640      |                              |                            | <b>\$46,466.28</b>        |                             | <b>\$39,275.07</b>   |                                    | <b>\$48,550.31</b>       |                        | <b>\$46,599.63</b>   |                 | <b>\$45,515.92</b> |
| <b>Wire, Insulated</b>                                     |              |                              |                            |                           |                             |                      |                                    |                          |                        |                      |                 |                    |
|  |              |                              | SCRAP RATE / lb            |                           | SCRAP RATE / lb             | TOTAL                | SCRAP RATE / lb                    |                          | SCRAP RATE / lb        |                      | SCRAP RATE / lb |                    |
| #10 PV RATED WIRE Cu per circuit (1000VDC)                 | 6,035        | Copper                       | \$1.30                     | \$7,845.50                | \$1.00                      | \$6,035.00           | \$0.84                             | \$5,069.40               | \$2.35                 | \$14,182.25          | \$2.40          | \$14,484.00        |
| 250MCM AL RHW-2 (1000VDC)                                  | 12877        | Aluminium                    | \$0.30                     | \$3,863.10                | \$0.45                      | \$5,794.65           | \$0.37                             | \$4,764.49               | \$0.35                 | \$4,506.95           | \$0.60          | \$7,726.20         |
| #1 AL EGC RHW-2 (1000VDC)                                  | 924          | Aluminium                    | \$0.30                     | \$277.20                  | \$0.45                      | \$415.80             | \$0.37                             | \$341.88                 | \$0.35                 | \$323.40             | \$0.60          | \$554.40           |
| 400 KCMIL AL.  | 488          | Aluminium                    | \$0.30                     | \$146.40                  | \$0.45                      | \$219.60             | \$0.37                             | \$180.56                 | \$0.35                 | \$170.80             | \$0.60          | \$292.80           |
| 350 KCMIL AL.  | 435          | Aluminium                    | \$0.30                     | \$130.50                  | \$0.45                      | \$195.75             | \$0.37                             | \$160.95                 | \$0.35                 | \$152.25             | \$0.60          | \$261.00           |
| 1/0 AWG AL. 15kv   | 332          | Aluminium                    | \$0.30                     | \$99.60                   | \$0.45                      | \$149.40             | \$0.37                             | \$122.84                 | \$0.35                 | \$116.20             | \$0.60          | \$199.20           |
| <b>Total Value of Aluminum and Copper</b>                  |              |                              |                            | <b>\$12,362.30</b>        |                             | <b>\$12,810.20</b>   |                                    | <b>\$10,640.12</b>       |                        | <b>\$19,451.85</b>   |                 | <b>\$23,517.60</b> |
| <b>Total Value per 2.6MW DC</b>                            |              |                              |                            | <b>\$58,828.58</b>        |                             | <b>\$52,085.27</b>   |                                    | <b>\$59,190.43</b>       |                        | <b>\$66,051.48</b>   |                 | <b>\$69,033.52</b> |
| <b>Total Salvage Value per MW DC</b>                       |              |                              |                            | <b>\$22,626.38</b>        |                             | <b>\$20,032.80</b>   |                                    | <b>\$22,765.55</b>       |                        | <b>\$25,404.41</b>   |                 | <b>\$26,551.35</b> |





10/8/18

# Metal Green Recycling Industries

Office: 551-580-7570

Fax: 877-249-6117

**All price is delivered to kearny NJ**

WS only

Shipping term

**Deliver**

\*\*Price are subject to change due to market conditions.

Quantity must be specified before a PO is issued

Circle the item and quantity, simply email/fax back

## Copper

\$2.76

Date:

10/8/2018

| Copper product                         |            |
|--|------------|
| Bare Bright Wire Only                  | CMX -14    |
| #1 copper                              | \$2.5200   |
| #2 copper                              | \$2.2800   |
| Tin plated copper ( wire only )        | \$2.3800   |
| Lead Plated Copper                     | \$2.2800   |
| Sheet copper (0% attachment)           | \$2.120    |
| Lead sheet copper / Irony sheet copper | 1.90 /Call |
| Copper turning clean & dry             | \$1.92     |

| Lead product                                |             |
|---|-------------|
| Soft Lead clean                             | \$0.70      |
| Boat keel w steel attachment                | \$0.60      |
| Wheel weights (pb)                          | \$0.24      |
| Clean Range lead indoor (Depend on quality) | \$0.58      |
| Range lead outdoor (Depend on quality)      | call        |
| Auto Battery / Steel case                   | 0.34 / 0.30 |
| Lead shot filtered                          | \$0.60      |

| Insulated wire (base on Copper %)           |                           |
|---|---------------------------|
| #1 MCM 85%                                  | \$1.96                    |
| #2 MCM 80%                                  | \$1.21                    |
| #1 single wire                              | \$1.79                    |
| #1 Single & House                           | \$1.50                    |
| #1 House wire                               | \$1.40                    |
| #2 ICW (min 50%)                            | \$0.84                    |
| #2 ICW 35% low grade                        | \$0.46                    |
| Auto wire (Harness) - no attachment         | \$0.90                    |
| Computer wire and plugs                     | \$0.22                    |
| Shredded wire                               | call                      |
| Christmas lights                            | \$0.23                    |
| Steel bx (no attachments)                   | \$0.28                    |
| Steel Bx with attachment                    | \$0.22                    |
| Insulated alum wire 65%                     | 0.34-0.40                 |
| Lead copper wire / URD                      | call (55-110)             |
| Bare / Black / irony CATV                   | Not Buying                |
| Cu coax open / close / Alum TV coaxial wire | 0.98 / 0.30 / Call \$0.00 |

| Brass product   |                 |
|---|-----------------|
| Clean Red brass ( 0% attachment)                          | \$1.9850        |
| Water meter / irony water meter                           | 1.95 /0.75      |
| Red pipe (Base on Sort)                                   | \$2.09          |
| Mixed Brass pipe  | \$1.900         |
| Yellow brass ****no shells****                            | \$1.7800        |
| Clean shells (no steel/alum/tin/chrom plated, 100% Clean) | \$1.73          |
| Mixed Shells(base on sort)                                | 1.60 x %        |
| Yellow brass turning clean (less Fe& Moisture, no Mn Trg) | 1.58 x %        |
| Mixed brass turning                                       | \$1.52          |
| Auto radiator / Irony auto Rads only                      | 1.57 / 0.80     |
| Irony Truck Rads  | \$0.45          |
| Clean Heater core(No FE)                                  | \$1.20          |
| Brass valves  | call            |
| Irony brass 50%   | not buying      |
| Faucet Brass  | \$0.70 - \$0.80 |

| Stainless steel product         |          |
|---------------------------------|----------|
| Clean 304 SS solid only - baled | \$0.4600 |
| SS 304 Unprepared               | \$0.25   |
| 316 SS solid only               | \$0.67   |
| 304 Stainless steel turning     | \$0.340  |

| Radiator product          |             |
|---------------------------|-------------|
| Alum copper rads / irony  | 1.14 / 1.01 |
| Aluminum radiator / Dirty | 0.43 / 0.20 |

| Misc Product                              |                     |
|---|---------------------|
| Electric motor small size / Mixed Motor   | 0.20/0.16           |
| Low Grade motor/w power tools             | \$0.100             |
| Huge motor / Excessive steel              | 0.09-0.13           |
| Seal units / Ballast / electronic Ballast | 0.16 / 0.12 / 0.04  |
| Altenator / Al. Starter / Steel Starter   | .34 / .24 / .19     |
| Clean Die cast / Irony 60% min            | 0.66 / 0.26         |
| Zinc anodes (w slightly iron)             | \$0.52              |
| AC compressor                             | \$0.21              |
| Whole Air Conditioner                     | \$0.12              |
| Magnesium clean                           | \$0.18              |
| Copper transformer Palm size              | \$0.29              |
| Copper transformer Mini Size              | call                |
| Cu/al transformer Palm size               | \$0.10              |
| Al transformer Large / Small Palm Size    | \$0.04 / not buying |
| Computer Complete                         | \$0.23              |
| Computer Incomplete                       | \$0.14              |
| ACR ends / alum cutoffs                   | 0.55 /No Quotes     |
| Mix electronic                            | No Quotes           |

| Aluminum product                            |            |
|---|------------|
| 356 wheel / chrom wheel - packaged/ skid    | 0.73/ 0.55 |
| 10/10 Extrusion (100%) Baled                | \$0.750    |
| Extrusion with Slightly Fe                  | \$0.680    |
| Litho clean (light ink)                     | \$0.70     |
| Bare MLC ( 100% Clean, boxed or baled)      | \$0.610    |
| Painted MLC ( 100% Clean, boxed or baled)   | \$0.59     |
| Painted siding ( 100% Clean, baled)         | \$0.550    |
| Siding with Slightly Fe                     | \$0.540    |
| UBC ( 100% Clean Baled only)                | \$0.45     |
| Cast aluminum 2% max ( boxed )              | \$0.44     |
| Clean Thermo Break ** No Glass **           | \$0.43     |
| Sheet aluminum 2% max                       | \$0.44     |
| Irony aluminum min. 50%                     | 0.08-0.12  |
| Sheet alum Off Spec / low grade taint tabor | \$0.23     |
| Transmission / Engine                       | \$0.11     |
| 2000/7000 MLC                               | \$0.35     |

**ice is delivered to kearny NJ**

#1 Prepared Steel \$10.00 Per Hundred LB \$224  
 #1 UnPrepared Steel \$8.50 " " "

RHB Removal & Salvage  
257 Milford Street  
Upton, MA 01568

To whom it may concern

This is an estimated cost for all the materials located at 211-213 Milford street in Upton, MA.

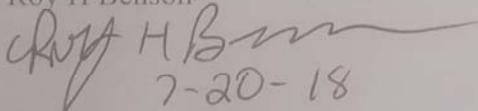
The value of the materials from the site would be

- Steel scrap would be worth around \$110. Per gross ton (2240=GT)
- Copper wire scrap would be worth \$.25 per lb
- Aluminum wire scrap would be worth \$.10 per lb
- Solar panels would need to be disposed of at a cost of \$135 per ton

Please bear in mind that all of these prices are at today's market prices and are subject to change in the future

Thank you

Roy H Benson



7-20-18

RHB Removal & Salvage

*Mike's Recycling  
10 Eddy Street  
Webster, MA 01570*

To whom it may concern

This is an estimated cost for all the materials located at 211-213 Milford street in Upton, MA. To be removed and recycled by my company. Prices are for removal only with no labor to be done by my company.

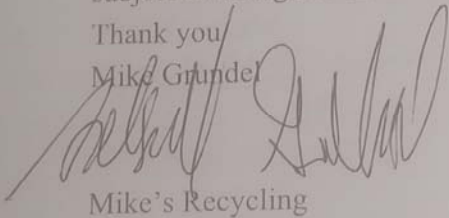
The value of the materials from the site would be

- Steel scrap would be worth around \$125. Per gross ton (2240=GT)
- Copper wire scrap would be worth \$.20 per lb
- Aluminum wire scrap would be worth \$.10 per lb
- Solar panels would need to be disposed of at a cost of \$135 per ton

Please bear in mind that all of these prices are at today's market prices and are subject to change in the future

Thank you

Mike Grundel



7-20-18

Mike's Recycling

## Conway Solar O&M Services Plan

December 2018

Conway Solar, LLC, a wholly-owned subsidiary of Nexamp, Inc., as the developer and construction manager of an approximately 6 MW (DC) solar PV array on property owned by the Newman family on Main Poland Road in Conway, MA, is pleased to provide this Operation and Maintenance (O&M) services plan.

Nexamp Asset Management Services, Inc. (NAMS) is a full service photovoltaic Operations and Maintenance company, servicing more than 100 MW as of 2018. Conway Solar, LLC intends to contract with NAMS in order to provide O&M services for the project for the first ten years of the system operation. At that time, Conway Solar, LLC will revisit that contract and intends to renew the term.

Attached to this Services Plan is a typical scope of work for an O&M provider for a large-scale solar PV array. NAMS has used this scope of work as the basis for its services for infrastructure that it currently maintains. In the following template, "Contractor" represents NAMS and "Owner" represents the project owner, Conway Solar, LLC.

The primary services under the scope of an O&M agreement include:

- Biannual array maintenance inspections, remote monitoring, unscheduled maintenance (fault detection), and scheduled equipment replacement.
- On-site services typically require a single pick-up truck and 2-4 licensed technicians.
- Technicians perform work with hand tools and battery-operated power tools and rarely require generators or any motorized or heavy equipment.
- The array is designed to facilitate major equipment replacement using truck mounted boom lift every 5-10 years.
- Conway Solar, LLC will develop the site with using a pile driven or screw mounting system for the array.

Maintenance Activities include:

- Mowing operations are typically conducted 2 to 4 times per season, depending on the weather conditions and resultant growth. Normally, 2 to 4 personnel using ride-on and self-propelled mowers and weed whackers will perform the mowing operations.
- The entire Site is inspected for any erosion problems upon each site visit and maintenance activity, a minimum of two times per year. Any erosion to roads, embankments, drainage structures/basins, ground cover, etc. is repaired using similar methods to the initial install, with like equipment and materials. Potentially,

additional erosion control blankets, jute netting, etc. will be added to protect the maintenance improvement.

- Depending on the array location and surrounding vegetation, an arborist with boom truck will thin shading tree growth.
- In the event that weed control is required, NAMS uses only non-persistent solutions previously approved for use by DEP and many municipalities for use in regulated and protected areas. The frequency of this activity is typically annually or biannually, if at all. Work is typically performed by licensed applicators using trailer born and backpack spraying apparatus.
- Conway Solar, LLC does not anticipate conducting module washing at this site. In the event that modules are washed, cleaning solution consists of 95% water and 5% non-toxic, non-persistent soap solution. Work is typically performed by 2-4 technicians using backpacks and scrubbing wands.
- Some snow removal may be required to allow site access during winter months, however no snow removal operations will be performed within the array areas.
- Inspection of the storm water management facilities will occur at each site inspection, no less than biannually, and maintenance provided to restore the facilities to their original condition.

## **Scope of Work – O&M Services Contract**

Nexamp Asset Management Services (the “Contractor”) will provide O&M services for the proposed approximately 6 MW (DC) solar photovoltaic system located on property owned by the Newman family off Main Poland Road in Conway, MA (the “Facility”). The services to be provided will include the operation, repair, monitoring and maintenance services listed below.

### **FACILITY OPERATIONS**

The Facility will be operated in conformity to the operating specifications and requirements set forth in the O&M Manual, in compliance with prudent industry practices, in accordance with the terms and conditions of the interconnection agreement between the Owner and the local distribution utility, and in accordance with applicable law. As required to achieve these operational requirements, the O&M Contractor shall be present at the Facility site.

### **PERFORMANCE MONITORING AND OPERATIONS REPORTING**

During the Service Term, Contractor shall:

- At all times perform basic monitoring of the Facility to make sure Facility is fully functional and record and report all meter data consistent with all Solar Program requirements.
- Provide Owner with web access to basic monitoring data.
- Provide Owner with quarterly reporting of performance against predicted power and historical performance beginning three calendar months after the Commercial Operations Date (as defined as “Substantial Completion” in the EPC Agreement) is achieved, including, summaries of energy measured and reported by the Facility’s revenue grade meters, a summary of planned maintenance, and a summary of all forced outages and emergency response measures and the steps that were taken to resolve such forced outages and emergency situations.
- Provide copies of all such information no later than thirty (30) calendar days of making or receiving information pertaining to maintenance and/or repair pertaining to the system and/or any portion thereof or the Interconnection.
- Maintain warranty records with all inverter, module, and mounting suppliers.
- Maintain service agreements with DAS suppliers.

### **SCHEDULED INSPECTION AND MAINTENANCE**

- Contractor will perform required maintenance of the Facility in accordance with the written manufacturer requirements for operation and maintenance of the

equipment that is part of the Facility (such written instructions are included in the O&M Manual).

- Contractor will provide continuous 24/7 active monitoring of Facility performance and provide a single point of contact for Facility maintenance and repair related issues.
- Contractor will implement the preventive maintenance schedule, if any, for each item of equipment that is part of the Facility, as set forth in the relevant portions of the O&M Manual.
- Contractor will maintain maintenance logs, records and reports documenting the provision of O&M Services hereunder in sufficient detail to allow Owner to verify that the Facility is performing in accordance with the Project Warranty and the performance requirements for the Facility. Contractor shall maintain current revisions of the drawings, specifications, lists, clarifications and other materials relating to the Facility.
- Contractor will complete and submit to Owner in a timely manner maintenance log sheets to document Contractor's provision of Services as required hereby in sufficient detail to allow Owner to verify that the Facility is performing in accordance with the Project Warranty and the performance requirements for the Facility.
- Contractor will regularly maintain the Facility, in accordance with the O&M Manual, and provide semi-annual on-site inspections by completing the following:
  - Visual inspection of all feeder terminations for corrosion.
  - Visual check of all power terminations/connections associated with the system e.g. DC combiner boxes, DC and AC disconnects, surge arrestors, inverters and PV modules and re-torque as necessary.
  - Test of ground continuity and correct any unsafe or abnormal issues.
  - Check of all fuses in inverters, combiner boxes, and disconnects (AC&DC).
  - Testing and recording of voltage and amperage of the arrays at the string level.
  - Inspection of the combiner boxes, disconnects (AC&DC), and inverters with an infrared camera, with the purpose of detecting hotspots, bad connections, etc.
  - Checking of the mechanical and structural integrity of the system.
  - Cleaning or replacement of inverter air filters where applicable if necessary.
  - Checking of inverter housing for dust/water ingress.
  - Checking and replacement of any unserviceable system labeling as necessary.
  - Visual inspection of weather stations and calibration verification against monitored data.

- Checking of modules for excessive dirt and debris. Cleaning is excluded.
- Providing written documentation to include summary report of findings including actions taken and recommendations for additional maintenance or repairs, etc.

## FAULT DETECTION AND DISPATCH

- Contractor shall respond to all alarms, alerts and service requests pertaining to the system within 24 hours of such alarm, alert and/or service request, as personnel safety and weather conditions permit.
- Contractor shall monitor and respond to forced outages and performance trends. Contractor and Owner shall notify the other as soon as practically possible, but in no event later than twenty-four (24) hours following their discovery, of “**Forced Outage**”, which is defined as: (a) any material malfunction in the operation of the Facility and/or (b) any interruption in the delivery of energy to the Facility’s revenue grade meters. Contractor shall apply safe industry best practices to fully resolve any Forced Outage as quickly as possible. To the extent the correction of the Forced Outage requires either O&M Services or Warranty Services, Contractor shall initiate the O&M Services or Warranty Services needed to return the Facility to service within 24 hours of such notice, and where applicable, as manufacturer service capabilities permit. Contractor shall provide Owner with an estimate of the time necessary to return the Facility to fully operational service. Contractor agrees to notify the Owner as soon as practicable when the Facility returns to service, but in no event later than twenty-four (24) hours following the Facility’s return to service.
- Contractor and Owner agree to notify the other upon the discovery of an Emergency condition pertaining to the Facility. If Contractor is notified of an Emergency condition by Owner or otherwise learns of an Emergency condition, Contractor agrees to promptly dispatch appropriate personnel to address such Emergency as quickly as possible in accordance with industry best practices, and as personnel safety permits. Contractor maintains the right to disconnect the Facility and/or to otherwise isolate the Facility from the electric distribution system servicing Owner’s and Owner’s property as a result of any Emergency condition pertaining to the Facility as determined at the Contractor’s discretion; provided, however, that the Contractor shall be responsible for any adverse consequences caused by such exercise of discretion if the exercise is negligent or represents a breach hereof.



## CONWAY SOLAR EMERGENCY RESPONSE AND COMMUNICATIONS PLAN

DECEMBER 2018

### Overview

This Emergency Response and Communications Plan (“ERCP”) outlines the general procedures followed for all emergency situations and incidents that could arise as a result of the operation, maintenance and decommissioning of the solar photovoltaic facility due to weather events, equipment failure, human error or other accident. Shortly after commercial operation, an affiliate of Conway Solar, LLC will meet with the local emergency service personnel (fire, police, and EMS) to review and discuss the operation and decommissioning processes, including unique equipment, the overall process, as well as schedule and phasing. Ongoing communication between town officials and police, fire, and emergency services officials, will help assure adequate levels of safety and protection. A site specific health and safety plan (HASP) will also be developed and maintained on site. Based on relevant experience, Conway Solar, LLC believes that the following types of hazards are most likely to have the potential to occur during maintenance and decommissioning activities.

- Personnel injury or medical emergency
  - Electrocution
  - Slips, trips and falls
  - Medical Emergency
- Auto and heavy equipment accidents
- Natural or electrical fire
- Construction spills
  - Gasoline
  - Diesel fuel
  - Hydraulic oil
  - Lubricating oil and grease

Conway Solar, LLC is committed to protecting the community, personal property, wildlife and the environment in adherence to all applicable local, state and federal laws and regulations.

### Emergency Contact Information

Conway Solar, LLC personnel, including a specified Emergency Response Coordinator, will be available to the site and may be utilized to assist during emergency situations and/or provide first aid as needed. For all emergency services including hospital, fire etc. call 9-1-1. During operation of the facility, a phone number where a Conway Solar, LLC representative can be reached 24 hours a day will be established and shown on a sign as “IN CASE OF EMERGENCY, PLEASE CONTACT NEXAMP AT (617) 431-1440 x8” and will be provided to local emergency personnel along with the location of the nearest hospital.

## **Internal Reporting**

The following procedures will be prescribed for internal reporting of emergencies.

1. Once notified by local emergency service personnel, the Emergency Response Coordinator will notify any on-site personnel, including any visitors, of the nature of the emergency either in person or via phone.
2. The Emergency Response Coordinator will specify the location for the first responders, if they are not already present onsite. A designated employee or contractor will meet the emergency response personnel at the access road of the emergency.
3. The Emergency Response Coordinator will notify local emergency personnel, if not already present, of the emergency using the contact information to be provided.
4. The Emergency Response Coordinator will identify any need for access control measures at the facility during the emergency and designate a competent person to implement.
5. Personnel will be trained that when any person identifies an emergency situation, or the potential for an emergency situation, and reports it to the Emergency Response Coordinator or his/her designee, the Emergency Response Coordinator will then activate the Plan.

## **External Reporting**

The following procedures will be prescribed for external reporting of emergencies.

- If immediate emergency response assistance is required, the Emergency Response Coordinator or his designee will call 9-1-1.
- A member of management or the Emergency Response Coordinator or his/her designee are the only persons authorized to speak on Conway Solar, LLC's behalf to outside agencies (police, fire department, medical services etc.) during an emergency situation.
- In the event of a spill in excess of reportable limits, the spill must be reported to the Department of Environmental Protection or relevant federal authority.

## **Emergency Response Procedures**

### ***Personnel Injury or Medical Emergency***

- Provide First Aid to all injured employees or contractors regardless of severity.
- A First Aid kit will be maintained onsite. First Aid kits are to be inspected regularly and restocked as needed following usage.
- Call 9-1-1 if the injury is serious and needs immediate medical treatment.
- For local emergency response assistance, a designated employee or contractor will meet the emergency responders at the access road of the tower site and direct them to the location of the emergency/injured employee.

- The designated employee or contractor should have a hand held orange safety flag to use to get the attention of the responding emergency services.
- Regular inspection of fire extinguishers, if required by the local fire department, at all facility locations where they are installed.

## ***Auto and Heavy Equipment Accidents***

- Personnel scheduled to work on site will be briefed prior to arrival on facility road conditions, speed limits and hazards
- Ground guides will be used in situations requiring cranes, excavators, lifts and other heavy equipment to operate in the vicinity of plant equipment, personnel and other vehicles.
- Personnel will be briefed not to approach working heavy equipment without first receiving acknowledgement and approval from the vehicle operator.
- Additional care will be exercised by all auto and equipment operators during periods of darkness, rain, snow and icy conditions.
- All collisions or near misses, regardless of severity, will be reported to the Emergency Response Coordinator or his/her representative.
- Accidents requiring medical or firefighting personnel will follow the instructions listed in those sections.

## ***Fire***

If a natural, vehicle or equipment related fire exists at the facility, personnel or contractors will follow the following procedures.

1. Provided it is safe to do so, employees can extinguish small fires using the onsite fire extinguisher.
2. For all other fires, alert others on site to immediately vacate the area and assemble at a specified location for accountability.
3. Shutdown the facility at the point of utility interconnection, provided it is safe to do so.
4. Restrict the area.
5. Request assistance from firefighting personnel, if needed, in controlling the fire.
6. If local emergency response personnel are required, have an employee go to the access road of incident site, to meet emergency personnel and direct them to the fire.
7. Employees will use a hand held orange safety flag, safety vest or other brightly covered material to get the attention of the responding emergency service personnel.

## ***Construction Spills***

Cautionary labeling will be provided for any construction materials, such as fuels, and the associated Material Safety Data Sheets (MSDS) or Globally Harmonized System (GHS) documentation will be provided accordingly.

1. The MSDS/GHS for all chemicals used at the facility will be provided to the local fire department and emergency service providers upon request.
2. Drip pans and associated control measures will be used for all refueling and hydraulic maintenance activities.
3. Small spills will be cleaned up immediately using absorbent materials such as hay, sand, socks or pads.
4. If the spill is of such magnitude that it cannot be contained, the Emergency Response Coordinator will contact the appropriate authority for assistance.
5. Personnel and contractors will be instructed to report all spills, regardless of severity, to the Emergency Response Coordinator.
6. Once a spill is identified, the Emergency Response Coordinator or his/her designee will maintain access control measures to safeguard personnel and environmental safety until the spill mitigation is complete.

### **Site Restoration/Remediation**

If any accident or incident at the facility necessitates site restoration or remediation, the restoration/remediation will be conducted according to applicable federal, state and local requirements.

### **Incident Reporting**

After every accident or incident, the Emergency Response Coordinator or designee will conduct a post incident evaluation to determine the following.

1. Suitability of the organization's structure, operations, equipment, communication plans, adequacy of training, alarm systems, security and access control, spill containment and recovery procedures, monitoring and safety programs.
2. If any of the above are found to be inadequate, the Emergency Response Coordinator will make necessary changes.

### **Safety Training**

On-site training for local emergency personnel may be given, at their request, by the Emergency Response Coordinator or their designees regarding the content, requirements, and appropriate actions to comply with the provisions of the Plan. The training will occur:

1. At the facility;
2. When changes are made to the plan;
3. At the request of local emergency personnel;
4. When Emergency Response Coordinator determines.

### **Recording of Responder Complaints**

1. Any and all complaints from responders will be kept in both a log book and an electronic log.
2. The name, address, telephone number, date and time of all responders issuing a complaint will be included with the responder's complaint.
3. Assurance will be provided to all responders that complaint has been mitigated and will not reoccur.
4. In addition to the above, complaints requiring significant plan or operational adjustments will be answered in writing within seven (7) days of the complaint.



# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)  
12/29/2017

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

|   |  |  |                                      |
|---|--|--|--------------------------------------|
| <b>PRODUCER</b><br>Willis of Massachusetts, Inc.<br>c/o 26 Century Blvd<br>P.O. Box 305191<br>Nashville, TN 372305191 USA | <b>CONTACT NAME:</b><br>PHONE (A/C, No, Ext): 1-877-945-7378 |  | <b>FAX (A/C, No):</b> 1-888-467-2378 |
|   | <b>E-MAIL ADDRESS:</b> certificates@willis.com               |  |                                      |
| <b>INSURED</b><br>Nexamp, Inc.<br>4 LIBERTY SQUARE<br>BOSTON, MA 02109 USA  | <b>INSURER(S) AFFORDING COVERAGE</b>                         |  | <b>NAIC #</b>                        |
|   | <b>INSURER A:</b> Axis Specialty Europe SE                   |  | C1783                                |
|   | <b>INSURER B:</b> Ohio Security Insurance Company            |  | 24082                                |
|   | <b>INSURER C:</b> Granite State Insurance Company            |  | 23809                                |
|   | <b>INSURER D:</b> Zurich American Insurance Company          |  | 16535                                |
|   | <b>INSURER E:</b><br><b>INSURER F:</b>                       |  |                                      |

**COVERAGES**

CERTIFICATE NUMBER: W5015860


REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR | TYPE OF INSURANCE  | ADDL INSD | SUBR WVD | POLICY NUMBER     | POLICY EFF (MM/DD/YYYY) | POLICY EXP (MM/DD/YYYY) | LIMITS   |                             |              |
|----------|--|-----------|----------|-------------------|-------------------------|-------------------------|--|-----------------------------|--------------|
| A        | <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY<br><input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR<br>GEN'L AGGREGATE LIMIT APPLIES PER:<br><input checked="" type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC<br>OTHER: |           |          | 3791010216EN      | 12/31/2017              | 12/31/2018              | EACH OCCURRENCE  | \$ 1,000,000                |              |
|          |  |           |          |                   |                         |                         | DAMAGE TO RENTED PREMISES (Ea occurrence)  | \$ 100,000                  |              |
|          |  |           |          |                   |                         |                         | MED EXP (Any one person)   | \$                          |              |
|          |  |           |          |                   |                         |                         | PERSONAL & ADV INJURY  | \$ 2,000,000                |              |
|          |  |           |          |                   |                         |                         | GENERAL AGGREGATE  | \$ 2,000,000                |              |
|          |  |           |          |                   |                         |                         | PRODUCTS - COMP/OP AGG   | \$ 2,000,000                |              |
|          |  |           |          |                   |                         |                         |  | \$                          |              |
| B        | <b>AUTOMOBILE LIABILITY</b><br><input type="checkbox"/> ANY AUTO OWNED AUTOS ONLY<br><input checked="" type="checkbox"/> HIRED AUTOS ONLY<br><input checked="" type="checkbox"/> SCHEDULED AUTOS<br><input checked="" type="checkbox"/> NON-OWNED AUTOS ONLY   |           |          | BAS (18) 58489128 | 12/31/2017              | 12/31/2018              | COMBINED SINGLE LIMIT (Ea accident)  | \$ 1,000,000                |              |
|          |  |           |          |                   |                         |                         | BODILY INJURY (Per person)   | \$                          |              |
|          |  |           |          |                   |                         |                         | BODILY INJURY (Per accident)   | \$                          |              |
|          |  |           |          |                   |                         |                         | PROPERTY DAMAGE (Per accident)   | \$                          |              |
|          |  |           |          |                   |                         |                         |  | \$                          |              |
| A        | <input checked="" type="checkbox"/> UMBRELLA LIAB<br><input type="checkbox"/> EXCESS LIAB<br><input checked="" type="checkbox"/> RETENTION \$ 0  |           |          | 3791010316EN      | 12/31/2017              | 12/31/2018              | EACH OCCURRENCE  | \$ 5,000,000                |              |
|          |  |           |          |                   |                         |                         | AGGREGATE  | \$ 5,000,000                |              |
|          |  |           |          |                   |                         |                         |  | \$                          |              |
| C        | <b>WORKERS COMPENSATION AND EMPLOYERS' LIABILITY</b><br>ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH)<br>If yes, describe under DESCRIPTION OF OPERATIONS below  | Y/N<br>No | N/A      | WC001-60-5334     | 08/10/2017              | 08/10/2018              | <input checked="" type="checkbox"/> PER STATUTE<br><input type="checkbox"/> OTH-ER | E.L. EACH ACCIDENT          | \$ 1,000,000 |
|          |  |           |          |                   |                         |                         |  | E.L. DISEASE - EA EMPLOYEE  | \$ 1,000,000 |
|          |  |           |          |                   |                         |                         |  | E.L. DISEASE - POLICY LIMIT | \$ 1,000,000 |
| D        | Professional Liability   |           |          | EOC 0398821-00    | 12/31/2016              | 01/07/2018              | Each Claim   | \$2,000,000.00              |              |
|          |  |           |          |                   |                         |                         | Aggregate  | \$2,000,000.00              |              |

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

**CERTIFICATE HOLDER****CANCELLATION**

|                      |  |
|----------------------|--|
| For Information Only | SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. |
|                      | AUTHORIZED REPRESENTATIVE<br>  |

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2/1/2018

## GROUND LEASE

This Ground Lease (the "Lease") is made and entered into as of August 25, 2018 (the "Effective Date") by and between **Robert Thomas Newman and Sarah G. Newman** (the "Landlord"), and **Conway Solar, LLC**, a Delaware limited liability company (the "Tenant") (each a "Party" and together, the "Parties").

WHEREAS, Landlord owns the real property located at 2394 Main Poland Road, Conway, Franklin County, Massachusetts, containing approximately 104 acres, as more particularly described in Exhibit A attached hereto (the "Property"); and

WHEREAS, the parties entered into a Lease Option Agreement, dated February 26, 2018, under which Landlord granted to Tenant the right to perform due diligence work regarding a solar energy generating project and an option to lease the Lease Area for the project (the "Option Agreement"), and under which Tenant did exercise its Option; and

WHEREAS, Landlord is willing to lease the Lease Area to Tenant, and Tenant is willing to lease the Lease Area from Landlord, to develop, construct, operate and maintain a solar powered electric generation facility and any uses necessary or ancillary thereto.

### Exhibits:

- A: Property Description
- B: Lease Area and Easement Descriptions
- C: Existing Encumbrances

NOW THEREFORE, in consideration of the premises, the covenants contained herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Landlord and Tenant agree as follows:

SECTION 1. DEFINITIONS. Capitalized terms within this Lease shall have the meanings as set forth in the Glossary of Terms, attached hereto and incorporated herein.

SECTION 2. LEASE. Landlord hereby leases the Lease Area to Tenant and Tenant leases the Lease Area from Landlord for the Permitted Uses for the Term. Subject to the rights of Landlord following an Event of Default by Tenant, Tenant shall have quiet and peaceful possession of the Lease Area and any other rights granted by this Lease for the entire Term without hindrance, interruption, suit, trouble or interference of any kind by Landlord or any other person or entity claiming (whether at law or in equity) by, through or under Landlord.

### SECTION 3. EASEMENTS.

(a) Landlord hereby grants the following easements (the "Easements") to Tenant for the following purposes, all as detailed on Exhibit B:

(i) A non-exclusive right of pedestrian, vehicular and equipment access to the Facility across or through Landlord's remaining property at all times, which is necessary or convenient for ingress and egress to the Facility;

(ii) an exclusive right to construct, operate, maintain, reconstruct, relocate, remove, and/or repair the electric utility service infrastructure and associated wires, lines and poles and other infrastructure necessary and convenient to interconnect each Facility unit to the LDC electrical distribution system, the location of which will be determined by the LDC prior to the Commercial Operations Date; and

(iii) a solar easement, upon which Landlord shall not construct buildings or structures, or plant new trees or vegetation of any type or allow any trees or other vegetation on the Property which now or hereafter in Tenant's reasonable opinion may be a hazard to the Facility, overshadow or otherwise block or interfere with access of sunlight to the Facility and/or interfere with Tenant's exercise of its rights hereunder. Tenant may (but shall not be obligated to) remove, at Landlord's cost, any buildings or other structures which violate this easement. Notwithstanding anything herein to the contrary, Landlord shall reimburse Tenant for such costs as an abatement of Rent. Nothing in this Section 3(a)(iii) shall prevent Tenant from accessing any portion of the Property (other than the Lease Area) for recreational purposes.

(iv) a non-exclusive easement of approximately 65,000 square feet to be located at a mutually acceptable location on the Property for temporary (A) storage and staging of tools, materials and equipment, (B) construction laydown, (C) parking of construction crew vehicles and temporary construction trailers, (D) vehicular and pedestrian access and access for Facility construction activities, and (E) other facilities reasonably necessary to construct, erect, install, expand, modify or remove the Facility. Upon completion of each construction phase, said easement shall terminate.

(b) Landlord's grant of Easements in Sections (3)(a)(i) through (3)(a)(iii) shall commence on the Effective Date and continue throughout the Term and any extensions of the Term. Landlord's grant of Easement in Sections (3)(a)(iv) shall commence on the Effective Date and shall continue through the Construction Period, during the Operations Period if Tenant is performing activities associated with expanding, modifying or repairing the Facility, and during the Decommissioning Period, but only for the amount of time associated with such activity.

(c) If required by the LDC, Landlord shall grant to the LDC an exclusive right to construct, operate, maintain, reconstruct, relocate, remove, and/or repair the electric utility service infrastructure and associated wires, lines and poles and other infrastructure necessary and convenient to interconnect each unit of the Facility to the LDC electrical distribution system, the location of which will be determined by the LDC prior to the Commercial Operations Date. Landlord's grant under this Section 3(c) shall commence on its effective date and continue through the Term and any extensions of the Term, unless otherwise required by the LDC.



(d) At Tenant's request, Landlord shall timely execute agreements necessary to give effect to the grant of Easements under this Section 3.

#### SECTION 4. TERM; EARLY TERMINATION.

(a) This Lease will consist of a Development and Construction Period, an Operations Period, and a Decommissioning Period.

(i) Development and Construction Period. The Development and Construction Period will begin on the Effective Date and will terminate on the earliest of:

(A) Delivery by Tenant of notice of termination in accordance with Section 4(b);

(B) 365 days after the commencement of the Development and Construction Period, except that such Period shall automatically extend for up to two (2) additional periods of six (6) months each for permitting and interconnection delays, or for changes in solar market conditions regarding Massachusetts solar programs. Extensions under this subsection are contingent upon Tenant providing evidence, at Landlord's reasonable request, that it continues to actively pursue developing the Facility; and

(C) the day after the Commercial Operation Date.

If the Commercial Operation Date does not occur prior to expiration of the Development and Construction Period (as it may be extended), this Lease shall terminate by its own terms with no action being required of either Party. Termination of this Lease in accordance with this Section 4(a)(i) shall not release either Party from any obligations arising prior to the effective date of such termination, but neither Party shall have the obligation to perform any obligations hereunder which, but for such termination, would have arisen after the effective date of such termination.

(ii) Operations Period. The Operations Period will commence at 12:01 a.m. on the day after the Commercial Operation Date and will end at 11:59 p.m. on the 20<sup>th</sup> anniversary of the Commercial Operation Date. Tenant may extend the Operations Period for one (1) ten (10) year term. Subject to Landlord's approval and consent, such consent not to be unreasonably withheld, conditioned or delayed, Tenant may extend the Operations Period for two (2) additional five (5) year terms following the one (1) ten (10) year extension. At least ninety (90) days prior to the beginning of an extension term, Tenant shall deliver in writing notice to Landlord of Tenant's intent to exercise that extension option, and Tenant and Landlord, at Tenant's expense, shall prepare and record any amendments to the Notice of Lease and/or any other documents necessary to evidence and give effect to the extension.

(iii) Decommissioning Period. The Decommissioning Period shall commence on the expiration of the Operations Period, and any extensions thereto, and shall continue for a period of 180 days, (provided that if such 180 day term begins or ends within the

months of December, January, February, March, or April, the Decommissioning Period shall extend to the next-occurring July 31) whereupon this Lease shall expire and shall be of no further force and effect, except that such termination shall not release or modify any of the obligations of the Parties arising prior to such termination.

(b) At any time during the Development and Construction Period, including any extensions thereof, Tenant may, in its sole discretion, terminate this Lease upon 30-days' written notice to Landlord (the thirtieth day after delivery of the notice shall be the effective date of the termination). Tenant shall execute and deliver to Landlord any amendments to the Notice of Lease and/or other documents reasonably necessary to evidence terminating this Lease. Termination of this Lease in accordance with this Section 4(b) shall not release either Party from any obligations arising prior to the effective date of such termination, but neither Party shall have the obligation to perform any obligations hereunder which, but for such termination, would have arisen after the effective date of such termination.

SECTION 5. TENANT'S USE OF THE PROPERTY. Tenant may use the Lease Area and Easements for Permitted Uses, subject to limitations set forth below:

(a) Development and Construction Period. During the Development and Construction Period, Tenant may use the Lease Area for development work and tests, project permitting and interconnection, and other activities associated with constructing the Facility. The Parties acknowledge that Robert Bros. Lumber Co., Inc. contracted with Landlord to harvest timber from the Lease Area (the "Timber Agreement") from October 29, 2017, through October 28, 2018, as that term may be extended for weather and other circumstances that may interrupt harvesting operations; that timber operations may occur during the time Tenant desires to construct the Facility; and that the Timber Agreement includes access and road construction rights that also may interfere with developing the Facility. Notwithstanding the Timber Agreement and the activities conducted on the Property under that agreement, Tenant may construct the Facility during the Timber Agreement term with Robert Bros. Lumber Co., Inc. consent, and Landlord will use its best efforts to facilitate that consent and Robert Bros. Lumber Co., Inc.'s good faith cooperation with Tenant and Tenant's efforts to develop the Facility in a timely manner.

(b) Operations Period. During the Operations Period, Tenant may use the Lease Area for any of the Permitted Uses.

(c) Decommissioning Period. Promptly following the Operations Period expiration, or an earlier termination of this Lease following a Tenant Default, Tenant shall cease the Facility's commercial operation, shall remove all structures, equipment, security barriers, and transmission lines from the Lease Area, and dispose of all Facility materials in accordance with Applicable Law, all at Tenant's sole cost and expense. This Section 5(c) shall survive Lease termination.

SECTION 6. DEFINING THE LEASE AREA; CONSTRUCTING THE FACILITY;  
LANDLORD RESTRICTIONS; TENANT'S RIGHT OF FIRST  
REFUSAL.

(a) During the Development and Construction Period, Tenant may, at its discretion, determine the Facility size and the specific location of the Lease Area and the Easements on the Property by means of a survey, and such survey shall then define the Lease Area and the Easements and shall be an amendment to this Lease as a revised Exhibit B.

(b) Tenant may construct the Facility as Tenant, in its sole discretion, determines, provided such construction shall comply with Applicable Law and with this Lease.

(c) Tenant may remove trees as necessary within the Property to obtain solar access to the Facility, consistent with Section 3(a)(iii) (regarding the solar easement); provided, for the avoidance of doubt, that Landlord shall have no obligation to maintain any tree removal or abatement. Tenant may also remove any buildings or other structures (including any existing stone walls on the Property) to the extent such buildings or structures are within the Lease Area, or otherwise consistent with Section 3; provided that Tenant shall take commercially reasonable steps to ensure that to the extent any existing stone walls on the Property are destroyed, the stones from such stone walls are not destroyed, and remain on the Property, in a reasonable location.

(d) After Tenant determines the Facility is capable of Commercial Operations, Tenant shall notify Landlord that Facility installation is complete and shall specify the Commercial Operation Date.

(e) Landlord has no obligation to improve the Lease Area or Property to accommodate the Facility.

(f) Landlord shall not engage in activities at the Property that will materially impact the Lease Area topography or soil conditions, or construct any structures or improvements on the Lease Area.

(g) Landlord shall not enter the Lease Area without Tenant's consent, such consent not to be unreasonably withheld, conditioned or delayed.

(h) (1) After Tenant determines the Lease Area pursuant to Section 6(a), before Landlord may sell the Lease Area to a third party, Landlord shall, in writing, first offer to sell the Lease Area to Tenant on the same terms and conditions as are offered to or by the third party. Tenant shall have thirty (30) Business Days from the date of Landlord's notice to Tenant during which to accept the terms of the offer. If Tenant accepts the terms of the offer, the Parties shall use good faith efforts to consummate the transaction within sixty (60) days from the date of Tenant's acceptance, and shall negotiate any remaining terms in good faith and to a commercially reasonable standard.

(2) If Tenant does not accept the offer within the 30-day period, Landlord may accept the third-party's offer on the terms presented to Tenant. If Landlord does not close the sale to the third party within ninety (90) days of the termination of Tenant's 30-day period, or if the material terms of the offer are amended, Landlord's right to sell the Lease Area

to the third party shall expire and Tenant's rights and the procedure described in this subsection (h) shall again apply.

- (3) Notwithstanding the right of first refusal set forth in Section 6(h)(1) above, Landlord may sell the Lease Area to any, all, or any combination of (i) Ian Robert Newman, (ii) Kipling David Newman, or (iii) Peter Sage Newman without first offering to sell the Lease Area to Tenant, so long as the purchaser or purchasers of the Lease Area have agreed in writing to be bound by the terms of this Lease.

SECTION 7. RENT PAYMENTS. Tenant shall pay Rent to Landlord as follows:

(a) Development and Construction Period. [REDACTED] per month, pro-rated for partial months, to be paid in arrears each month.

(b) Operations Period.

(i) During the Operations Period, Tenant shall pay to Landlord Rent of [REDACTED] per Operating Year, pro-rated for partial MWs.

(ii) Beginning with Operating Year 2 and continuing with each Operating Year thereafter, the annual Rent shall be increased by the sum determined by multiplying the previous Operating Year Rent [REDACTED] Rent for each Operating Year, including any Operations Period extensions, shall be paid quarterly, in arrears.

(iii) Rent for each Operating Year, including any Operations Period extensions, shall be paid quarterly, in arrears.

(c) Decommissioning Period. No Rent shall be due for the Decommissioning Period other than amounts due prior to the Decommissioning Period.

(d) Payment Method. Rent may be paid by check or wire transfer. Upon request by Tenant, Landlord shall provide Tenant with account information to which wire transfers may be made.

SECTION 8. TAXES

(a) Landlord shall be responsible for all taxes related to the Property other than Tenant's obligations stated in Section 8(b) and 8(c).

(b) Tenant shall be responsible for the following taxes during the Operations Period and the Decommissioning Period:

(i) all personal property taxes assessed against the Facility; and

(ii) real estate taxes assessed against the Lease Area due to Tenant's lease of the Lease Area and the Facility operation on the Lease Area.

(c) If the Property as of the Effective Date is valued, assessed and taxed under the provisions of Massachusetts General Laws, Chapter 61, 61A or 61B ("Chapter 61") Landlord and Tenant shall cooperate to remove the Lease Area, and the Easements, if necessary, from such classification. In particular, Tenant shall prepare, Landlord shall sign, and Tenant shall mail any notice required by Chapter 61 and Tenant shall pay any rollback taxes imposed by Chapter 61 that will become due on account of the removal of the Lease Area from Chapter 61 classification. Notwithstanding any other provisions of this Lease, Tenant shall not commence any construction activities on the Lease Area until the earlier of the expiration of any purchase option period specified in Chapter 61, or Landlord's receipt of notice from the applicable taxing jurisdiction that it will not exercise any purchase option under Chapter 61. If the applicable taxing jurisdiction, or its assignee, elects to exercise its statutory purchase option, this Lease shall terminate and be of no further effect, except for those Lease provisions that expressly survive termination, and Landlord may seek to rescind the notice withdrawing the Lease Area from Chapter 61 classification.

(d) Tenant shall pay all taxes for which Tenant is directly billed on or before the date such amounts are due, subject however to the right of Tenant to contest taxes in accordance with this Lease and Applicable Law. Tenant shall pay Landlord, within 10 business days after Tenant's receipt of the applicable invoice from Landlord, the amount of such taxes for which Tenant is responsible hereunder and which have not been billed directly to Tenant. Landlord will submit copies of tax bills or notices of assessments, appraisals or statements applicable to the Facility to Tenant promptly upon receipt thereof and, to the extent Landlord pays the same directly to the taxing authorities, Landlord will promptly provide evidence of such payment to Tenant.

(e) Each Party may contest in good faith any tax assessments or payments, provided that all payments are made when due and such contest (or appeal, as the case may be) complies with Massachusetts law. Each Party shall use all reasonable efforts to cooperate with the other in any such contests of tax assessments or payments. In no event shall either Party postpone during the pendency of an appeal of a tax assessment the payment of taxes otherwise due except to the extent such postponement in payment has been bonded or otherwise secured in accordance with Applicable Law.

(f) If Tenant fails to pay directly or reimburse Landlord for taxes for which Tenant is responsible hereunder, Landlord may pay the same and in such event shall be entitled to recover such amount from Tenant together with interest thereon at a rate equal to the lesser of (i) one and one-half percent (1 ½ %) per month (eighteen percent (18%) per annum) or (ii) the highest rate allowed under Applicable Law.

(g) If Landlord fails to pay any taxes, judgments or liens that become a lien upon Tenant's interest in the Lease Area or improvements thereon for which Landlord is responsible hereunder, Tenant may pay such amounts and in such event shall be entitled to recover such paid amount from Landlord, together with interest thereon at rate equal to the lesser of (i) one and

one-half percent (1 ½ %) per month (eighteen percent (18%) per annum) or (ii) the highest rate allowed under Applicable Law.

#### SECTION 9. TITLE AND LIENS.

(a) Landlord represents and warrants as of the Effective Date that Landlord has record title to the Property subject to no liens, easements, options or other encumbrances other than the Existing Encumbrances.

(b) After the Effective Date, in addition to Existing Encumbrances, and any refinancing of such Existing Encumbrances, Landlord may grant a mortgage on all or part of its interest in the Property if (i) such mortgage is subject to this Lease; and (ii) the mortgagee enters into an agreement, on terms and conditions reasonably acceptable to Tenant, recognizing the priority of Tenant's interest in the Property pursuant to this Lease. Tenant shall be permitted to record any such agreement, whether related to an Existing Encumbrance or a mortgage arising after the Effective Date, in the County land records.

(c) Landlord shall not allow any encumbrances against the Property other than Permitted Encumbrances. Landlord shall promptly pay all obligations secured by encumbrances against the Property (whether or not such encumbrances are Permitted Encumbrances) and shall not allow any uncured default to occur under obligations secured by encumbrances against the Property. In lieu of paying amounts secured by encumbrances which are not Permitted Encumbrances, Landlord may provide a surety bond or other adequate security in accordance with applicable law and Tenant's reasonable requirements.

(d) At Tenant's request, Landlord shall obtain from holders of Permitted Encumbrances such subordinations or non-disturbance agreements as Tenant may reasonably request to protect and secure Tenant's interest in the Property or for or in connection with a financing or other financial arrangement related to the Property and/or the Facility. Such agreements shall include undertakings by the holders of Permitted Encumbrances (i) to notify Tenant of any defaults by Landlord in performing its obligations secured by the Permitted Encumbrances; and (ii) to provide Tenant a reasonable period of time after Tenant's receipt of notice from the holder of the Permitted Encumbrance, not less than 30 days in the event of payment defaults, and 60 days in event of non-payment defaults, to cure the default on behalf of Landlord, before the holder of the Permitted Encumbrance can exercise any rights to foreclose upon or otherwise take ownership of the Property. If the default cannot reasonably be cured within a sixty-day period then, provided Tenant has promptly commenced and is diligently performing actions to cure the default, Tenant shall have such period of time as is reasonably necessary to cure the default, but not more than 120 days.

(e) All equipment and structures included within the Facility shall, to the extent permitted by law, be personal property and not real property, and title to the Facility shall be in Tenant or its mortgagees and assigns. Neither Landlord nor anyone claiming through Landlord may file liens on the Facility or Tenant's interest in the Property, except to the extent that a Default under the terms of this Lease exists and remains uncured after any notice and cure period required herein.

(f) Neither Tenant nor anyone claiming through Tenant (including contractors hired by Tenant) shall have the right to file liens on the Property, other than on Tenant's leasehold rights arising under this Lease.

#### SECTION 10. FILINGS.

Landlord hereby acknowledges Tenant intends to develop, construct and operate the Facility on the Lease Area. Tenant is hereby authorized, in the name of Landlord, Tenant or both, as Tenant may deem to be necessary or appropriate, to file with such federal, state and local authorities as Tenant deems appropriate (i) one or more applications to obtain any zoning relief regarding the Property or portions thereof as may be necessary and/or desirable to develop, construct and operate the Facility on the Lease Area; (ii) one or more applications to obtain construction, use or occupancy permits for the Facility or any portion thereof, and (iii) the notice required by Massachusetts General Laws, Chapter 61 to remove the Lease Area from Chapter 61 classification (see Section 8(c), regarding taxes). Landlord shall cooperate in good faith with Tenant and shall execute any such applications promptly upon Tenant's request, and shall not oppose or interfere with Tenant in such regard. Landlord is not obligated to incur expense in connection with such efforts.

#### SECTION 11. INSURANCE AND INDEMNITY.

(a) Each party shall maintain appropriate insurance for its respective interests in, and activities on, the Property, and shall provide certificates of insurance to the other Party evidencing such coverage promptly following the request.

(b) To the fullest extent permitted by law, each Party (the "Indemnifying Party") shall indemnify, defend and hold the other Party, its shareholders, partners, members, directors, officers, employees, agents and contractors (the "Indemnified Persons"), harmless from and against all Losses incurred by the Indemnified Persons to the extent arising from, or out of, any claim for, or arising out of, any injury to or death of any person or loss or damage to property to the extent arising out of the Indemnifying Party's, its employees' and agents' negligence, willful misconduct, or unlawful conduct. The Indemnifying Party shall not be obligated to indemnify any Indemnified Person for any Loss to the extent such Loss is due to the negligence or willful misconduct of any Indemnified Person or for statutory violation of, or punitive damages against, any Indemnified Person except to the extent the statutory violation or punitive damages are caused by or result from the acts or omissions of the Indemnifying Party or of any of the Indemnifying Party's contractors, subcontractors, sub-subcontractors, materialmen, or agents of any tier or their respective employees. Such obligation shall not be construed to negate, abridge, or otherwise reduce other rights or obligations of indemnity which would otherwise exist as to a Party or person described in this Agreement.

(c) Landlord shall indemnify, defend and hold harmless the Tenant from and against any and all Losses arising from or out of any pollution or contamination that violates any local, state or federal environmental protection law, policy or regulation, that existed on or before the Effective Date or that is caused by the Landlord or any of its employees, invitees, agents or contractors following the Effective Date. Tenant shall indemnify, defend and hold harmless Landlord from and against any and all Losses arising from or out of any pollution or

contamination that violates any local, state or federal environmental protection law, policy or regulation, that is caused by the Tenant or any of its employees, invitees, agents or contractors following the Effective Date.

## SECTION 12. MAINTENANCE, SECURITY AND UTILITIES.

(a) Maintenance. The Lease Area and all Easements shall be maintained by Tenant at its own expense.

(b) Security. Tenant is responsible for Lease Area security.

(c) Utilities. Tenant is responsible for utilities furnished to the Lease Area and Facility and used by Tenant throughout the Term hereof, and for all other costs and expenses in connection with the Facility use, operation, and maintenance.

## SECTION 13. CONDEMNATION.

(a) If, during the Term, any competent authority for any public or quasi-public purpose (“Condemnor”) seeks to take or condemn all or any portion of the Lease Area, Landlord and Tenant may use all reasonable and diligent efforts, each at its own expense, to contest such taking. In the event either party seeks to contest any such taking the other party agrees to cooperate in any such proceeding provided such party is not obligated to incur any expense in connection with such efforts.

(b) If, at any time during the Term, any Condemnor shall condemn all or substantially all of the Lease Area, or the Facility, so that the purposes of this Lease are frustrated, then the interests and obligations of Tenant under this Lease in or affecting the Lease Area shall cease and terminate upon the earlier of (i) the date that the Condemnor takes possession of the Lease Area or the Facility, (ii) the date that Tenant is, in its sole judgment, no longer able or permitted to operate the Facility on the Lease Area in a commercially viable manner, or (iii) the date title vests in the Condemnor. Tenant shall continue to pay all amounts payable hereunder to Landlord until the earlier of such dates at which time Landlord and Tenant shall be relieved of any and all further obligations and conditions to each other under this Lease, except for indemnity obligations, which shall survive any termination thereunder.

(c) If, at any time during the Term any Condemnor shall condemn a portion, but not all or substantially all of the Facility or the Lease Area, then the interest and obligations of Tenant under this Lease as to that portion of the Facility or the Lease Area so taken shall cease and terminate upon the earlier of, (i) the date that the Condemnor takes possession of such portion of the Facility or the Lease Area, (ii) the date that Tenant, in its sole judgment, is no longer able or permitted to operate the Facility on the Lease Area, or any portion thereof, in a commercially viable manner, or (iii) the date title vests in the Condemnor; and, unless this Lease is terminated as herein provided, this Lease shall continue in full force and effect as to the remainder of the Facility or the Lease Area. If the Lease Area becomes insufficient or unsuitable for Tenant’s purposes hereunder, as determined by Tenant in its sole discretion, then Tenant may terminate this Lease in accordance with this Section 13 as to the portion of the Lease Area to which Tenant continues to hold the rights, at which time Landlord and Tenant shall be relieved



of any further obligations and duties to each other under this Lease, except for indemnity obligations and Tenant's decommissioning obligations under Section 18, which shall survive any termination hereunder.

(d) For any taking covered by Sections 13(b) or 13(c), all sums, including damages and interest, awarded shall be paid and distributed to Tenant and Landlord in accordance with their respective interests under this Lease. In determining their respective interests:

(i) Landlord's interest shall be based on the value of Landlord's interest in the Lease Area (but excluding any of Tenant's interest in the Facility or any other of Tenant's improvements on the Lease Area), taking into account the amounts paid or due to be paid by Tenant hereunder and all other terms and provisions of this Lease; and

(ii) Tenant's interest shall be based on the value of Tenant's interest in the Lease Area (determined at the time of the taking), including the value of the Facility and Tenant's other improvements for the Term, plus any cost or loss that Tenant may sustain in the removal and/or relocation of any Facility; provided, however, that in each case the value of the respective interests of Landlord and Tenant shall be calculated as if no taking covered by Sections 13(b) or 13(c) were to occur.

#### SECTION 14. ASSIGNMENT.

(a) This Lease and rights hereunder may be assigned by Tenant

(i) in Tenant's sole discretion,

A. to any entity in which Tenant, or an affiliate thereof, has an interest;

B. to any entity as security for or in connection with a financing or other financial arrangement related to the Lease Area and/or the Facility, as set forth in Section 15; and,

(ii) subject to Landlord's approval and consent, such consent not to be unreasonably withheld, conditioned or delayed, to any other person or entity who assumes all of Tenant's rights and obligations hereunder, provided however that the effectiveness of any such assignment shall be conditioned on the Tenant not being then in Default.

(b) Any assignment permitted hereunder shall release the assignor from obligations accruing after the date that liability is assumed by the assignee.

(c) Upon any assignment pursuant to this Section 14, Tenant shall provide to Landlord current information regarding Tenant's and all Financing Parties' addresses and the term "Tenant" in this Lease shall refer to the entity that was assigned the rights and obligations of Tenant hereunder.

#### SECTION 15. FINANCING.

(a) Tenant may encumber its interest in the Lease Area and in the Facility by mortgage, lease, sale and leaseback, deed of trust or similar instrument or instruments and by security agreement, fixture filing and financing statements or similar instrument or instruments in favor of any person or persons providing all or a portion of the financing for the Facility or any person or persons providing a refinancing of any such financing or any trustee for such person or persons (each, a "Financing Party").

(b) If Tenant's rights or property are foreclosed upon or seized, or if a Financing Party exercises any other right under a security agreement granted by Tenant to that Financing Party, Landlord shall permit such Financing Party to exercise any and all Tenant rights hereunder, so long as there are no existing uncured Defaults. Landlord shall execute any document reasonably requested by any Financing Party to evidence and give effect to the provisions of this Section 15(b), subject only to the condition precedent that no Tenant Payment Default exists.

(c) At Tenant's request, Landlord shall amend this Lease to include any provision reasonably be requested by an existing or proposed Financing Party, provided such amendment shall not impair Landlord's rights under this Lease.

(d) Landlord shall, within ten (10) days after Tenant's written request, execute and deliver to Tenant (or to such party or parties as Tenant shall designate, including a Financing Party) the following written statements:

(i) (1) certifying whether this Lease is in full force and effect (or modified and stating the modification), (2) stating the dates on which amounts due to Landlord have been paid, (3) stating that there are no known defaults existing at the time of execution of the statement, or that defaults exist and the nature of such defaults, and (4) stating that, as of the date of such estoppel certificate, there are no disputes or proceedings under this Lease between Landlord and Tenant or, if any such dispute exists, describe the nature of such disputes or proceedings;

(ii) (1) recognizing a particular entity as a Financing Party under this Agreement and (2) agreeing to accord to such entity all the rights and privileges of a Financing Party hereunder.

## SECTION 16. RECORDATION, CONFIDENTIALITY.

(a) This Lease shall not be recorded, but the Parties shall, at Tenant's expense, execute and record with the County an appropriate notice of lease ("Notice of Lease or Memorandum of Lease"). Also, a Financing Party may record Tenant's mortgage of this Lease to the Financing Party, and may record subordinations and/or non-disturbance agreements obtained from holders of Permitted Encumbrances.

(b) Except as provided in Section 16(a), neither Party may disclose the terms of this Lease to any other person, other than immediate family members and assignees or prospective purchasers of Parties, except that either Party may disclose the terms hereof to any counsel, lender, accountant or advisor engaged by it, and that Tenant may disclose the terms hereof to any

contractor or supplier bidding upon construction of all or part of the Facility, to any person which may seek to provide financing for or to invest in the Facility and to any future subtenant or assignee. Further, each Party may disclose any terms hereof to the extent required by law, provided that the disclosing Party, to the extent practicable, gives notice of any request for disclosure to the non-disclosing Party and cooperates with efforts by the non-disclosing Party to minimize the extent of the information disclosed and the persons to whom it is disclosed.

#### SECTION 17. DEFAULT AND REMEDIES.

(a) If Tenant fails to perform any of Tenant's material obligations under this Lease and such failure remains uncured following the required notice and cure periods as required in Section 17(c) (a "Default"), Landlord may terminate this Lease by notice to Tenant and exercise any other remedies provided in this Lease or under Applicable Law. A Default may be either a Payment Default or a Non-Payment Default. A "Payment Default" is failing to make timely payments required herein.

(b) Landlord shall simultaneously notify in writing Tenant and all Tenant Financing Parties who have given advance notice of their interest in this Lease to Landlord, of any failure by Tenant to perform any Tenant obligations under this Lease, which notice shall be sent according to Section 20 and shall set forth in reasonable detail the facts pertaining to such failure and specify a reasonable method of cure.

(c) Before Landlord exercises any rights or remedies against Tenant as a result of a Tenant Default, Landlord shall give Tenant and each Financing Party (i) sixty (60) days' notice of and the opportunity to cure any Tenant Payment Default, (ii) ninety (90) days' notice of and the opportunity to cure any Tenant Non-payment Default, and (iii) a reasonable further opportunity to cure a Tenant Non-payment Default, in which case Tenant, or the Financing Party on the Tenant's behalf, shall notify Landlord of the anticipated date for curing of the Non-Payment Default and shall begin to diligently undertake the cure within the 90-day period, weather permitting.

(d) Tenant and any Financing Party may cure any Payment Default by paying all then overdue payments in full together with interest thereon at the rate of one and one half percent (1½%) per month.

(e) If Landlord fails to perform any of its obligations hereunder, including failure to perform with respect to any obligations secured by encumbrances against the Property, Tenant may offset against any amounts owing to Landlord hereunder any amounts paid by Tenant to cure such non-performance by Landlord together with interest thereon at the rate of one and one-half percent (1½%) per month and exercise any other remedies available under this Lease or Applicable Law.

SECTION 18. FORCE MAJEURE. If performance of this Lease or of any obligation hereunder (other than an obligation to pay any Rent) is prevented or substantially restricted or interfered with by reason of an event of "Force Majeure" (defined below), the affected party, upon giving notice to the other party, shall be excused from such performance to the extent of and for the duration of such prevention, restriction or interference. The affected

party shall use reasonable efforts to avoid or remove such causes of nonperformance, and shall continue performance hereunder whenever such causes are removed. “Force Majeure” means any act or event that prevents the affected Party from performing its obligations in accordance with this Agreement, if such act or event is beyond the reasonable control, and not the result of the fault or negligence, of the affected Party and such Party had been unable to overcome such act or event with the exercise of due diligence (including the expenditure of reasonable sums). Subject to the foregoing, Force Majeure may include the following acts or events: (i) Acts of God or acts of Providence including hurricanes, floods, washouts, lightning, earthquakes, storm warnings and any other adverse weather conditions which directly result in a party’s inability to perform its obligations, (ii) acts of civil disorder including acts of sabotage, acts of war, lockouts, insurrection, riot, mass protests or demonstrations, threats of any of the foregoing, and police action in connection with or in reaction to any such acts of civil disorder, when any such acts of civil disorder directly results in a party’s inability to perform its obligations, and (iii) failures resulting from fires, washouts, mechanical breakdowns of or necessities for making repairs or alterations to transformers, power lines, switching equipment, inverters, machinery, cables, meters or any of the equipment therein or thereon, when any such failure directly results in a Party’s inability to perform its obligations.

SECTION 19. NOTICES. Notices under this Lease shall be sent to the addresses set forth below:

If to Landlord, by U.S. Postal Service:

Robert Thomas Newman and Sarah G. Newman  
2394 Main Poland Road  
Williamsburg, MA 01096  
Attn: Sarah Newman  
Email: [onion.and.sarah@gmail.com](mailto:onion.and.sarah@gmail.com)

If to Landlord, by other delivery service:

Robert Thomas Newman and Sarah G. Newman  
2394 Main Poland Road  
Conway, MA 01341  
Attn: Sarah Newman  
Email: [onion.and.sarah@gmail.com](mailto:onion.and.sarah@gmail.com)

If to Developer: Conway Solar, LLC  
c/o Nexamp, Inc.  
4 Liberty Square, Third Floor  
Boston, MA 02109  
Attn: Ethan Gyles  
Email: [egyles@nexamp.com](mailto:egyles@nexamp.com)

Notices shall be deemed received if sent by certified mail (return receipt requested), courier or nationally recognized overnight delivery service to last known address of the intended recipient.

Notices may also be sent by email for which the sending Party receives an affirmative confirmation that the email message has been completely transmitted without error (of which auto-replies are insufficient). Email messages received on any day that is not a business day, or after 5:00 p.m. local time on a business day, shall be deemed to have been delivered on the next business day. A Party may change its address for delivery of notices hereunder by notice given in accordance with this Section. Failure of the Tenant to notify the Landlord of an address change for it or any Financing Party shall excuse the Landlord from complying with any notice obligation herein to such changed addresses, provided however that the Landlord will in no event be excused from providing notices required herein to all addresses that Landlord has notice of. Notices will be deemed given upon receipt or upon the failure to accept delivery.

SECTION 20. NO PARTNERSHIP. Landlord does not, in any way or for any purpose, become a partner of Tenant in the conduct of its business, or otherwise, or joint venturer or a member of a joint enterprise with Tenant by reason of this Lease.

SECTION 21. DISPUTE RESOLUTION.

(a) Negotiation Period. The Parties shall negotiate in good faith and attempt to resolve any dispute, controversy or claim arising out of or relating to this Agreement (a “Dispute”) within 30 days after the date that a Party gives written notice of such Dispute to the other Party.

(b) Mediation. If, after such negotiation in accordance with Section 21(a), the Dispute remains unresolved, a Party may require that a non-binding mediation take place. In such mediation, representatives of the Parties with authority to resolve the dispute shall meet for at least three (3) hours with a mediator whom they choose together. If the Parties are unable to agree on a mediator, then either Party is hereby empowered to request the American Arbitration Association (the “AAA”) to appoint a mediator. The mediator’s fee and expenses shall be paid equally by each involved Party.

(c) Arbitration of Disputes.

(i) Rules of Arbitration. Any Dispute that is not settled to the mutual satisfaction of the Parties pursuant to Sections 21(a) or 21(b) shall (except as provided in Section 21(c)(iii) be settled by binding arbitration between the Parties conducted in Boston, Massachusetts, or such other location mutually agreeable to the Parties, and in accordance with the AAA Commercial Arbitration Rules in effect on the date that a Party gives notice of its demand for arbitration.

(ii) Expenses. Unless otherwise ordered by the arbitrator, each Party shall bear its own expenses and proportionate cost of the arbitration panel. Payments of the arbitrator’s costs shall be made on a monthly basis prior to any award.

(iii) Exceptions to Arbitration. The obligation to arbitrate shall not be binding upon any Party with respect to (i) requests for preliminary injunctions, temporary restraining orders, specific performance, or other procedures in a court of competent jurisdiction to obtain interim relief deemed necessary by such court to preserve the status

quo or prevent irreparable injury pending resolution by arbitration of the actual Dispute; (ii) actions to enforce an award of an arbitrator or otherwise to collect payments not subject to bonafide dispute; or (iii) claims involving third parties who have not agreed to participate in the arbitration of the Dispute.

(iv) Survival of Arbitration Provisions. The provisions of this Section 21 shall survive any termination of this Agreement and shall apply (except as provided herein) to any Disputes arising out of this Agreement.

SECTION 22. REPRESENTATIONS AND WARRANTIES. Each Party represents and warrants to the other Party as follows:

(i) Organization and Qualification. If an entity, it is duly organized and validly existing under the laws of the state of its purported organization with all power and authority to own or lease and dispose of all of its properties and assets, to conduct its business as presently conducted, and to enter into and carry out this Lease.

(ii) Authority. It has all requisite power and authority to execute and deliver this Lease and each of the related documents to which it is a party, to perform its obligations hereunder and thereunder and to consummate the transactions contemplated hereby and thereby. Its execution and delivery of this Lease and each of the related documents to which it is a party, its performance hereunder and thereunder and the consummation of the transactions contemplated hereby and thereby have been duly and validly authorized by all requisite action its part and no other proceedings on its part are necessary to authorize this Lease and each related documents to which it is a party, the performance of such obligations or the consummation of such transactions.

(iii) No Violation or Conflict; Consents. Neither the execution and delivery of this Lease or any of the related documents to which it is a party, nor the performance of its obligations hereunder and thereunder, nor the consummation of the transactions contemplated hereby and thereby will, directly or indirectly (with or without notice or lapse of time or both), (1) violate, contravene, conflict with or breach any term or provision of its organizational documents, (2) result in a violation or breach of, or constitute (with or without due notice or lapse of time or both) a default (or give rise to any right of termination, cancellation or acceleration) under, or require any consent under, any contract or other instrument or obligation to which it is a party or by which it or any of its respective properties or assets are bound, (3) violate any laws applicable to it or any of its affiliates or any of their respective properties or assets, or (4) except as specifically provided herein and in any related documents, require any filing with, or the obtaining of any further authorization, permit, or other consent from any governmental authority, or (5) require any further authorization or other consent from any person or body with authority over or within its organization.

SECTION 23. MISCELLANEOUS PROVISIONS.

(a) Governing Law. This Lease shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts.

(b) Rules of Interpretation. References to sections are, unless the context otherwise requires, references to sections of this Lease. The words “hereto”, “hereof” and “hereunder” shall refer to this Lease as a whole and not to any particular provision of this Lease. The word “person” shall include individuals; partnerships; corporate bodies (including to corporations, limited partnerships and limited liability companies); non-profit corporations or associations; governmental bodies and agencies; and regulated utilities. The word “including” shall be deemed to be followed by the words “without limitation”.

(c) Entire Agreement/Amendment. This Lease contains the entire agreement of the Parties and there are no other promises, conditions, understandings or other agreements, whether oral or written, relating to the subject matter of this Lease. This Lease may be modified or amended in writing, if the writing is signed by the Parties obligated under the amendment and notice thereof is registered with the County.

(d) Severability. If any non-material part of this Lease is held to be unenforceable, the rest of the Lease will continue in effect. If a material provision is determined to be unenforceable and the Party which would have been benefited by the provision does not waive its unenforceability, then the Parties shall negotiate in good faith to amend the Lease to restore to the Party that was the beneficiary of such unenforceable provision the benefits of such provision. If the Parties are unable to agree upon an amendment that restores the Parties benefits, the matter shall be resolved under Section 21 (regarding dispute resolution) and an arbitrator may reform the Agreement as the arbitrator deems just and equitable in order to restore to the Party that was the beneficiary of the unenforceable provision the economic benefits of such provision.

(e) Waiver. The failure of either Party to enforce any provisions of this Lease shall not be construed as a waiver or limitation of that Party’s right to subsequently enforce and compel strict compliance with every provision of this Lease.

(f) Binding Effect. The provisions of this Lease shall be binding upon and inure to the benefit of the Parties and their respective heirs, legal representatives, successors and permitted assigns.

(g) No Assurance as to Development. Tenant makes no representations, warranties, commitments or guarantees of any kind as to the likelihood of Tenant successfully developing, financing and/or constructing the Facility on the Lease Area.

(h) Cooperation. The Parties acknowledge that the performance of each Party’s obligations under this Lease may often require the assistance and cooperation of the other Party. Each Party therefore agrees, in addition to those provisions in this Lease specifically providing for assistance from one Party to the other, that it will at all times during the Term cooperate with the other Party as required, in its reasonable discretion, and provide all reasonable assistance to the other Party to help the other Party perform its obligations hereunder. From time to time and at any time at and after the execution of this Lease, each Party shall execute, acknowledge and deliver such documents, and assurances, reasonably requested by the other and shall take any other action consistent with the terms of the Lease that may be reasonably requested by the other for the purpose of effecting or confirming (but not altering or expanding) any of the transactions

contemplated by this Lease. Neither Party shall unreasonably withhold, condition or delay its compliance with any reasonable request made pursuant to this Section 23(h).

(i) Business Days. Any payment or other obligation which is due to be performed on or before a day which is not a business day in the Commonwealth of Massachusetts may be performed on or before the next business day following the date provided herein.

(j) Counterparts. This Lease may be executed in counterparts, which shall together constitute one and the same agreement. Facsimile signatures shall have the same effect as original signatures and each Party consents to the admission in evidence of a facsimile or photocopy of this Lease in any court or arbitration proceedings between the Parties.

IN WITNESS WHEREOF, the Parties entered into this Lease as of the Effective Date.

**TENANT**

**LANDLORD**

**Conway Solar, LLC**

**Robert Thomas Newman and Sarah G. Newman**

By: Nexamp Capital, LLC,  
its sole member

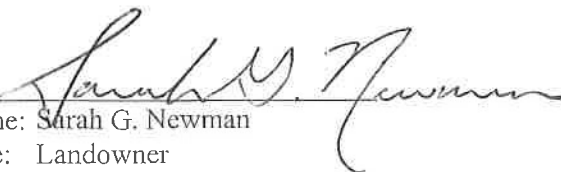
By: Nexamp, Inc.,  
its sole member

By: 

By: 

Name: CHRIS CLARR  
Title: Authorized Officer

Name: Robert Thomas Newman  
Title: Landowner

By:   
Name: Sarah G. Newman  
Title: Landowner



## GLOSSARY OF TERMS

As used herein, the following terms shall have the meanings set forth beside them:

“Applicable Law” means any constitutional provision, law, statute, rule, regulation, ordinance, treaty, order, decree, judgment, decision, certificate, holding injunction, registration, license, franchise, permit, authorization, or guideline issued by a Governmental Authority that is applicable to a Party to this Agreement or the transaction described herein.

“Chapter 61” means Massachusetts General Laws, Chapter 61, 61A or 61B, regarding tax classification for forest, agricultural, horticultural, or recreational land.

“Commercial Operation” shall occur for the Facility when (i) Tenant has obtained all necessary licenses, permits and approvals under Applicable Law for installing and operating the Facility, (ii) the Facility has been connected to the LDC’s electricity distribution system, and (iii) the Facility is ready and able to generate and supply electricity to the LDC electricity distribution system.

“Commercial Operation Date” means the date Tenant receives authority to interconnect the Facility from the LDC, notice of which shall be given according to Section 6(d).

“County” means the county within which the Facility is located.

“Decommission” or “Decommissioning”: means performing the activities described in Section 5(c).

“Decommissioning Period” is defined in Section 4(a)(iii).

“Default” is defined in Section 17(a).

“Development and Construction Period” is defined in Section 4(a)(i).

“Easement(s)” shall mean those areas of land described in Section 3, as detailed in Exhibit B, until during the Development and Construction Period when Tenant shall determine the boundaries of the easements by means of a survey, and such survey shall then define the Lease Area as an amendment to this Lease as a revised Exhibit B.

“Environmental Attributes” means Renewable Energy Certificates, carbon trading credits, emissions reductions credits, emissions allowances, green tags, Green-e certifications, or other entitlements, certificates, products, or valuations attributed to the Facility and its displacement of conventional energy generation, or any other entitlement pursuant to any federal, state, or local program applicable to renewable energy sources, whether legislative or regulatory in origin, as amended from time to time, and excluding, for the avoidance of doubt, any Tax Attributes.

“Existing Encumbrances” mean those interests in the Lease Area set forth in Exhibit C attached hereto.

“Facility” means the solar powered electric generating facility and all related equipment and structures, including inverters, transformers and facilities for interconnection with the LDC, to be installed by Tenant on the Lease Area in accordance with this Lease.

“Financing Party” is defined in Section 15(a).

“Force Majeure” is defined in Section 18.

“Governmental Authority” means any international, national, federal, state, municipal, county, regional or local government, administrative, judicial or regulatory entity, and includes any department, commission, bureau, board, administrative agency or regulatory body of any government.

“Indemnified Persons” is defined in Section 11(b).

“Indemnifying Party” is defined in Section 11(b).

“Lease Area” means the Property, unless during the Development and Construction Period Tenant determines the boundaries of the final Lease Area, by means of a survey, which survey shall then define the Lease Area as an amendment to this Lease as a revised Exhibit B.

“LDC” means the local electric power distribution company.

“Losses” means any and all losses, liabilities, claims, demands, suits, causes of action, judgments, awards, damages, cleanup and remedial obligations, interest, fines, fees, penalties, costs, and expenses (including all reasonable attorney’s fees and other costs and expenses incurred in defending any such claims or matters or in asserting or enforcing any indemnity obligation).

“Memorandum of Lease” is defined in Section 16(a).

“Non-payment Default” is defined in Section 17(a).

“Notice of Lease” is defined in Section 16(a).

“Operating Year” means a twelve month period commencing on an anniversary of the Commercial Operation Date (or with respect to the first Operating Year, commencing on the Commercial Operation Date) and ending on the date immediately preceding the next anniversary of the Commercial Operation Date.

“Operations Period” is defined in Section 4(a)(ii).

“Payment Default” is defined in Section 17(a).

“Permitted Encumbrances” mean the Existing Encumbrances and any additional mortgages granted by Landlord in accordance with Section 9(b) hereof.

“Permitted Use” means the use of the Lease Area i) to develop, install, construct, interconnect, maintain, operate, repair, replace and decommission the Facility and energy storage device(s), ii) to produce, deliver and sell electricity produced by the Facility and associated Environmental Attributes and Tax Attributes and iii) to store such equipment, supplies, tools and replacement parts as reasonably required to accomplish (i) and (ii) above, including the construction of a single story storage shed.

“Property” means the real property located at 2394 Main Poland Road, Conway, MA, containing approximately 104 acres, as more particularly described in Exhibit A.

“Renewable Energy Certificate” or “REC” means a certificate, credit, allowance, green tag, or other transferable indicia, howsoever entitled, created by an applicable program or certification authority indicating generation of a particular quantity of energy, or product associated with the generation of a megawatt-hour (MWh) from a renewable energy source by a renewable energy generating facility.

“Rent” means the payments to be made in accordance with Section 7 hereof.

“Tax Attributes” means investment tax credits (including any grants or payments in lieu thereof) and any tax deductions or other benefits under the Internal Revenue Code or applicable federal, state, or local law available as a result of the ownership and/or operation of the Facility or the output generated by the Facility (including, without limitation, tax credits (including any grants or payments in lieu thereof) and accelerated and/or bonus depreciation). Tax Attributes do not include Environmental Attributes.

“Term” means all of the Development and Construction Period, the Operations Period, and the Decommissioning Period, as such periods are described in Section 4.

## **EXHIBIT A**

### **PROPERTY DESCRIPTION**

The Property means the real property located at 2394 Main Poland Road, Conway, Franklin County, Massachusetts, Assessors Map 415 Lot 15.1, containing approximately 104 acres, which is all the property conveyed to Landlord by deed dated June 21, 2000 recorded in the Franklin County Registry of Deeds at Book 3639, Page 247.

## EXHIBIT B

### LEASE AREA AND EASEMENTS DESCRIPTION

#### **Lease Area:**

The Lease Area shall mean the Property unless during the Development and Construction Period Tenant determines the boundaries of the final Lease Area by means of a survey, which survey shall then define the Lease Area and shall be an amendment to this Lease as a revised Exhibit B.

#### **Easements:**

The Easements shall mean those areas of land described in Section 3 of the Lease. During the Development and Construction Period the Easements boundaries shall be determined according to this Lease by means of a survey, and such survey shall then define the Easements and shall be an amendment to this Lease as a revised Exhibit B.

**EXHIBIT C**  
**EXISTING ENCUMBRANCES**

*[Landlord to provide]*

**Nexamp Solar, LLC**  
**4,890 kW Photovoltaic Project**  
**Distribution System Impact Study**

September 25, 2018

6A3350-2018

Project # 2337

This Document may contain Critical Energy Infrastructure Information  
(CEII)

## Introduction

On behalf of NSTAR Electric Company (NSTAR) DBA Eversource Energy (Eversource), RLC Engineering, LLC (RLC) conducted a Distribution Impact Study (the “Study”) on a proposed solar facility (the “Project”) interconnecting to Eversource utility system. The Study ensured the Project is in accordance with NSTAR Electric Tariff M. D. P. U. No. 55, “Standards for Interconnection of Distributed Generation” (the “Tariff”). As listed in Table 0-1, the Project will interconnect to the 38A1 Eversource feeder, which is served from Eversource’s Ashfield 38A Substation.

| Application #  | Address                                    | Developer         | Maximum Output (kW) |
|--|--|-------------------|---------------------|
| 6A3350-2018 – Option 1 (PV Only)                                       | 2394 Main Poland Road,<br>Conway, MA 01341 | Nexamp Solar, LLC | 4,890               |
| 6A3350-2018 – Option 2 (PV and DC Coupled Energy Storage System (ESS)) | 2394 Main Poland Road,<br>Conway, MA 01341 | Nexamp Solar, LLC | 4,890               |

**Table 0-1: Project Interconnecting on the 38A1 Feeder**

The primary focus of this Study is to:

1. Assess compliance of the proposed Project designs with requirements of distributed generation interconnecting to the Eversource system according to the Tariff and applicable standards.
2. Assess the steady state and short-circuit impacts of the proposed Project on the distribution systems served from the Ashfield 38A1 feeder.
3. Identify distribution system and substation upgrades that may be necessary to complete the interconnection of the Project.

This Study includes a design review, voltage flicker analysis, thermal analysis, short circuit analysis, effective grounding analysis, load flow analysis, risk of islanding and cost estimate required for the interconnection of the Project.

### *Conceptual Design of Solar Photovoltaic (PV) and Energy Storage System (ESS) Interconnection Facility*

It should be noted that Nexamp Solar, LLC (the “Developer” or “Customer”) submitted documentation indicating an interconnection to a 13.8 kV feeder, however the 38A1 feeder is actually a 23 kV system operating at 22.86 kV voltage. The Study assumed this was a typo and that the Customer intends to interconnect at the 22.86 kV voltage. The Study was performed with the 38A1 feeder operating at 22.86 kV voltage. The Customer will need to revise their documentation and one-lines.

The Customer has proposed to construct either a 4,890 kWac nominal / 4,890 kWac maximum / 6,498.63 kWdc PV generation facility (Option 1) or a 4,890 kWac nominal / 4,890 kWac maximum / 6,498.63 kWdc PV generation and 2000 kW of DC coupled energy storage facility (Option 2) located at 2394 Main Poland Road, Conway, MA 01360. The proposed Project will interconnect to the Eversource 23 kV distribution system via the 38A1 feeder, which originates at



the Eversource Ashfield 38A Substation. The Project will interconnect using one of the following Options:

#### *Option 1*

The Customer proposes to interconnect 4,890 kW of PV generation using one (1) Power Electronics PE FS2600 CU15 600V inverter and one (1) Power Electronics PE FS1475 CU15 600V inverter to the utility distribution system through one (1) Customer owned, grounded wye primary – delta secondary, 23,000/600 V step-up transformer rated at 3,110 kVA with a 13 Ohm neutral reactor on the primary winding and one (1) Customer owned, grounded wye primary – delta secondary, 23,000/600 V step-up transformer rated at 1,780 kVA with a 10 Ohm neutral reactor on the primary winding.

#### *Option 2*

The Customer proposes to interconnect 4,890 kW of PV generation using the same configuration as Option 1 along with a DC coupled 1000 kW energy storage system (ESS) connecting to each of the inverters, for a total of 2,000 kW of ESS.

The proposed inverters have been certified as UL 1741 and indicate compliance with IEEE 1547, however there has been no documentation provided that indicates UL 1741-SA compliance for LVRT capability has been met. The Project will not be allowed to operate until compliance is met.

#### *Compliance with M.D.P.U No. 55*

Provided all recommendations of this report are met, the proposed Project interconnection complies with the requirements detailed in Section 4 of M. D. P. U. No. 55.

## **Study Findings**

The Project was modeled from zero to full power output to simulate a full spectrum of generation and loading scenarios. Short circuit, effective grounding, voltage flicker, load flow, risk of islanding, and thermal analyses were the primary impact assessments performed in this Study. It must be noted that this Study evaluated the Power Electronics PE FS2600 CU15, Power Electronics PE FS1475 CU15 inverters (Option 1 & 2) and energy storage (Option 2 only) as shown on the Project one-lines. A new application and study will be required if more inverters are added to the Project or other changes are made.

#### *Short Circuit Analysis*

Short circuit analysis was conducted with all Ashfield 38A1 feeder generation online, as this results in the greatest fault current contribution. The greatest fault current for both Options measured near the Point of Common Coupling (PCC) increased by 7.78% as presented in Table 0-2 with the grounding bank specified in Table 0-3. This meets the requirement of the M. D. P. U. No. 55, which states that the proposed facility will not contribute more than 10% to the distribution feeder's maximum fault current at the PCC. This requirement ensures the Project's fault current contribution will not have a significant impact on the distribution feeder's protective devices. Eversource will make the final determination as to whether the 7.78% increase to 3LG and 5.33% to 1LG fault current adversely impacts the existing equipment and protection schemes.

| Eversource Project #                   | Fault Type | Pre-Project   |      | Post-Project  |      | Change |
|--|------------|---------------|------|---------------|------|--------|
|  |            | Fault Current | X/R  | Fault Current | X/R  |        |
| 6A3350-2018 – Option 1<br>(PV Only)    | 3LG        | 1,433         | 3.93 | 1,544         | 4.26 | 7.78%  |
|  | 1LG        | 1,013         | 3.45 | 1,067         | 3.48 | 5.33%  |
| 6A3350-2018 – Option 2<br>(PV and ESS) | 3LG        | 1,433         | 3.93 | 1,544         | 4.26 | 7.78%  |
|  | 1LG        | 1,013         | 3.45 | 1,067         | 3.48 | 5.33%  |

**Table 0-2: Fault Duty at 6A3350-2018 PCC**

### *Effective Grounding Analysis*

For both Project Options the Customer proposed step up transformers configured as grounded wye primary – delta secondary with a neutral reactor connected on the primary side. Analysis determined that this configuration satisfies Eversource effective grounding criteria ( $2 < X0/X1 < 3$ ), however, unacceptable increase in single line to ground fault resulted at the Project PCC (34.78%). The Study has determined that the step-up transformers are required to be grounded wye – grounded wye configuration with a grounding bank located on the low side of each step-up transformer to satisfy Eversource’s effective grounding criteria and maintain the single line to ground fault current to an acceptable level. Table 0-3 summarizes the required grounding transformer specifications for both Options.

| Eversource Project #   | Grounding Bank Size | Grounding Bank Impedance (%Z) |
|------------------------|---------------------|-------------------------------|
| 6A3350-2018 – Option 1 | 45 kVA              | 5.0                           |
| 6A3350-2018 – Option 2 | 45 kVA              | 5.0                           |

Note: Reference IEEE 142 and NFPA 70 for grounding bank requirements. Final design is the responsibility of the interconnecting customer.

**Table 0-3: Grounding Bank Required for Effective Grounding**

### *Voltage Regulation and Fault Duty*

The power generation produced by the Project reduces local losses when generating and raises voltage at and in the general vicinity of the Project. The Project is not expected to have a significant effect on the operation of the LTC on the distribution transformer of the Ashfield 38A1 distribution transformer LTC.

With the Project inverters operating at unity Power Factor (PF) voltages were above Eversource criteria (104.5 pu) on the distribution feeder and voltage flicker was greater than the 2% criteria required for PV units. Based on the electrical specifications, the inverters are designed to operate at unity power factor to achieve full active power output. The Project’s inverters are capable of operating at a 0.80 leading and 0.80 lagging power factor. Voltage and flicker criteria

were satisfied by operating the Project inverters at 0.99 fixed leading power factor for both Options.

### *Reactive Power Requirements*

The Project was required to operate at a 0.99 fixed leading PF (i.e., consuming reactive power) for both Options in order to meet Eversource voltage and flicker criteria under the operating conditions studied.

To maintain near unity power factor at the Ashfield 38A Substation, additional reactive compensation may be required due to the Project operating with a leading power factor. Eversource will review and make the final determination on the necessary reactive compensating device design and operation. The following reactive compensation was modeled near the Ashfield 38A Substation for this Study:

- Option 1:
  - 1,200 kVAR reactive device (modeled as a fixed shunt capacitor near Pole 3/120 located on the Baptist Corner Road).
- Option 2:
  - 1,200 kVAR reactive device (modeled as a fixed shunt capacitor near Pole 3/120 located on the Baptist Corner Road).

### *Switching and Transfer Trip Requirements*

The certified inverter requirement (UL 1741 SA) stated in the updated ROI process flow is required since the Project application submittal was after March 1, 2018. The Project will not be allowed to operate until compliance is met.

Once UL 1741 SA compliance is demonstrated, a risk of islanding (ROI) is required since the Project exceeds 200 kW. Four (4) circuit interrupting devices bound the Project PCC; however, only the Substation breaker was evaluated, as this is the worst-case scenario. If the ROI evaluation fails for the 38A1-2 breaker, then one of the following may be required:

- Dynamic ROI study to prove that the Project does not pose an islanding risk, or
- SCADA recloser, or
- Reclose blocking, or
- DTT scheme from the Project PCC recloser to the Substation breaker.

The Project failed the Eversource ROI and since the Project is greater than 2,000 kW, a Sandia Screen evaluation is required. The Sandia Screen consists of four (4) steps:

- Step 1. Is the aggregate distributed generation (DG) alternating current (AC) rating greater than 67% of the minimum load within the bounded section? If this step is true, continue to Step 2.
- Step 2. Is the reactive consumption from the load and the DG within 1% of the aggregate capacitor rating within the bounded section? If this step is true, additional study or direct transfer trip (DTT) is necessary.

- Step 3. Does the bounded section contain inverters and rotating DG AND is the rotating DG greater than 25% of the total DG within the bounded section? If this step is true, additional study or DTT is necessary.
- Step 4. Are there more than 10 inverters within the bounded section AND are less than two thirds of the inverters from the same manufacturer? If this step is true, additional study or DTT is necessary.

If the answer to Steps 2, 3, or 4 is “yes”, then either a dynamic ROI study is required to prove that the Project does not pose an islanding risk, or additional control and protection is required as a form of loss of mains detection (LOMD) to trip the Project under an islanding event.

The Project failed Steps 1 and 2 of the Sandia Screen and Step 4 could not be completed due to insufficient manufacturer data. Consequently, the Project will require:

- A dynamic ROI study to prove the Project does not pose an islanding risk, or
- SCADA reclose blocking, or
- A DTT scheme from the Project PCC to the Substation circuit breaker 38A1-2 interconnecting feeder breaker at the Ashfield 38A Substation and the reclosers located between the Ashfield 38A Substation and the Project.

The Project will only operate on the normal configuration of the 38A1 Feeder. Operating in an alternate switched configuration will not be permitted. Eversource will write a Special Operating Guideline, which will address operation of the distribution system and the proposed Project.

## Cost Estimates

The Project requires a DTT, a primary service, and primary revenue metering. Engineering design and some relay settings will be required.

**Please Note: There is a prior project that is responsible for installing DTT at the substation. Should this project cancel/withdraw, Nexamp Solar (6A3350-3018) is responsible for the cost to install this equipment. The cost estimate for this equipment and labor is NOT included in the cost estimate listed below.**

### **6A3350-2018 – Option 1:**

Direct Transfer Trip (DTT) overhead line  
 New Primary Service  
 Install 1,200 kVAR of reactive compensation near the Substation  
 Replace two fuse locations with DSCADA recloser  
 Replace hydraulic triple single reclosers with DSCADA recloser  
 Primary Revenue Metering  
 DSCADA recloser on the primary service  
 Project Oversight

---

Preliminary +/- 25% Cost Estimate excluding CIAC (17%) \$554,794

**6A3350-2018 – Option 2:**

Direct Transfer Trip (DTT) overhead line  
New Primary Service  
Install 1,200 kVAR of reactive compensation near the Substation  
Replace two fuse locations with DSCADA recloser  
Replace hydraulic triple single reclosers with DSCADA recloser  
Primary Revenue Metering  
DSCADA recloser on the primary service  
Project Oversight

---

Preliminary +/- 25% Cost Estimate excluding CIAC (17%) \$554,794

\*NOTE: The CIAC rate in place at the time the Interconnection Service Agreement is sent out for signature will be applied to the distribution system modifications. Currently the CIAC is 17% and is subject to change monthly.

The Interconnecting Customer is separately responsible for procuring and installing non-Company owned items including Interconnecting Customer owned fuses, switches, utility grade multifunction protective relaying, PTs and CTs for protection, and production metering equipment required for a Class II or III and net metering facility.

The estimate is for work to be conducted by the Company for distribution system modifications including the new primary service, revenue metering and recloser with DSCADA, DTT and recloser control. The Interconnecting Customer is responsible for contacting other pole attachments (such as telephone company, cable television, etc.) to determine what costs they will incur for their work.

The Customer is responsible for obtaining communication (dedicated analog telephone or Ethernet) to the revenue meter and for the ongoing monthly cost for such communication. These costs are not included in the cost estimate above.

This is an Eversource Energy pole set area.

A Detailed Study will be required to engineer the transfer trip scheme and write the construction work orders. The cost of the Study is not included in the above estimate.

The Customer is responsible for CIAC which at this time is 17% and is subject to charge monthly. The Internal Revenue Code of 1986 (Tax Reform Act of 1986) mandates that "Contribution In Aid of Construction" (CIAC) Tax Liability Gross Up for reimbursable Customer work is considered taxable income to the receiving utility. This means that Eversource is required to pay federal income tax on all Customer contributions (reimbursable Customer work). The Commonwealth of Massachusetts also has a corporate income tax which is based on the federal taxable income. Therefore, Eversource pays both a federal and a state income tax on contributions received from customers. Eversource is required under present laws to pay federal and state taxes on CIAC payments. All customers are subject to tax liability, including non-profit "tax-exempt" organizations. Churches, schools, town halls, even the National Guard are subject to tax liability.

## **CONCLUSIONS and RECOMMENDATIONS**

The primary objective of this Study is to assess the impacts on the Ashfield 38A Substation, the 38A1 distribution feeder, and to identify distribution system modifications that may be necessary to complete the interconnection of the PV Project. As a result of the assessment the following conclusions are made for the two options:

1. The Project is compliant with the requirements detailed in M. D. P. U. No. 55 provided items from the initial review as well as additional requirements below are met by the Interconnecting Customer.
2. The proposed inverter indicates UL1741 SA compliance is pending. Compliance is required for applications submitted after March 1, 2018, therefore the Project will not be allowed to operate until UL1741 SA compliance is demonstrated.
3. The Project is required to operate at 0.99 leading power factor (Both Options) to satisfy Eversource flicker and voltage criteria.
4. Install one 1,200 kVAR fixed capacitor bank near pole 3/120 Baptist Corner Road
5. The Project step-up transformers are required to be grounded wye – grounded wye configuration. A 45 kVA zig-zag grounding transformer with an impedance of 5%Z is required on the secondary side of the GSU transformers to satisfy Eversource's effective grounding criteria. The grounding transformer requires a positive interlock to be installed with the inverters so that if it is removed, the inverters cannot operate. The interlock must be fail safe, such that any circuit or device failure will result in a safe mode of operation. A revised Project one-line will need to be submitted to show these changes.
6. The Project one-lines provided for both Options have the primary interconnecting voltage as 13.8 kV. The interconnection voltage is 22.86 kV. The Project one-lines need to be updated to reflect 22.86 kV.
7. The Project requires DTT from the Project PCC to the Substation circuit breaker 38A1-2 interconnecting feeder breaker at the Ashfield 38A Substation. The project prior to this is responsible for installing DTT at the substation. Should that project cancel/withdraw Nexamp Solar is responsible to pay for the installation of DTT at the substation.
8. Replace hydraulic triple single reclosers pole 35/1 with DSCADA recloser
9. Replace two fuse locations with DSCADA reclosers poles 32B/73 and 32/89 Main Poland Road.
10. The Customer shall ensure BIL ratings of Project equipment are sufficient to coordinate with the utility system and the applicant should apply sufficient surge protection at locations such as risers and transformers. The 23 kV system is considered a 25 kV voltage class requiring a BIL of at least 125 kV unless other environmental conditions warrant increased values.
11. The protective relay design is required to include a test switch for the PT and CT inputs.

12. The Project's relay settings shall be compliant with Eversource criteria for voltage and frequency trip settings. The settings shall be set to the new Eversource LVRT criteria since the application was submitted after March 1, 2018. The Project one-line shall be updated to reflect Eversource LVRT criteria set points.
13. The Project facility protection is required to be located as close to the utility PCC as possible.
14. Once the Project one-line reflects final changes, it is required to be re-stamped by an electrical MA PE and resubmitted.
15. Eversource's Transmission Planning Department will review the risk of reverse power under minimum load conditions and determine if a transmission study is required.
16. A MA PE stamped Project three-line drawing consistent with the one-line drawing is required for the protection review if the installed equipment is not part of a manufactured assembly.
17. The Project will only operate on the normal configuration of the Ashfield 38A1 circuit.
18. The high level  $\pm 25\%$  estimate for construction is \$645,709 including CIAC estimated at 17%.
19. A Detailed Study is required to engineer the distribution system modifications, develop the construction schedule, and if an early ISA is not requested, refine the interconnection cost to  $\pm 10\%$  for inclusion in the Interconnection Service Agreement. The cost of the Detailed Study is not included in the high level estimate for construction.
20. Estimates for system modifications does not include any costs for equipment which may be required by ISO-NE or for the future SMART Program if the Customer elects to participate in that program.
21. The Project must notify Eversource if they will be in any ISO-NE markets such as frequency or capacity.
22. ISO-NE notification is required.
23. A Witness Test will be required.

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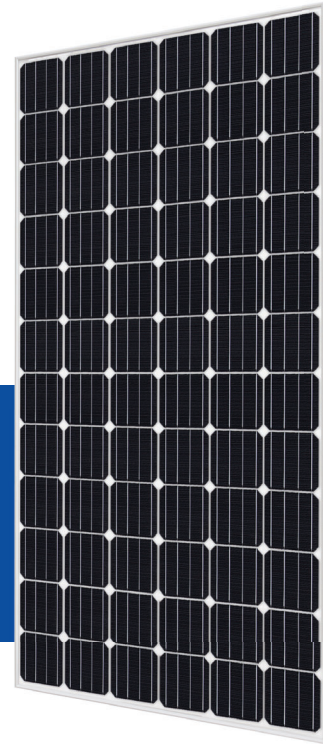


# HYUNDAI SOLAR MODULE

**KI**  
SERIES

## Mono-Crystalline Type

HiS-S330KI    HiS-S335KI    HiS-S340KI    HiS-S345KI  
HiS-S350KI    HiS-S355KI    HiS-S360KI



72

Cells



For Utility-Scale Applications



UL 1,500V Saves BOS Costs



More Power Generation In Low Light



Hyundai Cell



### PERL Technology

PERL technology provides ultra-high efficiency with better performance in low irradiation. Maximizes installation capacity in limited space.



### Anti-LID / PID

Both LID (Light Induced Degradation) and PID (Potential Induced Degradation) are strictly eliminated to ensure higher actual yield during lifetime.



### Mechanical Strength

Tempered glass and reinforced frame design withstand rigorous weather conditions such as heavy snow and strong wind.



### Reliable Warranty

Global brand with powerful financial strength provide reliable 30-year warranty.



### Corrosion Resistant

Various tests under harsh environmental conditions such as ammonia and salt-mist passed.



### UL / VDE Test Labs

Hyundai's R&D center is an accredited test laboratory of both UL and VDE.

#### Hyundai's Warranty Provisions



- 12-Year Product Warranty
- On materials and workmanship



- 30-Year Performance Warranty
- Initial year: 97.6%
- Linear warranty after second year: with 0.6%p annual degradation, 80.2% is guaranteed up to 30 years

#### About Hyundai Solar

Established in 1972, Hyundai Heavy Industries (HHI) is one of the most trusted names in the heavy industry sector with 48,000 employees and more than 40 Billion USD in annual sales (2015). As a global leader and innovator, Hyundai Heavy Industries is committed to building a future growth engine by developing and investing heavily in the field of renewable energy.

Started as a core business division of HHI, Hyundai Solar (Hyundai Heavy Industries Green Energy) now stands as an independent company and an affiliate of HHI as from December 2016. We have strong pride in providing high-quality solar PV products to more than 3,000 customers worldwide.

#### Certification



## Electrical Characteristics

|   |     | Mono-Crystalline Type(HiS-S KI) |      |      |      |      |      |      |
|---|-----|---------------------------------|------|------|------|------|------|------|
|   |     | 330                             | 335  | 340  | 345  | 350  | 355  | 360  |
| Nominal Output (P <sub>mpp</sub> )              | W   | 330                             | 335  | 340  | 345  | 350  | 355  | 360  |
| Open Circuit Voltage (V <sub>oc</sub> )         | V   | 46.3                            | 46.5 | 46.7 | 46.9 | 47.1 | 47.3 | 47.4 |
| Short Circuit Current (I <sub>sc</sub> )        | A   | 9.3                             | 9.4  | 9.5  | 9.6  | 9.6  | 9.7  | 9.8  |
| Voltage at P <sub>max</sub> (V <sub>mpp</sub> ) | V   | 38.0                            | 38.2 | 38.4 | 38.6 | 38.7 | 38.9 | 39.1 |
| Current at P <sub>max</sub> (I <sub>mpp</sub> ) | A   | 8.7                             | 8.8  | 8.9  | 9.0  | 9.0  | 9.1  | 9.2  |
| Module Efficiency                               | %   | 16.9                            | 17.1 | 17.4 | 17.6 | 17.9 | 18.1 | 18.4 |
| Cell Type                                       | -   | 6", mono-crystalline silicon    |      |      |      |      |      |      |
| Maximum System Voltage                          | V   | 1,500                           |      |      |      |      |      |      |
| Temperature Coefficient of P <sub>max</sub>     | %/K | -0.42                           |      |      |      |      |      |      |
| Temperature Coefficient of V <sub>oc</sub>      | %/K | -0.30                           |      |      |      |      |      |      |
| Temperature Coefficient of I <sub>sc</sub>      | %/K | 0.047                           |      |      |      |      |      |      |

\*All data at STC (Standard Test Conditions). Above data may be changed without prior notice.

## Mechanical Characteristics

|               |  |
|---------------|--|
| Dimensions    | 998 mm (39.29") (W) × 1,960 mm (77.17") (L) × 40 mm (1.57") (H)  |
| Weight        | Approx. 22.9 kg (50.5 lbs)   |
| Solar Cells   | 72 cells in series (6 × 12 matrix) (Hyundai cell, Made in Korea)   |
| Output Cables | 4 mm <sup>2</sup> (12AWG) cables with polarized weatherproof connectors, IEC certified (UL listed and UL 4703 certified), Length 1.2 m (47.2") |
| Junction Box  | IP67, weatherproof, IEC certified (UL listed)  |
| Bypass Diodes | 3 bypass diodes to prevent power decrease by partial shade   |
| Construction  | Front : Anti-reflection coated glass, 3.2 mm (0.126")<br>Encapsulant : EVA   Back Sheet : Weatherproof film                                    |
| Frame         | Clear anodized aluminum alloy type 6063  |

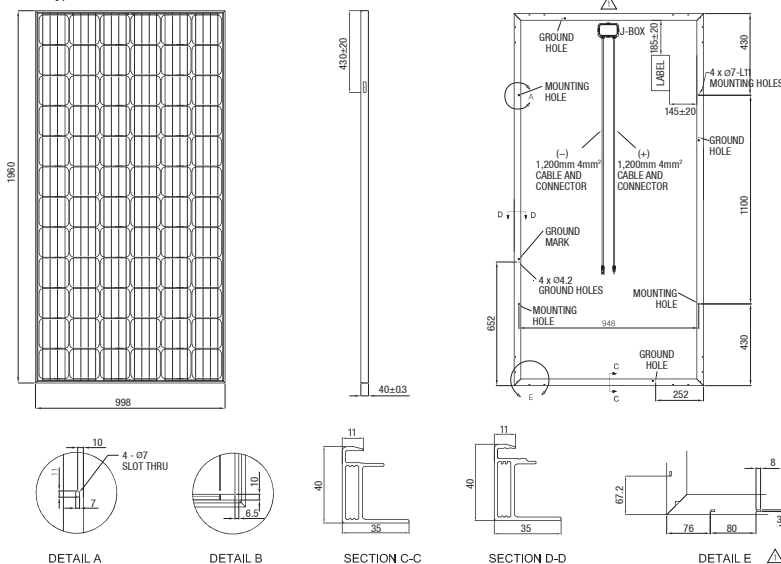
## Installation Safety Guide

- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not damage or scratch the rear surface of the module.
- Do not handle or install modules when they are wet.

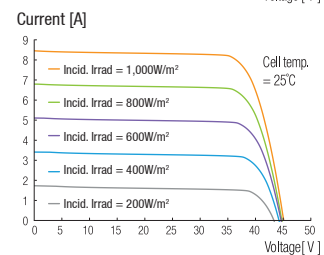
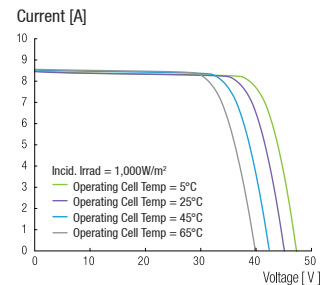
|                                    |                                      |
|------------------------------------|--------------------------------------|
| Nominal Operating Cell Temperature | 46°C ± 2                             |
| Operating Temperature              | -40 – 85°C                           |
| Maximum System Voltage             | DC 1,500 V (UL)                      |
| Maximum Reverse Current            | 15A (Up to 350W)<br>20A (Above 355W) |

## Module Diagram (unit : mm)

Mono-Crystalline  
SI Type-Front Side View

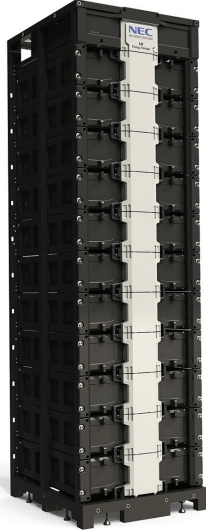


## I-V Curves



**HYUNDAI**  
GREEN ENERGY

The Long Duration (LD) Energy Storage Rack from NEC Energy Solutions is a fully integrated, high energy battery storage system that provides reliable storage capacity for a wide range of long duration energy applications.



The LD Energy Storage Rack is an element of NEC Energy Solutions GBS® integrated grid-scale energy storage systems and can easily be applied as a standalone DC source for a wide range of grid and behind-the-meter (BTM) applications. The LD Energy Storage Rack is a standardized product that delivers high energy performance and inherent multi-layer safety for the most demanding energy storage scenarios.

### LD Energy Storage Racks include:

- LD Battery Modules utilizing industry-proven cell technology (16 for the 700V design; 22 for the 950V design)
- An integral Battery Management System (BMS) that continuously monitors voltage, temperature, current and system conditions and performs cell balancing
- Integrated ducting for forced air cooling (as needed)
- Nested safety features providing layered protection at the cell, module, BMS, and rack level
- CAN bus communications between BMS and higher-level system controls

## EXAMPLE APPLICATIONS

### Distributed Energy Storage (DES)

LD Energy Storage Racks support third party systems and can be furnished in NEC's Grid Battery Storage System (GBS®) for long duration, high energy storage to enable customer energy bill management and market participation for:

- Energy Time-Shift
- Supply Capacity
- Load Following
- Area Regulation
- Reserve Capacity
- Voltage Support
- Transmission Support
- Transmission Congestion Relief
- Transmission and Distribution Upgrade Deferral
- Renewables Energy Time-Shift
- Renewables Generation Capacity Firming
- Renewables Grid Integration

| LD Battery Rack Characteristics                         | 700V LD                                   | 950V LD                      |
|---|---|------------------------------|
| Battery Type  | Lithium Ion                               |                              |
| Nominal Voltage   | 700 VDC                                   | 950 VDC                      |
| Operating Voltage Range                                 | 545–750 VDC                               | 750–1050 VDC                 |
| Max. Charge/Discharge Power                             | 73 kW<br>(1 full cycle/day)               | 100 kW<br>(1 full cycle/day) |
| Continuous Charge/Discharge Power                       | 38 kW                                     | 52 kW                        |
| Available Energy (Nominal)                              | 75 kWh                                    | 100 kWh                      |
| Nominal Capacity  | 120 Ah                                    |                              |
| Maximum Discharge Current                               | 150 A                                     |                              |
| Usable State of Charge (SOC)                            | 0–100%                                    |                              |
| Round Trip Efficiency                                   | 97% (1C), 98% (C/2)                       |                              |
| Cycle Life (1C charge /1C discharge, to 80% BOL @ 23°C) | >3,900 cycles (100% DOD)                  |                              |
| Cycle Life (1C charge /1C discharge, to 70% BOL @ 23°C) | >4,500 cycles (100% DOD)                  |                              |
| Operating Temperature                                   | -40 to 60°C*                              |                              |
| Thermal Interface                                       | Integrated cooling (twin top air intakes) |                              |
| Shipping/Storage Temperature Range                      | -40 to 60°C                               |                              |
| Communications  | CAN bus                                   |                              |
| DC Contactor Interlock                                  | Yes                                       |                              |
| Dimensions (W x D x H)                                  | 660 x 760 x 2400 mm (26 x 30.2 x 94.6 in) |                              |
| Weight  | 932 kg (2050 lbs)                         | 1204 kg (2650 lbs)           |

\* Recommended temp range for optimal battery performance is 15°C–30°C

## STANDARDS AND COMPLIANCE

- EN 61000-6-2, Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
- IEC 61000-6-4, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
- IEC 61000-6-5, Electromagnetic compatibility (EMC) - Part 6-5: Generic standards - Emission standard for industrial environments
- FCC Part 15 class "A"
- ICES 003 issue 4, Interference-Causing Equipment Standard, Digital Apparatus

- IEC 62133, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety
- IEC 62040-1, Uninterruptible power systems (UPS)
- UL 1642, Lithium Batteries
- UL 1973, Batteries for use in Light Electric Rail (LER) and stationary applications
- UL 1778, Uninterruptible Power Systems
- NFPA 70, National Electrical Code 2011
- CAN/CSA-C22.2 No. 0 107.2-01 (R2011)

## Behind-the-Meter and Off-Grid Energy Storage

Commercial, industrial and institutional organizations can apply energy storage systems equipped with LD Energy Storage Racks to reduce energy costs, reduce diesel fuel consumption, defer electrical infrastructure upgrades, enable installation or expansion of renewable energy, improve power quality and increase energy security for their facilities. The LD Energy Storage Racks are ideally suited to provide the following functions:

- Time of Use Energy management (TOU, arbitrage)
- Demand charge reduction (energy and demand charges)
- Supply firming of existing onsite renewable energy
- Generator optimization / bridge to generator during service interruptions
- Demand response management

## HIGH PERFORMANCE

The LD Energy Storage Rack delivers an unparalleled combination of cycle life, calendar life and energy performance. Multi-year testing of the cells and modules, under both realistic and extreme conditions, confirms life expectancy of > 4,500 cycles.

## NESTED SAFETY DESIGN

The LD Energy Storage Rack is engineered for the utmost safety, enabled by layered safety features, fusing at the cell level, module level and rack level, extensive fault monitoring at the module level and automatic opening of the dual contactors upon power loss or safety cover removal.

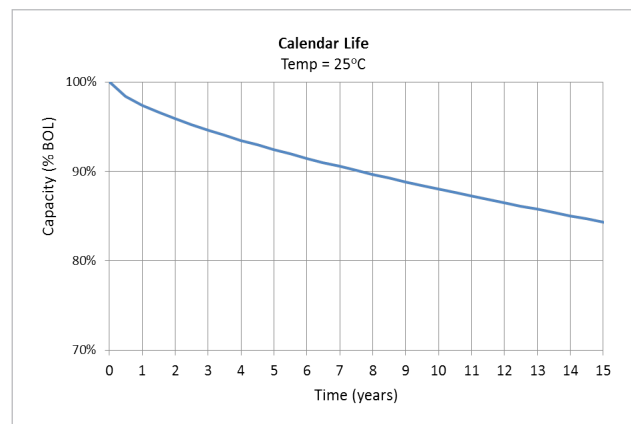
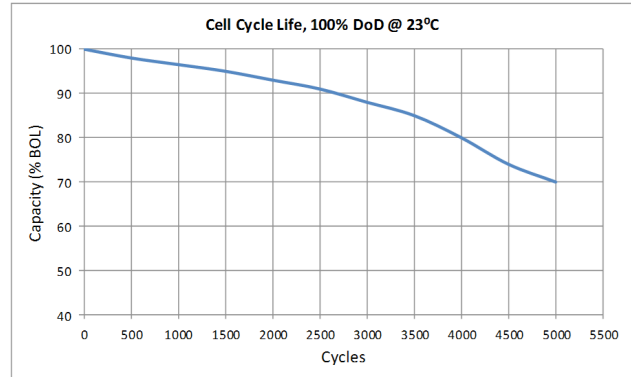
## BATTERY MODULE FEATURES

LD Energy Storage Racks contain field-replaceable battery modules with on-board intelligence that communicates with the BMS to:

- Monitor voltage on every cell bank and provide independent module voltage measurements
- Measure representative cell temperatures
- Maintain cells in optimum state-of-charge and help prevent overvoltage conditions
- Monitor overvoltage conditions and signal shutdown if detected

## BMS FEATURES

NEC Energy's BMS continuously monitors voltage, temperature, and current to initiate protective actions if any unsafe condition is detected. The BMS has automated independent control of two separate contactors that disconnect and de-energize an individual rack from the external DC bus if needed. These contactors mechanically default open (OFF) if the control link from the contactor to the BMS is lost, or, if auxiliary power to the BMS is interrupted. The BMS also contains a high voltage rack level fuse



to supplement contactor overcurrent protection. The BMS offers communications through a configurable CAN bus interface for integration with a larger system, as well as a separate local CAN bus interface for local diagnostics.

## RACK-LEVEL FEATURES

- Supports standalone, single rack applications, or, scalable to multi-rack megawatt (MW) systems
- Integrated ducting for forced air cooling
- Patented Pre-charge and Equalizer circuits allow individual racks to be safely energized despite being at higher/lower voltage levels from adjacent racks in the system
- Safety Interlock Access Covers
- Built-in rigging/lifting points
- May be installed to Seismic Demand Spectrum (SDS) 1 or 2
- DC Bus Contactor (24V)



**NEC Energy Solutions, Inc.**

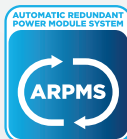
Phone: +1.508.497.7319

Web: [www.neces.com](http://www.neces.com)

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# HEC-US<sub>V1500</sub>

UTILITY SCALE SOLAR INVERTER



## **HEC-US V1500**

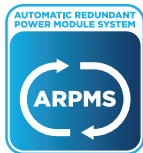
The new Power Electronics HEC-US V1500 outdoor inverters are powerful and reliable 1500Vdc utility scale PV units for the US market. The HEC-US V1500 inverter family has 25 different UL-1741 certified models ranging from 1MW to 3MW with no derating at 50°C and a 98.5% CEC rated efficiency.

Power Electronics designs and manufactures 1700Vdc power converters for market leading customers in the mining, oil & gas and water industries and for the most demanding environments. With up to 7 425KW power modules connected in parallel, the HEC-US V1500 is a multilevel 1500Vdc system built on the Power Electronics expertise in >1,000Vdc systems and the proven Freesun HEC modular topology. The HEC-US V1500 has a standard stainless steel enclosure and best-in-class cooling at 50°C without derating to ensure reliable performance in the most demanding conditions.

Power Electronics offers customized NEC2014 compliant FSDK15 external DC Recombiner cabinets. The FSDK15 includes user specified overcurrent protection up to 400 Amps with 16 or 32 inputs to support higher ratio DC:AC PV designs. FSDK15 cabinets include current monitoring.

Power Electronics continues to evolve with the solar industry and the HEC-US V1500 is designed specifically to meet the new demand for 1500Vdc PV systems.

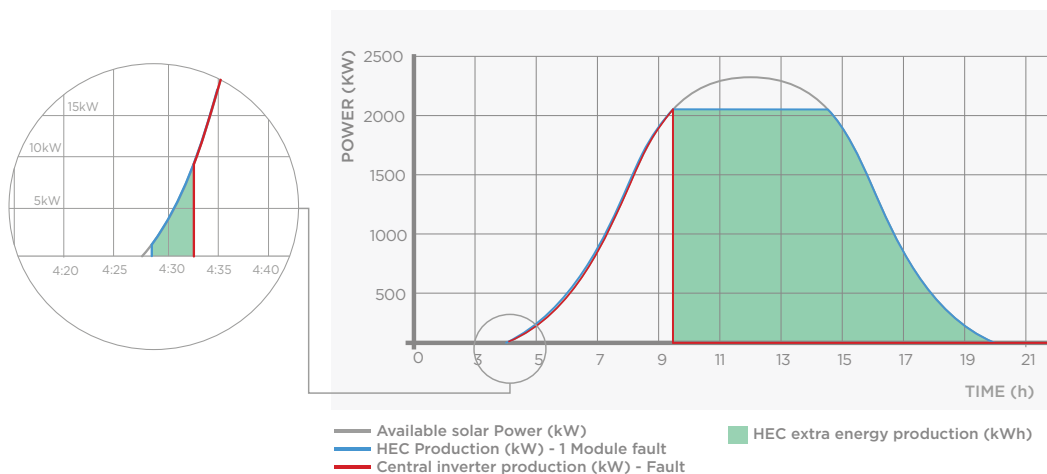
THE MOST POWERFUL AND  
RELIABLE 1500V<sub>DC</sub> UL-1741  
CERTIFIED UTILITY-SCALE PV  
INVERTER IN THE MARKET



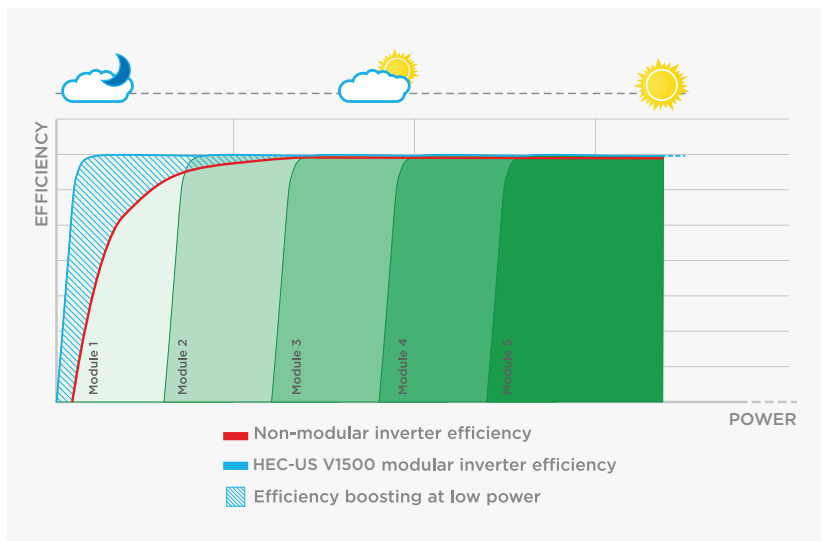
## AUTOMATIC REDUNDANT POWER MODULE SYSTEM (ARPMS)

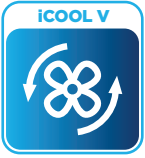
The HEC-US V1500 topology combines the advantages of a central inverter with the availability of string inverters. HEC-US V1500 is a modular central inverter based on an Automatic Redundant Power Module (350kVA to 500kVA per stage).

If there is a fault in one power module, it is taken off-line and its output power is distributed evenly among the remaining functioning modules. All power modules work in parallel controlled by a dual redundant main control. As the main governor of the system it is responsible for the MPPT tracking, synchronization sequence and overall protection. The automatic redundant capability based on our industrial systems is able to shift the main control in the event of a fault, restoring the backup control and restarting the station to guarantee high availability. (patent pending)



A modular inverter is more efficient than a standard central inverter. During low radiation conditions, a modular architecture uses the correct number of power modules to provide power, while a central inverter must consume power internally to support the entire system. With lower losses, a modular inverter can provide power earlier in the morning and stop later at the end of the day. As a result, throughout the entire service life of the PV plant, the HEC-US V1500 inverter generates higher yields than a standard central inverter with a higher reliability than string inverters.





## REVOLUTIONARY COOLING SYSTEM

The Power Electronics HEC-US V1500 series includes the innovative and sophisticated iCOOL V performance that allows HEC-US V1500 to work up to 140°F (60°C) at nominal power. The cooling system iCOOL V smartly cools the inverter, regulating the cooling system capacity depending on data from the temperature sensors.

HEC-US V1500 modules are divided into two main areas: clean area (electronics) and hot area (heat sink). The electronics are totally sealed in a NEMA4 area and use a temperature control low flow cooling system that reduces filters clogging and maintenance intervals. The hot area integrates a speed controlled fan for each module, simplifying the cooling system and reducing the maintenance tasks.

Furthermore, due to the modular topology, the iCOOL V reduces the Stand-by consumption at low capacity to the maximum, boosting the cooling capacity for photovoltaic installations situated up to 4000 meters above sea level. (patent pending)



Electronics

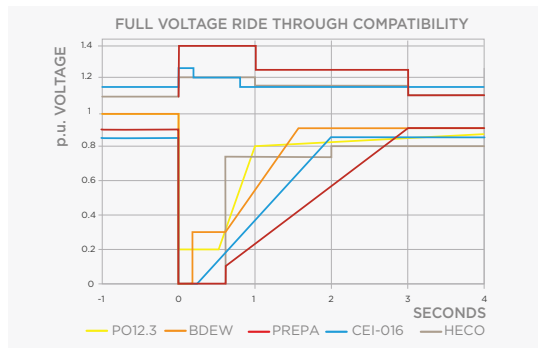
Heat sinks



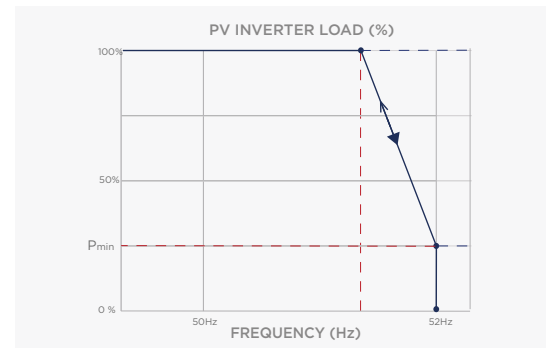


## DYNAMIC GRID SUPPORT

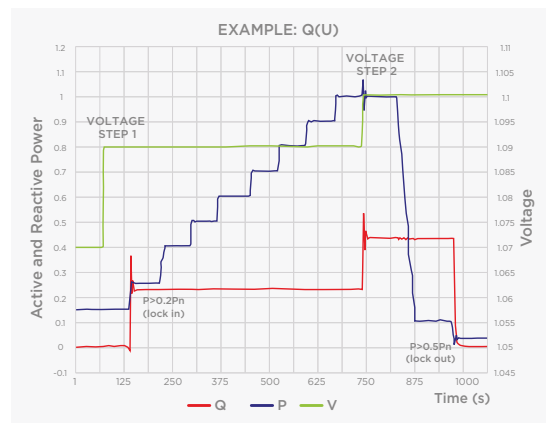
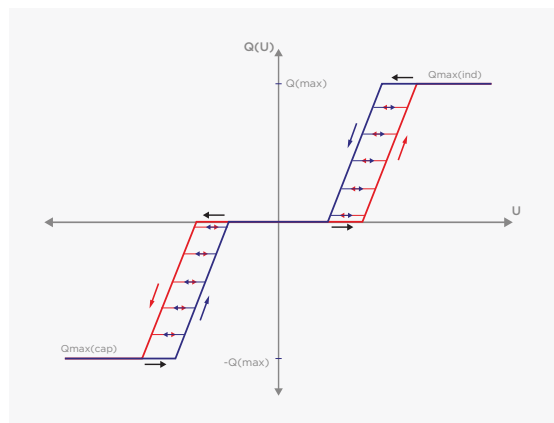
HEC-US V1500 firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment...), and is compatible with all the specific requirements of the utilities.



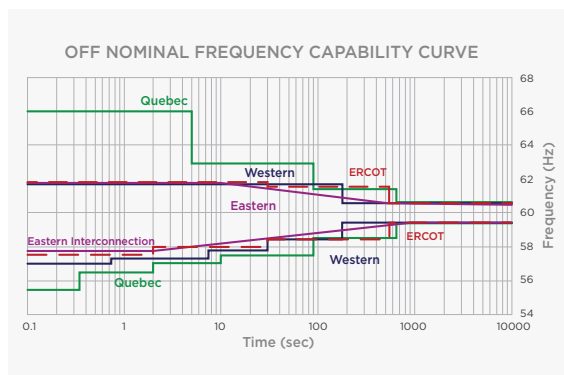
▲ **LVRT or ZVRT (Low Voltage Ride Through).** Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.



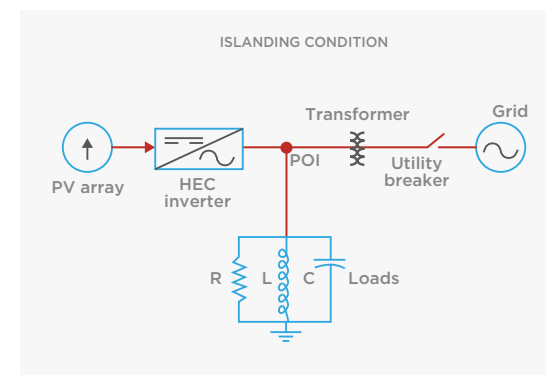
▲ **FRS (Frequency Regulation System).** Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.



▲ **Q(V) curve:** It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



▲ **FRT (Frequency Ride Through):** Freesun solar inverters have flexible frequency protection settings, and can be easily adjusted to comply with future requirements.



▲ **Anti-islanding:** This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.



### VAR AT NIGHT

At night, the HEC-US V1500 inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).



### EASY TO MONITOR

The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors. The app user friendly interface allows quick and easy access to critical information (energy registers, production and events).



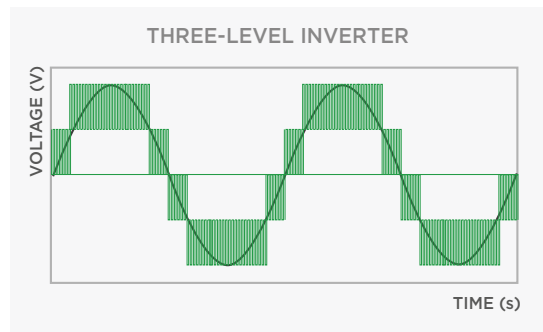
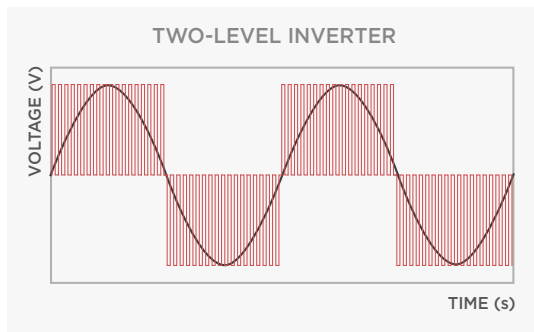
### ACTIVE HEATING

At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors. This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. (patented)



### MULTILEVEL TOPOLOGY

The multilevel IGBT topology makes the difference in the 1500Vdc technology, being the most efficient way to manage high DC link voltages. Based in our long IGBT experience components used in the HEC PLUS series, the HEC-US V1500 takes profit of the three level IGBT topology reducing the power stage losses, increasing the efficiency and offering a very low total harmonic distortion.



# HEC-US<sub>V1500</sub>

## TECHNICAL CHARACTERISTICS

|                          |  | 690VAC - MPpt Window 976V-1310V   |                    |                    |                    |                    |
|--------------------------|--|---|--------------------|--------------------|--------------------|--------------------|
|                          |  | FRAME 3   | FRAME 4            | FRAME 5            | FRAME 6            | FRAME 7            |
| NUMBER OF MODULES        |  | 3   | 4                  | 5                  | 6                  | 7                  |
| REFERENCE                |  | FS1275CU15  | FS1700CU15         | FS2125CU15         | FS2550CU15         | FS3000CU15         |
| OUTPUT                   | AC Output Power(kVA/kW) @50°C <sup>[1]</sup>         | 1275  | 1700               | 2125               | 2550               | 3000               |
|                          | AC Output Power(kVA/kW) @25°C <sup>[1]</sup>         | 1530  | 2040               | 2550               | 3060               | 3500               |
|                          | AC Output Power(kW) @50°C; PF=0.9                    | 1150  | 1530               | 1910               | 2250               | 2700               |
|                          | Max. AC Output Current (A) @25°C                     | 1285  | 1710               | 2140               | 2570               | 3000               |
|                          | Operating Grid Voltage (VAC)                         | 690V ±10%   |                    |                    |                    |                    |
|                          | Operating Grid Frequency (Hz)                        | 60Hz  |                    |                    |                    |                    |
|                          | Current Harmonic Distortion (THDi)                   | < 3% per IEEE519  |                    |                    |                    |                    |
|                          | Power Factor (cosine phi) <sup>[2]</sup>             | 0.0 leading ... 0.0 lagging / Reactive Power injection at night   |                    |                    |                    |                    |
|                          | Power Curtailment (kVA)                              | 0...100% / 0.1% Steps   |                    |                    |                    |                    |
| INPUT                    | MPpt @full power (VDC) <sup>[1]</sup>                | 976V - 1310V  |                    |                    |                    |                    |
|                          | Maximum DC voltage                                   | 1500V   |                    |                    |                    |                    |
|                          | Minimum Start Voltage                                | 1100V - User configurable   |                    |                    |                    |                    |
|                          | Max. DC continuous current (A)                       | 1600  | 2140               | 2675               | 3210               | 3745               |
|                          | Max. DC short circuit current (A)                    | 2320  | 3100               | 3880               | 4650               | 5450               |
| EFFICIENCY & AUX. SUPPLY | Efficiency (Max) (η)                                 | 98.5%   | 98.7%              | 98.7%              | 98.7%              | 98.7%              |
|                          | CEC (η)  | 98.0%   | 98.5%              | 98.5%              | 98.5%              | 98.5%              |
|                          | Max. Standby Consumption (Pnight)                    | < approx. 50W/per module  |                    |                    |                    |                    |
|                          | Control Power Supply                                 | 120V / 208VAC-6kVA power supply available for external equipment (optional)   |                    |                    |                    |                    |
| CABINET                  | Dimensions [WxDxH] [inches]                          | 119.6"x37.2"x86.5"  | 147.6"x37.2"x86.5" | 175.7"x37.2"x86.5" | 203.8"x37.2"x86.5" | 231.9"x37.2"x86.5" |
|                          | Dimensions [WxDxH] [mm]                              | 3038x945x2198   | 3751x945x2198      | 4464x945x2198      | 5177x945x2198      | 5890x945x2198      |
|                          | Weight (kg)  | 2635  | 3290               | 3945               | 4600               | 5255               |
|                          | Weight (lbs)   | 5809  | 7253               | 8697               | 10141              | 11585              |
|                          | Air Flow   | Bottom intake. Exhaust top rear vent.   |                    |                    |                    |                    |
| ENVIRON-<br>MENT         | Type of ventilation                                  | Forced air cooling  |                    |                    |                    |                    |
|                          | Degree of protection                                 | NEMA 3R   |                    |                    |                    |                    |
|                          | Permissible Ambient Temperature                      | -31°F to +140°F, -35°C <sup>[3]</sup> to +60°C / Active Power derating >50°C/122°F  |                    |                    |                    |                    |
|                          | Relative Humidity                                    | 0% to 100% non condensing   |                    |                    |                    |                    |
|                          | Max. Altitude (above sea level)                      | 2000m / >2000m power derating (Max. 4000m)  |                    |                    |                    |                    |
| CONTROL<br>INTERFACE     | Noise level <sup>[4]</sup>                           | < 79 dBA  |                    |                    |                    |                    |
|                          | Interface  | Graphic Display (inside cabinet) / Optional Freesun App   |                    |                    |                    |                    |
|                          | Communication protocol                               | Modbus TCP  |                    |                    |                    |                    |
|                          | Power Plant Controller                               | Optional  |                    |                    |                    |                    |
|                          | Keyed ON/OFF switch                                  | Standard  |                    |                    |                    |                    |
| PROTECTIONS              | Digital I/O  | User configurable   |                    |                    |                    |                    |
|                          | Analog I/O   | User configurable   |                    |                    |                    |                    |
|                          | Ground Fault Protection                              | Floating PV array: Isolation Monitoring per MPP<br>NEC2014 Grounded PV Array: GFDDI protection<br>Optional PV Array transfer kit: GFDDI and Isolation monitoring device |                    |                    |                    |                    |
|                          | Humidity control                                     | Active Heating  |                    |                    |                    |                    |
|                          | General AC Protection & Disconn.                     | Circuit Breaker   |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | General DC Protection & Disconn.                     | External Disconnecting Unit Cabinet   |                    |                    |                    |                    |
|                          | Module AC Protection & Disconn.                      | AC contactor & fuses  |                    |                    |                    |                    |
|                          | Module DC Protection                                 | DC fuses  |                    |                    |                    |                    |
|                          | Overvoltage Protection                               | AC and DC protection (type 2)   |                    |                    |                    |                    |
|                          | Safety   | UL 1741; CSA 22.2 No.1071-01  |                    |                    |                    |                    |
| Utility interconnect     | IEEE 1547 with Utility Interactive Control functions |   |                    |                    |                    |                    |

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.  
 [2] Consult P-Q charts available: Q(kVAr)=√(S(kVA)<sup>2</sup>-P(kW)<sup>2</sup>)  
 [3] Heating kit option required below -20°C.  
 [4] Sound pressure level at a distance of 1m from the rear part.

# HEC-US<sup>v1500</sup>

## TECHNICAL CHARACTERISTICS

|                          |  | 645VAC - MPpt Window 913V-1310V   |                    |                    |                    |                    |
|--------------------------|--|---|--------------------|--------------------|--------------------|--------------------|
|                          |  | FRAME 3   | FRAME 4            | FRAME 5            | FRAME 6            | FRAME 7            |
| NUMBER OF MODULES        |  | 3   | 4                  | 5                  | 6                  | 7                  |
| REFERENCE                |  | FS1200CU15  | FS1600CU15         | FS2000CU15         | FS2400CU15         | FS2800CU15         |
| OUTPUT                   | AC Output Power(kVA/kW) @50°C <sup>[1]</sup> | 1200  | 1600               | 2000               | 2400               | 2800               |
|                          | AC Output Power(kVA/kW) @25°C <sup>[1]</sup> | 1430  | 1910               | 2390               | 2860               | 3345               |
|                          | AC Output Power(kW) @50°C; PF=0.9            | 1080  | 1440               | 1800               | 2160               | 2520               |
|                          | Max. AC Output Current (A) @25°C             | 1285  | 1710               | 2140               | 2570               | 3000               |
|                          | Operating Grid Voltage (VAC)                 | 645V ±10%   |                    |                    |                    |                    |
|                          | Operating Grid Frequency (Hz)                | 60Hz  |                    |                    |                    |                    |
|                          | Current Harmonic Distortion (THDi)           | < 3% per IEEE519  |                    |                    |                    |                    |
|                          | Power Factor (cosine phi) <sup>[2]</sup>     | 0.0 leading ... 0.0 lagging / Reactive Power injection at night   |                    |                    |                    |                    |
| INPUT                    | Power Curtailment (kVA)                      | 0...100% / 0.1% Steps   |                    |                    |                    |                    |
|                          | MPpt @full power (VDC) <sup>[1]</sup>        | 913V - 1310V  |                    |                    |                    |                    |
|                          | Maximum DC voltage                           | 1500V   |                    |                    |                    |                    |
|                          | Minimum Start Voltage                        | 1075V - User configurable   |                    |                    |                    |                    |
| EFFICIENCY & AUX. SUPPLY | Max. DC continuous current (A)               | 1600  | 2140               | 2675               | 3210               | 3745               |
|                          | Max. DC short circuit current (A)            | 2320  | 3100               | 3880               | 4650               | 5450               |
|                          | Efficiency (Max) (η)                         | 98.4%   | 98.5%              | 98.6%              | 98.6%              | 98.6%              |
|                          | CEC (η)                                      | 98.0%   | 98.0%              | 98.5%              | 98.5%              | 98.5%              |
| CABINET                  | Max. Standby Consumption (Pnight)            | < approx. 50W/per module  |                    |                    |                    |                    |
|                          | Control Power Supply                         | 120V / 208VAC-6kVA power supply available for external equipment (optional)   |                    |                    |                    |                    |
|                          | Dimensions [WxDxH] [inches]                  | 119.6"x37.2"x86.5"  | 147.6"x37.2"x86.5" | 175.7"x37.2"x86.5" | 203.8"x37.2"x86.5" | 231.9"x37.2"x86.5" |
| ENVIRON-<br>MENT         | Dimensions [WxDxH] [mm]                      | 3038x945x2198   | 3751x945x2198      | 4464x945x2198      | 5177x945x2198      | 5890x945x2198      |
|                          | Weight (kg)                                  | 2635  | 3290               | 3945               | 4600               | 5255               |
|                          | Weight (lbs)                                 | 5809  | 7253               | 8697               | 10141              | 11585              |
|                          | Air Flow                                     | Bottom intake. Exhaust top rear vent.   |                    |                    |                    |                    |
|                          | Type of ventilation                          | Forced air cooling  |                    |                    |                    |                    |
|                          | Degree of protection                         | NEMA 3R   |                    |                    |                    |                    |
| CONTROL<br>INTERFACE     | Permissible Ambient Temperature              | -31°F to +140°F, -35°C <sup>[3]</sup> to +60°C / Active Power derating >50°C/122°F  |                    |                    |                    |                    |
|                          | Relative Humidity                            | 0% to 100% non condensing   |                    |                    |                    |                    |
|                          | Max. Altitude (above sea level)              | 2000m / >2000m power derating (Max. 4000m)  |                    |                    |                    |                    |
|                          | Noise level <sup>[4]</sup>                   | < 79 dBA  |                    |                    |                    |                    |
| PROTECTIONS              | Interface                                    | Graphic Display (inside cabinet) / Optional Freesun App display   |                    |                    |                    |                    |
|                          | Communication protocol                       | Modbus TCP  |                    |                    |                    |                    |
|                          | Power Plant Controller                       | Optional  |                    |                    |                    |                    |
|                          | Keyed ON/OFF switch                          | Standard  |                    |                    |                    |                    |
|                          | Digital I/O                                  | User configurable   |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | Analog I/O                                   | User configurable   |                    |                    |                    |                    |
|                          | Ground Fault Protection                      | Floating PV array: Isolation Monitoring per MPP<br>NEC2014 Grounded PV Array: GFDI protection<br>Optional PV Array transfer kit: GFDI and Isolation monitoring device |                    |                    |                    |                    |
|                          | Humidity control                             | Active Heating  |                    |                    |                    |                    |
|                          | General AC Protection & Disconn.             | Circuit Breaker   |                    |                    |                    |                    |
|                          | General DC Protection & Disconn.             | External Disconnecting Unit Cabinet   |                    |                    |                    |                    |
|                          | Module AC Protection & Disconn.              | AC contactor & fuses  |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | Module DC Protection                         | DC fuses  |                    |                    |                    |                    |
|                          | Overvoltage Protection                       | AC and DC protection (type 2)   |                    |                    |                    |                    |
|                          | Safety                                       | UL 1741; CSA 22.2 No.1071-01  |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | Utility interconnect                         | IEEE 1547 with Utility Interactive Control functions  |                    |                    |                    |                    |

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.

[2] Consult P-Q charts available:  $Q(kVAr)=\sqrt{(S(kVA))^2-P(kW)^2}$

[3] Heating kit option required below -20°C.

[4] Sound pressure level at a distance of 1m from the rear part.

# HEC-US<sup>v1500</sup>

## TECHNICAL CHARACTERISTICS

NEW RATINGS

|                          |  | 630VAC - MPpt Window 891V-1310V   |                    |                    |                    |                    |
|--------------------------|--|---|--------------------|--------------------|--------------------|--------------------|
|                          |  | FRAME 3   | FRAME 4            | FRAME 5            | FRAME 6            | FRAME 7            |
| NUMBER OF MODULES        |  | 3   | 4                  | 5                  | 6                  | 7                  |
| REFERENCE                |  | FS1270CU15  | FS1695CU15         | FS2120CU15         | FS2540CU15         | FS3001CU15         |
| OUTPUT                   | AC Output Power(kVA/kW) @50°C <sup>[1]</sup> | 1180  | 1570               | 1965               | 2360               | 2750               |
|                          | AC Output Power(kVA/kW) @40°C <sup>[1]</sup> | 1270  | 1695               | 2120               | 2540               | 3000               |
|                          | AC Output Power(kVA/kW) @25°C <sup>[1]</sup> | 1400  | 1870               | 2340               | 2800               | 3275               |
|                          | Max. AC Output Current (A) @50°C             | 1080  | 1440               | 1800               | 2160               | 2520               |
|                          | Max. AC Output Current (A) @40°C             | 1165  | 1550               | 1940               | 2330               | 2715               |
|                          | Max. AC Output Current (A) @25°C             | 1285  | 1710               | 2140               | 2570               | 3000               |
|                          | Operating Grid Voltage (VAC)                 | 630V ±10%   |                    |                    |                    |                    |
|                          | Operating Grid Frequency (Hz)                | 60Hz  |                    |                    |                    |                    |
|                          | Current Harmonic Distortion (THDi)           | < 3% per IEEE519  |                    |                    |                    |                    |
|                          | Power Factor (cosine phi) <sup>[2]</sup>     | 0.0 leading ... 0.0 lagging / Reactive Power injection at night   |                    |                    |                    |                    |
| Power Curtailment (kVA)  | 0..100% / 0.1% Steps                         |   |                    |                    |                    |                    |
| INPUT                    | MPpt @full power (VDC)                       | @50°C 891V-1310V / @40°C 891V-1285V / @25°C 891V-1250V  |                    |                    |                    |                    |
|                          | Maximum DC voltage                           | 1500V   |                    |                    |                    |                    |
|                          | Minimum Start Voltage                        | 1050V - User configurable   |                    |                    |                    |                    |
|                          | Max. DC continuous current (A)               | 1600  | 2140               | 2675               | 3210               | 3745               |
|                          | Max. DC short circuit current (A)            | 2320  | 3100               | 3880               | 4650               | 5450               |
| EFFICIENCY & AUX. SUPPLY | Efficiency (Max) (η) Preliminary             | 98.5%   |                    |                    |                    |                    |
|                          | CEC (η) Preliminary                          | 98.5%   |                    |                    |                    |                    |
|                          | Max. Standby Consumption (Pnight)            | < approx. 50W/per module  |                    |                    |                    |                    |
|                          | Control Power Supply                         | 120V / 208VAC-6kVA power supply available for external equipment (optional)   |                    |                    |                    |                    |
| CABINET                  | Dimensions [WxDxH] [inches]                  | 119.6"x37.2"x86.5"  | 147.6"x37.2"x86.5" | 175.7"x37.2"x86.5" | 203.8"x37.2"x86.5" | 231.9"x37.2"x86.5" |
|                          | Dimensions [WxDxH] [mm]                      | 3038x945x2198   | 3751x945x2198      | 4464x945x2198      | 5177x945x2198      | 5890x945x2198      |
|                          | Weight (kg)                                  | 2635  | 3290               | 3945               | 4600               | 5255               |
|                          | Weight (lbs)                                 | 5809  | 7253               | 8697               | 10141              | 11585              |
|                          | Air Flow                                     | Bottom intake. Exhaust top rear vent.   |                    |                    |                    |                    |
| ENVIRON-<br>MENT         | Type of ventilation                          | Forced air cooling  |                    |                    |                    |                    |
|                          | Degree of protection                         | NEMA 3R   |                    |                    |                    |                    |
|                          | Permissible Ambient Temperature              | -31°F to +140°F, -35°C <sup>[3]</sup> to +60°C / Power derating >40°C/104°F   |                    |                    |                    |                    |
|                          | Relative Humidity                            | 0% to 100% non condensing   |                    |                    |                    |                    |
|                          | Max. Altitude (above sea level)              | 2000m / >2000m power derating (Max. 4000m)  |                    |                    |                    |                    |
|                          | Noise level <sup>[4]</sup>                   | < 79 dBA  |                    |                    |                    |                    |
| CONTROL<br>INTERFACE     | Interface                                    | Graphic Display (inside cabinet) / Optional Freesun App   |                    |                    |                    |                    |
|                          | Communication protocol                       | Modbus TCP  |                    |                    |                    |                    |
|                          | Power Plant Controller                       | Compatible with third party SCADA controls  |                    |                    |                    |                    |
|                          | Keyed ON/OFF switch                          | Standard  |                    |                    |                    |                    |
|                          | Digital I/O                                  | User configurable   |                    |                    |                    |                    |
| PROTECTIONS              | Analog I/O                                   | User configurable   |                    |                    |                    |                    |
|                          | Ground Fault Protection                      | Floating PV array: Isolation Monitoring per MPP<br>NEC2014 Grounded PV Array: GFDI protection<br>Optional PV Array transfer kit: GFDI and Isolation monitoring device |                    |                    |                    |                    |
|                          | Humidity control                             | Active Heating  |                    |                    |                    |                    |
|                          | General AC Protection & Disconn.             | Circuit Breaker   |                    |                    |                    |                    |
|                          | General DC Protection & Disconn.             | External Disconnecting Unit Cabinet   |                    |                    |                    |                    |
|                          | Module AC Protection & Disconn.              | AC contactor & fuses  |                    |                    |                    |                    |
|                          | Module DC Protection                         | DC fuses  |                    |                    |                    |                    |
| Overvoltage Protection   | AC and DC protection (type 2)                |   |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | Safety                                       | UL 1741; CSA 22.2 No.107.1-01 (pending)   |                    |                    |                    |                    |
|                          | Utility interconnect                         | IEEE 1547 with Utility Interactive Control functions  |                    |                    |                    |                    |

NOTES [1] Values at 1.00-Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.

[2] Consult P-Q charts available:  $Q(kVAr)=\sqrt{(S(kVA))^2-P(kW)^2}$

[3] Heating kit option required below -20°C.

[4] Sound pressure level at a distance of 1m from the rear part.

# HEC-US<sup>v1500</sup>

## TECHNICAL CHARACTERISTICS

|                                     |  | 600VAC - MPpt Window 849V-1310V   |                    |                    |                    |                    |
|-------------------------------------|--|---|--------------------|--------------------|--------------------|--------------------|
|                                     |  | FRAME 3   | FRAME 4            | FRAME 5            | FRAME 6            | FRAME 7            |
| <b>NUMBER OF MODULES</b>            |  | <b>3</b>  | <b>4</b>           | <b>5</b>           | <b>6</b>           | <b>7</b>           |
| <b>REFERENCE</b>                    |  | <b>FS1100CU15</b>   | <b>FS1475CU15</b>  | <b>FS1850CU15</b>  | <b>FS2225CU15</b>  | <b>FS2600CU15</b>  |
| <b>OUTPUT</b>                       | AC Output Power(kVA/kW) @50°C <sup>[1]</sup> | 1100  | 1475               | 1850               | 2225               | 2600               |
|                                     | AC Output Power(kVA/kW) @25°C <sup>[1]</sup> | 1335  | 1780               | 2225               | 2660               | 3110               |
|                                     | AC Output Power(kW) @50°C; PF=0.9            | 990   | 1325               | 1665               | 2000               | 2340               |
|                                     | Max. AC Output Current (A) @25°C             | 1285  | 1710               | 2140               | 2570               | 3000               |
|                                     | Operating Grid Voltage (VAC)                 | 600V ±10%   |                    |                    |                    |                    |
|                                     | Operating Grid Frequency (Hz)                | 60Hz  |                    |                    |                    |                    |
|                                     | Current Harmonic Distortion (THDI)           | < 3% per IEEE519  |                    |                    |                    |                    |
|                                     | Power Factor (cosine phi) <sup>[2]</sup>     | 0.0 leading ... 0.0 lagging / Reactive Power injection at night   |                    |                    |                    |                    |
| <b>INPUT</b>                        | Power Curtailment (kVA)                      | 0...100% / 0.1% Steps   |                    |                    |                    |                    |
|                                     | MPpt @full power (VDC) <sup>[1]</sup>        | 849V - 1310V  |                    |                    |                    |                    |
|                                     | Maximum DC voltage                           | 1500V   |                    |                    |                    |                    |
|                                     | Minimum Start Voltage                        | 1050V - User configurable   |                    |                    |                    |                    |
|                                     | Max. DC continuous current (A)               | 1600  | 2140               | 2675               | 3210               | 3745               |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b> | Max. DC short circuit current (A)            | 2320  | 3100               | 3880               | 4650               | 5450               |
|                                     | Efficiency (Max) (η)                         | 98.4%   | 98.5%              | 98.6%              | 98.6%              | 98.6%              |
|                                     | CEC (η)                                      | 98.0%   | 98.0%              | 98.5%              | 98.5%              | 98.5%              |
|                                     | Max. Standby Consumption (Pnight)            | < approx. 50W/per module  |                    |                    |                    |                    |
| <b>CABINET</b>                      | Control Power Supply                         | 120V / 208VAC-6kVA power supply available for external equipment (optional)   |                    |                    |                    |                    |
|                                     | Dimensions [WxDxH] [inches]                  | 119.6"x37.2"x86.5"  | 147.6"x37.2"x86.5" | 175.7"x37.2"x86.5" | 203.8"x37.2"x86.5" | 231.9"x37.2"x86.5" |
|                                     | Dimensions [WxDxH] [mm]                      | 3038x945x2198   | 3751x945x2198      | 4464x945x2198      | 5177x945x2198      | 5890x945x2198      |
|                                     | Weight (kg)                                  | 2635  | 3290               | 3945               | 4600               | 5255               |
|                                     | Weight (lbs)                                 | 5809  | 7253               | 8697               | 10141              | 11585              |
|                                     | Air Flow                                     | Bottom intake. Exhaust top rear vent.   |                    |                    |                    |                    |
|                                     | Type of ventilation                          | Forced air cooling  |                    |                    |                    |                    |
| <b>ENVIRON-<br/>MENT</b>            | Degree of protection                         | NEMA 3R   |                    |                    |                    |                    |
|                                     | Permissible Ambient Temperature              | -31°F to +140°F, -35°C <sup>[3]</sup> to +60°C / Active Power derating >50°C/122°F  |                    |                    |                    |                    |
|                                     | Relative Humidity                            | 0% to 100% non condensing   |                    |                    |                    |                    |
|                                     | Max. Altitude (above sea level)              | 2000m / >2000m power derating (Max. 4000m)  |                    |                    |                    |                    |
|                                     | Noise level <sup>[4]</sup>                   | < 79 dBA  |                    |                    |                    |                    |
| <b>CONTROL<br/>INTERFACE</b>        | Interface                                    | Graphic Display (inside cabinet) / Optional Freesun App   |                    |                    |                    |                    |
|                                     | Communication protocol                       | Modbus TCP  |                    |                    |                    |                    |
|                                     | Power Plant Controller                       | Optional  |                    |                    |                    |                    |
|                                     | Keyed ON/OFF switch                          | Standard  |                    |                    |                    |                    |
|                                     | Digital I/O                                  | User configurable   |                    |                    |                    |                    |
| <b>PROTECTIONS</b>                  | Analog I/O                                   | User configurable   |                    |                    |                    |                    |
|                                     | Ground Fault Protection                      | Floating PV array: Isolation Monitoring per MPP<br>NEC2014 Grounded PV Array: GFDI protection<br>Optional PV Array transfer kit: GFDI and Isolation monitoring device |                    |                    |                    |                    |
|                                     | Humidity control                             | Active Heating  |                    |                    |                    |                    |
|                                     | General AC Protection & Disconn.             | Circuit Breaker   |                    |                    |                    |                    |
|                                     | General DC Protection & Disconn.             | External Disconnecting Unit Cabinet   |                    |                    |                    |                    |
|                                     | Module AC Protection & Disconn.              | AC contactor & fuses  |                    |                    |                    |                    |
|                                     | Module DC Protection                         | DC fuses  |                    |                    |                    |                    |
| Overvoltage Protection              | AC and DC protection (type 2)                |   |                    |                    |                    |                    |
| <b>CERTI-<br/>FICA-<br/>TIONS</b>   | Safety                                       | UL 1741; CSA 22.2 No.1071-01  |                    |                    |                    |                    |
|                                     | Utility interconnect                         | IEEE 1547 with Utility Interactive Control functions  |                    |                    |                    |                    |

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.

[2] Consult P-Q charts available: Q(kVAr)=√(S(kVA)<sup>2</sup>-P(kW)<sup>2</sup>)

[3] Heating kit option required below -20°C.

[4] Sound pressure level at a distance of 1m from the rear part.

# HEC-US<sub>V1500</sub>

## TECHNICAL CHARACTERISTICS

|                          |  | 565VAC - MPpt Window 800V-1310V   |                    |                    |                    |                    |
|--------------------------|--|---|--------------------|--------------------|--------------------|--------------------|
|                          |  | FRAME 3   | FRAME 4            | FRAME 5            | FRAME 6            | FRAME 7            |
| NUMBER OF MODULES        |  | 3   | 4                  | 5                  | 6                  | 7                  |
| REFERENCE                |  | FS1050CU15  | FS1400CU15         | FS1750CU15         | FS2100CU15         | FS2450CU15         |
| OUTPUT                   | AC Output Power(kVA/kW) @50°C <sup>[1]</sup> | 1050  | 1400               | 1750               | 2100               | 2450               |
|                          | AC Output Power(kVA/kW) @25°C <sup>[1]</sup> | 1250  | 1675               | 2090               | 2510               | 2930               |
|                          | AC Output Power(kW) @50°C; PF=0.9            | 945   | 1260               | 1575               | 1890               | 2205               |
|                          | Max. AC Output Current (A) @25°C             | 1285  | 1710               | 2140               | 2570               | 3000               |
|                          | Operating Grid Voltage (VAC)                 | 565V ±10%   |                    |                    |                    |                    |
|                          | Operating Grid Frequency (Hz)                | 60Hz  |                    |                    |                    |                    |
|                          | Current Harmonic Distortion (THDi)           | < 3% per IEEE519  |                    |                    |                    |                    |
|                          | Power Factor (cosine phi) <sup>[2]</sup>     | 0.0 leading ... 0.0 lagging / Reactive Power injection at night   |                    |                    |                    |                    |
| INPUT                    | Power Curtailment (kVA)                      | 0...100% / 0.1% Steps   |                    |                    |                    |                    |
|                          | MPpt @full power (VDC) <sup>[1]</sup>        | 800V - 1310V  |                    |                    |                    |                    |
|                          | Maximum DC voltage                           | 1500V   |                    |                    |                    |                    |
|                          | Minimum Start Voltage                        | 1050V - User configurable   |                    |                    |                    |                    |
|                          | Max. DC continuous current (A)               | 1600  | 2140               | 2675               | 3210               | 3745               |
| EFFICIENCY & AUX. SUPPLY | Max. DC short circuit current (A)            | 2320  | 3100               | 3880               | 4650               | 5450               |
|                          | Efficiency (Max) (η)                         | 98.2%   | 98.4%              | 98.5%              | 98.5%              | 98.5%              |
|                          | CEC (η)                                      | 98.0%   | 98.0%              | 98.0%              | 98.5%              | 98.5%              |
|                          | Max. Standby Consumption (Pnight)            | < approx. 50W/per module  |                    |                    |                    |                    |
| CABINET                  | Control Power Supply                         | 120V / 208VAC-6kVA power supply available for external equipment (optional)   |                    |                    |                    |                    |
|                          | Dimensions [WxDxH] [inches]                  | 119.6"x37.2"x86.5"  | 147.6"x37.2"x86.5" | 175.7"x37.2"x86.5" | 203.8"x37.2"x86.5" | 231.9"x37.2"x86.5" |
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|                          | Weight (kg)                                  | 2635  | 3290               | 3945               | 4600               | 5255               |
|                          | Weight (lbs)                                 | 5809  | 7253               | 8697               | 10141              | 11585              |
|                          | Air Flow                                     | Bottom intake. Exhaust top rear vent.   |                    |                    |                    |                    |
| ENVIRON-<br>MENT         | Type of ventilation                          | Forced air cooling  |                    |                    |                    |                    |
|                          | Degree of protection                         | NEMA 3R   |                    |                    |                    |                    |
|                          | Permissible Ambient Temperature              | -31°F to +140°F, -35°C <sup>[3]</sup> to +60°C / Active Power derating >50°C/122°F  |                    |                    |                    |                    |
|                          | Relative Humidity                            | 0% to 100% non condensing   |                    |                    |                    |                    |
|                          | Max. Altitude (above sea level)              | 2000m / >2000m power derating (Max. 4000m)  |                    |                    |                    |                    |
| CONTROL<br>INTERFACE     | Noise level <sup>[4]</sup>                   | < 79 dBA  |                    |                    |                    |                    |
|                          | Interface                                    | Graphic Display (inside cabinet) / Optional Freesun App   |                    |                    |                    |                    |
|                          | Communication protocol                       | Modbus TCP  |                    |                    |                    |                    |
|                          | Power Plant Controller                       | Optional  |                    |                    |                    |                    |
|                          | Keyed ON/OFF switch                          | Standard  |                    |                    |                    |                    |
| PROTECTIONS              | Digital I/O                                  | User configurable   |                    |                    |                    |                    |
|                          | Analog I/O                                   | User configurable   |                    |                    |                    |                    |
|                          | Ground Fault Protection                      | Floating PV array: Isolation Monitoring per MPP<br>NEC2014 Grounded PV Array: GFDI protection<br>Optional PV Array transfer kit: GFDI and Isolation monitoring device |                    |                    |                    |                    |
|                          | Humidity control                             | Active Heating  |                    |                    |                    |                    |
|                          | General AC Protection & Disconn.             | Circuit Breaker   |                    |                    |                    |                    |
|                          | General DC Protection & Disconn.             | External Disconnecting Unit Cabinet   |                    |                    |                    |                    |
| CERTI-<br>FICA-<br>TIONS | Module AC Protection & Disconn.              | AC contactor & fuses  |                    |                    |                    |                    |
|                          | Module DC Protection                         | DC fuses  |                    |                    |                    |                    |
|                          | Overvoltage Protection                       | AC and DC protection (type 2)   |                    |                    |                    |                    |
|                          | Safety                                       | UL 1741; CSA 22.2 No.1071-I-01  |                    |                    |                    |                    |
|                          | Utility interconnect                         | IEEE 1547 with Utility Interactive Control functions  |                    |                    |                    |                    |

NOTES [1] Values at 1.00•Vac nom and cos Φ=1. Consult Power Electronics for derating curves.  
 [2] Consult P-Q charts available:  $Q(kVAr)=\sqrt{(S(kVA))^2-P(kW)^2}$   
 [3] Heating kit option required below -20°C.  
 [4] Sound pressure level at a distance of 1m from the rear part.

MAXIMUM YIELD  
AND RELIABILITY





| CABLE SCHEDULE |                |                                       |           |                      |                  |              |              |
|----------------|----------------|---------------------------------------|-----------|----------------------|------------------|--------------|--------------|
| CIRCUIT ID     | VOLTAGE RATING | CONDUCTOR QUANTITY, SIZE AND MATERIAL | WIRE TYPE | QUANTITY OF CONDUITS | SIZE OF CONDUITS | CONDUIT TYPE | NOTES        |
| A              | 25kV           | (3) #10 AWG AL, (1) #10 AWG AL N      | BARE      | -                    | -                | -            |              |
| B              | 25kV           | (3) #10 AWG AL, (1) #10 AWG AL N      | MV-105    | 1                    | 4"               | PVC          | XLPI133% JCN |
| C              | -              | FACTORY INSTALLED SKID                | -         | -                    | -                | -            |              |
| D              | 25kV           | (1) #10 AWG AL                        | MV-105    | 1                    | 1"               | PVC          | XLPI133% JCN |
| E              | 1000V          | (3) #10 AWG N                         | XHHW-2    | 1                    | 1"               | PVC          |              |
| F              | 1000V          | (6) #10 AWG                           | XHHW-2    | 1                    | 1.5"             | PVC          |              |
| G              | -              | (1) #18 AWG T.P. SHIELD               | -         | 1                    | 1.5"             | PVC          |              |
| H              | 1000V          | (6) #10 AWG                           | RHW-2     | 1                    | 1"               | PVC          |              |
| I              | 600V           | (6) #10 AWG                           | RHW-2     | -                    | -                | -            |              |
| J              | 25kV           | (2) #10 AWG AL                        | BARE      | 1                    | -                | -            |              |
| K              | 600V           | (2) #10 AWG                           | RHW-2     | 1                    | 1"               | PVC          |              |

1. ALL CONDUCTORS SHALL BE COPPER UNLESS OTHERWISE NOTED.

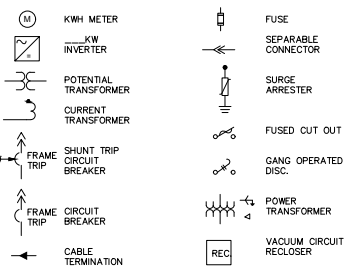
| PROTECTIVE RELAY SETTINGS     |             |                                |                        |                                 |                           |  |
|-------------------------------|-------------|--------------------------------|------------------------|---------------------------------|---------------------------|--|
| INVERTER PROTECTIVE FUNCTIONS | TRIP OUTPUT | VOLTAGE SETTING (SEC) PRI (PU) | FREQUENCY SETTING (HZ) | TOTAL CLEARING TIME CYC. (SEC.) | CURRENT SETTING SEC (PRI) |  |
| 27P1 - FAST UNDERVOLTAGE      | X           | (60) 6599 (50%)                | -                      | 66 (1.1)                        |                           |  |
| 27P2 - UNDERVOLTAGE           | X           | (66) 7259 (55%)                | -                      | 120 (2)                         |                           |  |
| 27P3 - OVERVOLTAGE            | X           | (102) 11218 (85%)              | -                      | 120 (2)                         |                           |  |
| 59P1 - FAST OVERVOLTAGE       | X           | (138) 15178 (115%)             | -                      | 9.6 (0.16)                      |                           |  |
| 81UP1 - UNDERFREQUENCY        | X           | -                              | 56.5                   | 9.6 (0.16)                      |                           |  |
| 81UP2 - UNDERFREQUENCY        | X           | -                              | 58.5                   | 18000 (300)                     |                           |  |
| 81OP2 - OVERFREQUENCY         | X           | -                              | 61.2                   | 18000(300)                      |                           |  |
| 81OP2 - OVERFREQUENCY         | X           | -                              | 62                     | 9.6 (0.16)                      |                           |  |
| 51 - OVERCURRENT              | X           | CURVE: U4<br>T.M.0.3           | -                      | 0.26 (165)                      |                           |  |
| 51C - PHASE OVERCURRENT       | X           | CURVE: U4<br>T.M.0.6           | -                      | 0.10 (62)                       |                           |  |
| 51 CG - GROUND OVERCURRENT    | X           | CURVE: U4<br>T.M.0.4           | -                      | 0.05 (31)                       |                           |  |
| 79 - RECLOSER                 | X           | -                              | -                      | 5 MINUTES                       | SEE NOTE 18               |  |
| ALARM                         | X           | -                              | -                      | <120                            |                           |  |

1. VOLTAGE SETTING VALUES ARE L-L  
2. TOTAL CLEARING TIME = TIME DELAY + CLEARING TIME OF 3 CYCLES

| INVERTER PROTECTIVE SETTINGS (1&2) |                          |                      |                                 |
|------------------------------------|--------------------------|----------------------|---------------------------------|
| INVERTER PROTECTIVE FUNCTIONS      | VOLTAGE SETTING PRI (PU) | FREQUENCY SETTING HZ | TOTAL CLEARING TIME CYC. (SEC.) |
| 27 - FAST UNDERVOLTAGE             | 300 (50%)                | -                    | 66 (1.1)                        |
| 27 - UNDERVOLTAGE                  | 528 (88%)                | -                    | 120 (2)                         |
| 27 - OVERVOLTAGE                   | 660 (110%)               | -                    | 120 (2)                         |
| 59 - FAST OVERVOLTAGE              | 720 (120%)               | -                    | 9.6 (0.16)                      |
| 59 - LOAD REJECTION OVERVOLTAGE    | 840 (140%)               | -                    | 0.06 (0.001)                    |
| 81 - UNDERFREQUENCY                | -                        | 56.5                 | 9.6 (0.16)                      |
| 81 - UNDERFREQUENCY                | -                        | 58.5                 | 18000 (300)                     |
| 81 - UNDERFREQUENCY                | -                        | 61.2                 | 18000(300)                      |
| 81 - OVERFREQUENCY                 | -                        | 61.2                 | 18000(300)                      |
| 81 - OVERFREQUENCY                 | -                        | 62                   | 9.6 (0.16)                      |

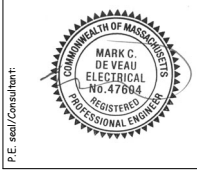
1. VOLTAGE SETTING VALUES ARE L-L  
2. INVERTER RIDE THROUGH SHALL BE PROGRAMMED IN ACCORDANCE WITH IEEE 1547-2018 (2ND EDITION)

ONE LINE DIAGRAM LEGEND



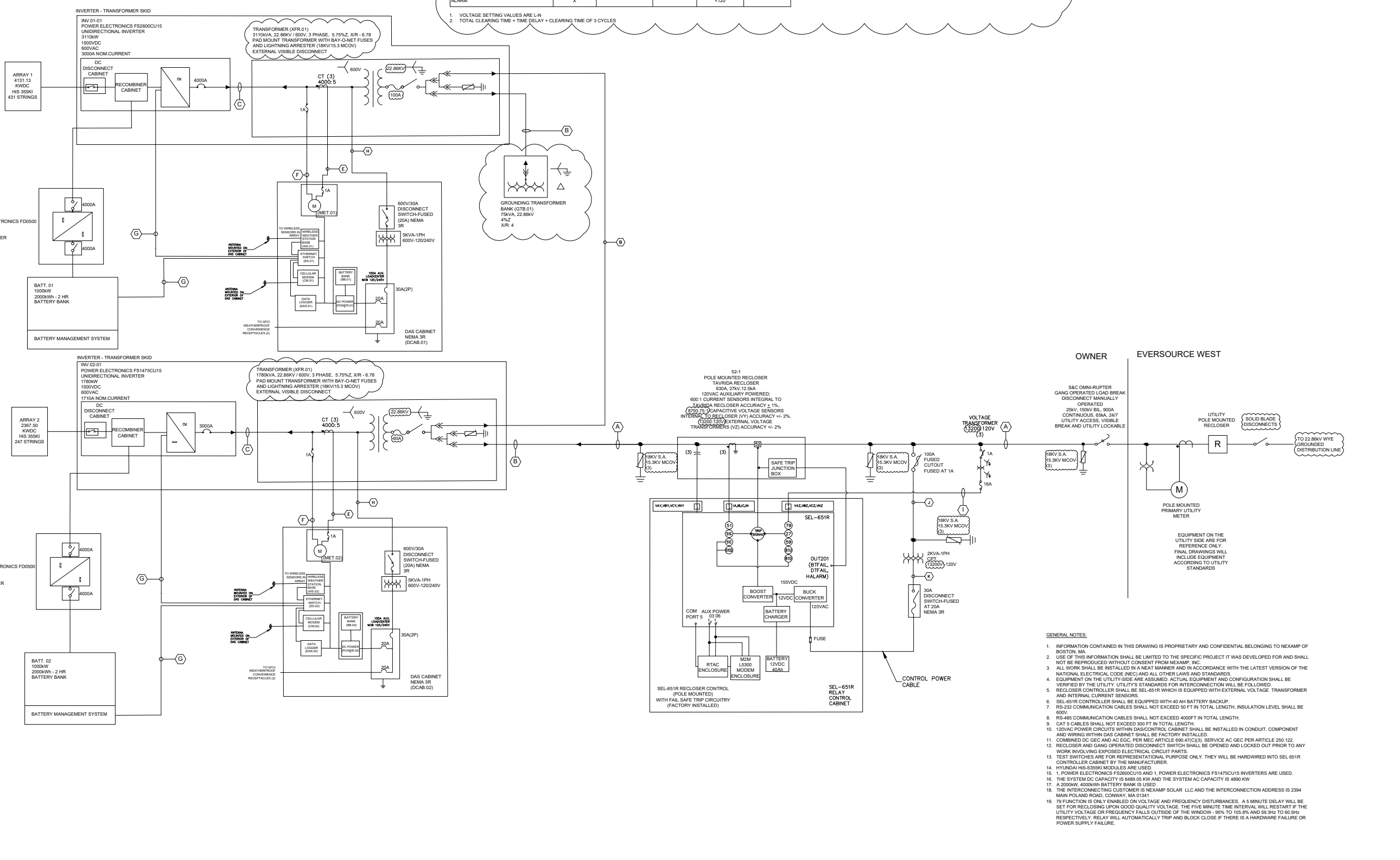
4 Liberty Square, Boston, MA 02109  
Tel: (617) 431-1440 Fax: (978) 416-2525 Web: nexamp.com

| Rev | Issued For                          | Date Issued |
|-----|-------------------------------------|-------------|
| A   | Utility Interconnection Application | 02/28/2018  |
| B   | Utility Interconnection Application | 10/29/2018  |



Project: **06428 Conway Newman PV**  
2394 Main Poland Road, Conway, MA 01341

Project: **AC Electrical Diagram (OPTION 1)**  
Approved by: M.G. Gajar  
Scale: N.T.S.  
Drawing Title: **E-601 B**



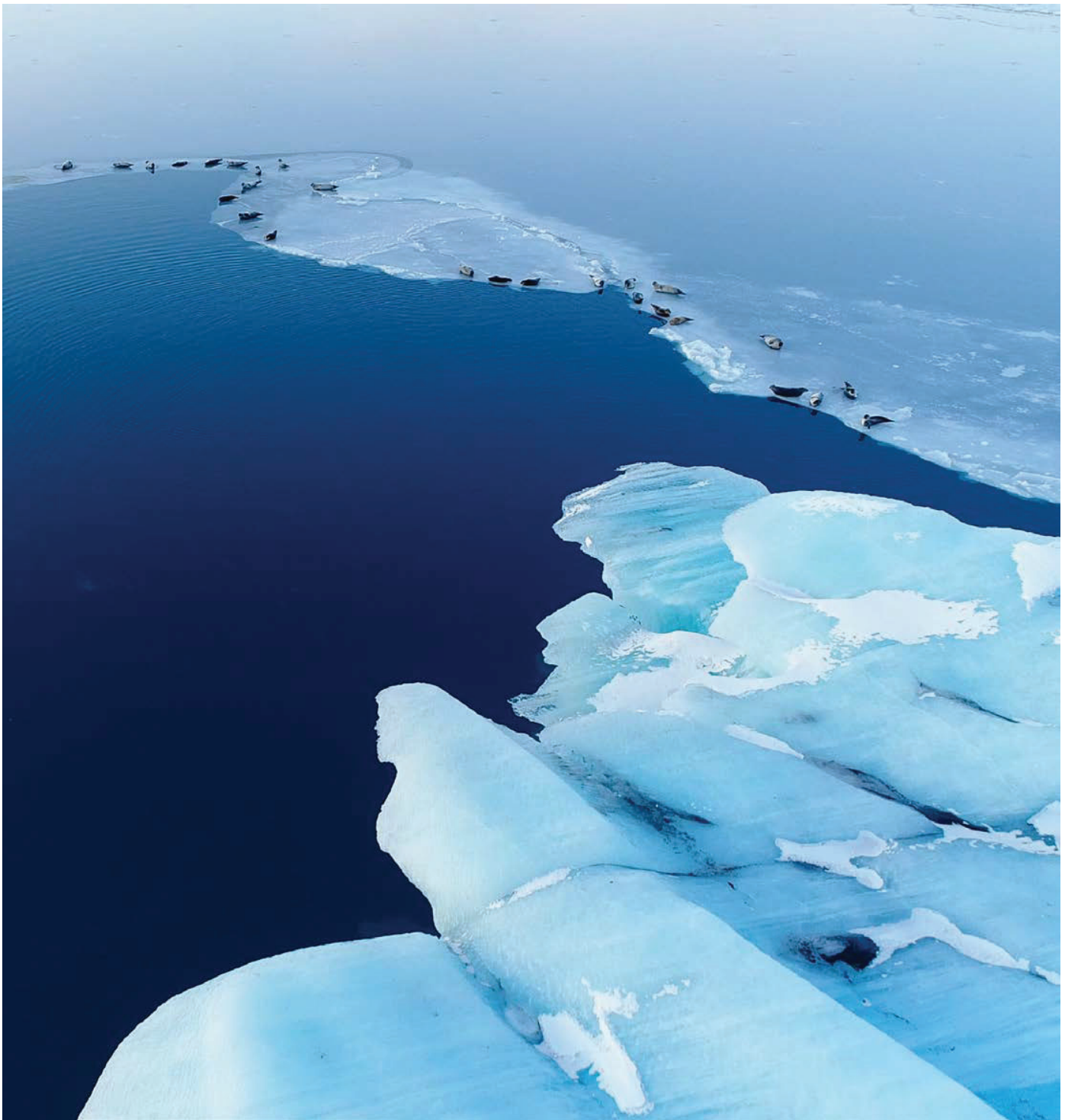
- GENERAL NOTES:
- INFORMATION CONTAINED IN THIS DRAWING IS PROPRIETARY AND CONFIDENTIAL BELONGING TO NEXAMP OF BOSTON, MA.
  - USE OF THIS INFORMATION SHALL BE LIMITED TO THE SPECIFIC PROJECT IT WAS DEVELOPED FOR AND SHALL NOT BE REPRODUCED WITHOUT CONSENT FROM NEXAMP, INC.
  - ALL WORK SHALL BE INSTALLED IN A NEAT MANNER AND IN ACCORDANCE WITH THE LATEST VERSION OF THE NATIONAL ELECTRICAL CODE (NEC) AND ALL OTHER LAWS AND STANDARDS.
  - EQUIPMENT ON THE UTILITY-SIDE ARE ASSIGNED. ACTUAL EQUIPMENT AND CONFIGURATION SHALL BE VERIFIED BY THE UTILITY. UTILITY'S STANDARDS FOR INTERCONNECTION WILL BE FOLLOWED.
  - RECLOSER CONTROLLER SHALL BE SEL-651R WHICH IS EQUIPPED WITH EXTERNAL VOLTAGE TRANSFORMER AND INTERNAL CURRENT SENSORS.
  - SEL-651R CONTROLLER SHALL BE EQUIPPED WITH 40 AH BATTERY BACKUP.
  - RS-232 COMMUNICATION CABLES SHALL NOT EXCEED 90 FT IN TOTAL LENGTH, INSULATION LEVEL SHALL BE 600V.
  - RS-485 COMMUNICATION CABLES SHALL NOT EXCEED 4000FT IN TOTAL LENGTH.
  - CAT 5 CABLES SHALL NOT EXCEED 300 FT IN TOTAL LENGTH.
  - 120VAC POWER CIRCUITS WITHIN DAS/CONTROL CABINET SHALL BE INSTALLED IN CONDUIT. COMPONENT AND WIRING WITHIN DAS CABINET SHALL BE FACTORY INSTALLED.
  - COMBINED DC GEC AND AC GEC PER NEC ARTICLE 690.47(C)(3). SERVICE AC GEC PER ARTICLE 250.122.
  - RECLOSER AND GANG OPERATED DISCONNECT SWITCH SHALL BE OPENED AND LOCKED OUT PRIOR TO ANY WORK INVOLVING EXPOSED ELECTRICAL CIRCUIT PARTS.
  - TEST SWITCHES ARE FOR REPRESENTATIONAL PURPOSE ONLY. THEY WILL BE HARDWIRED INTO SEL-651R CONTROLLER CABINET BY THE MANUFACTURER.
  - HYUNDAI HS-3355KI MODULES ARE USED.
  - POWER ELECTRONICS FS260CUI5 AND 1. POWER ELECTRONICS FS1475CUI5 INVERTERS ARE USED.
  - THE SYSTEM DC CAPACITY IS 6488.05 KW AND THE SYSTEM AC CAPACITY IS 4890 KW.
  - A 2000WH, 4000WH BATTERY BANK IS USED.
  - THE INTERCONNECTING CUSTOMER IS NEXAMP SOLAR, LLC AND THE INTERCONNECTION ADDRESS IS 2394 MAIN POLAND ROAD, CONWAY, MA 01341.
  - 79 FUNCTION IS ONLY ENABLED ON VOLTAGE AND FREQUENCY DISTURBANCES. A 5 MINUTE DELAY WILL BE SET FOR RECLOSING UPON GOOD QUALITY VOLTAGE. THE FIVE MINUTE TIME INTERVAL WILL RESTART IF THE UTILITY VOLTAGE OR FREQUENCY FALLS OUTSIDE OF THE WINDOW. 95% TO 105.8% AND 59.3HZ TO 60.5HZ RESPECTIVELY. RELAY WILL AUTOMATICALLY TRIP AND BLOCK CLOSE IF THERE IS A HARDWARE FAILURE OR POWER SUPPLY FAILURE.

Company Confidential - This drawing or print is the property of Nexamp, Inc. and is subject to return on request. The design concepts and information contained herein are proprietary to Nexamp, Inc. and its subsidiaries and are submitted in confidence. They are not transferable and must be used only for the purpose for which the Drawing/print is expressly loaned. They must not be disclosed, reproduced detrimental to the interest of Nexamp, Inc. All patent rights are expressly assigned in writing by a duly authorized representative of Nexamp, Inc.



**PURE ENERGY**

# **ENERGY STORAGE POWER QUALITY**



# PURE ENERGY

**Pure Energy** is our motivation for leading the renewable energy generation, it is the search for product and service perfection, it is our vision of a world, clean and sustainable for our children and future generations.



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**Since 1987** Power Electronics Industrial division has been producing high power variable speed drives and soft starters for low and medium voltage AC motor applications. This experience has allowed Power Electronics to position itself as the leading manufacturer of utility scale solar inverters thanks to our unique product features, patented designs, fastest global delivery times and unbeatable 24/7 Power on Support. Power Electronics fully designs and manufactures its Freemag converters in Valencia Spain and is proud to have some of the most advanced R&D laboratories and factories in the industry.

 **30 YEARS OF PRODUCT EXCELLENCE**

 **24/7 POWER ON SUPPORT**

 **INTERNATIONAL PRESENCE**

 **FINANCIAL STABILITY AND STRENGTH**

 **INDEPENDENT REPORTS AND CERTIFICATIONS**

 **SUSTAINABLE GROWTH**

## ENGINEERING & CONSULTING

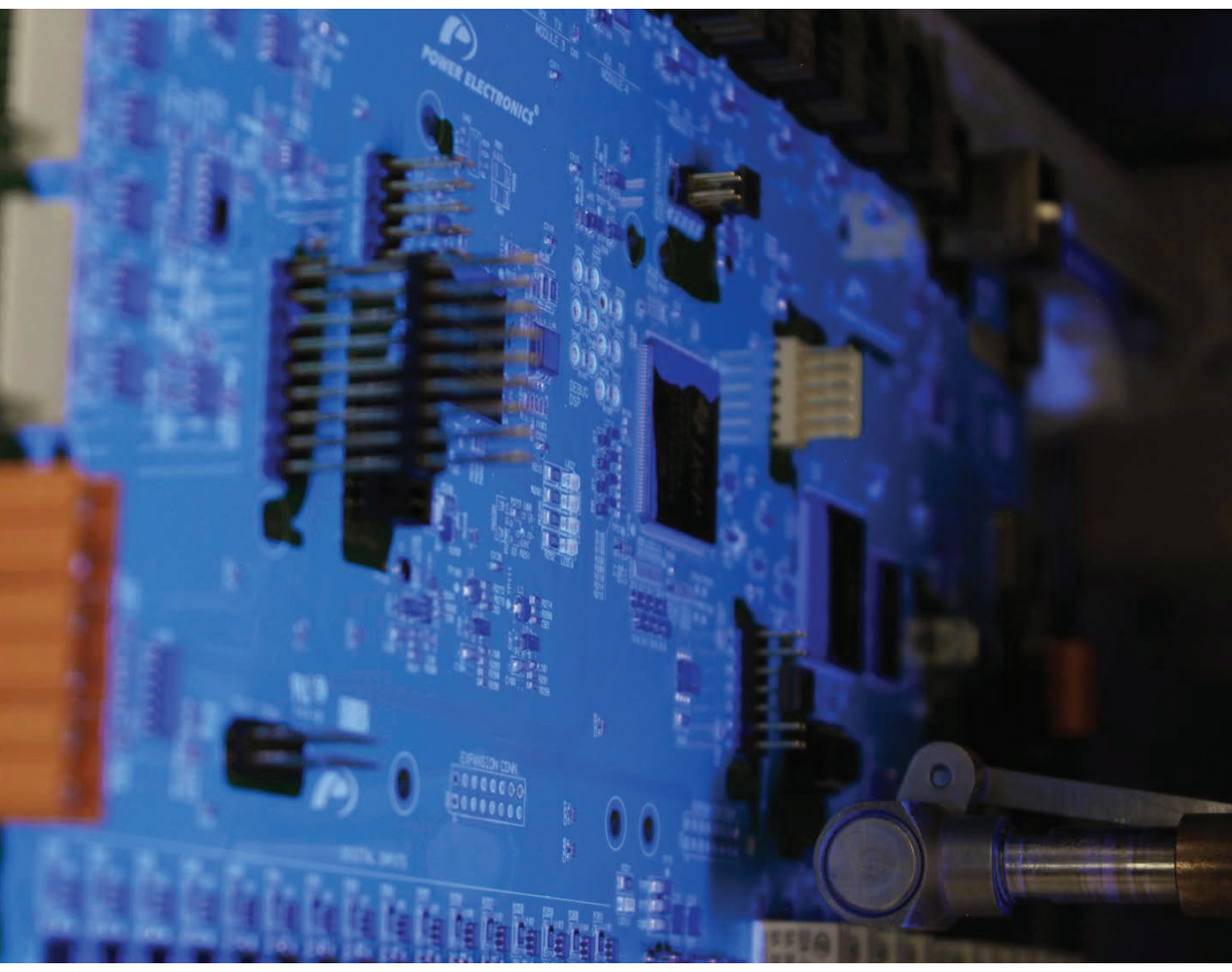
**Energy projects** often require customer specific solutions, for this reason our clients also have our Engineering and Consulting department at their disposal, which comprise a wide number of highly skilled and experienced engineers that are available to modify our standard product to suit customer demands and ensure our clients get the product they need.

TECHNICAL ADVICE  
ENGINEERING  
CUSTOMIZED SOLUTIONS  
PROJECT MANAGEMENT  
COMMISSIONING  
24/7 SERVICE

## VERTICAL INTEGRATION

**Flexibility and specialization** play a key role in the manufacture of standard products, but even more so in personalized products. We design and manufacture integrally the mechanics of our equipment. Vertical integration gives us the flexibility to adapt to customer requirements and still provide very short delivery times.

INNOVATION & DESIGN FLEXIBILITY  
HIGH QUALITY COMPONENTS  
RELIABLE ENGINEERING  
FACTORY TESTED  
VALUE CHAIN SUPERVISION  
IMMEDIATE DELIVERY





AVAILABILITY



COMMISSIONING



CUSTOMER SUPPORT



ONSITE ASSISTANCE



SPARE PARTS WARRANTY



TRAINING SEMINARS



WARRANTY

## POWER ON SUPPORT

**Power on Support is the concept** of a customer oriented strategy implemented by Power Electronics since its origins more than 30 years ago with 24/7 after sales service available for all our customers and end users without the need of signing an O&M contract.

*Customer Oriented Strategy*

## WORLDWIDE PRESENCE

From the beginning, customer service and internationalization have been key elements for the development of the company. Thanks to the global expansion in the five continents, today we have presence and provide technical service throughout the world.



HEADQUARTERS



**+20**

DELEGATIONS

**+100**

SALES COUNTRIES

**+12GW**

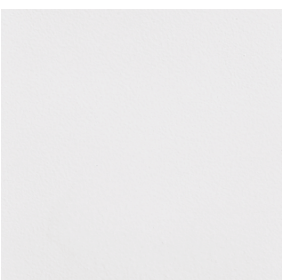
INVERTERS INSTALLED

**+12GW**

ANNUAL CAPACITY PRODUCTION



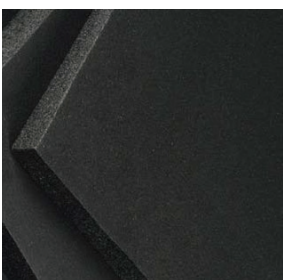
# ROBUST DESIGN



**Polymeric Painting**

FreeMaq series has been designed to last for more than 30 years of operation in harsh environments and extreme weather conditions. FreeMaq units are tested and ready to withstand conditions from the frozen siberian tundra to the Californian Death Valley, featuring:

- Totally sealed electronics cabinet protects electronics against dust and moisture.
- Conformal coating on electronic boards shields PCBs from harsh atmospheres.
- Temperature and humidity controlled active heating prevents internal water condensation.



**Closed-Cell Insulation**

- Galvanized Steel construction with 2mm thickness for maximum enclosure longevity. (Stainless Steel Optional)
- Closed-Cell insulation panel isolates the cabinet from solar heat gains.

- Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages. The solid structure avoids the need of additional external structures.

- Random units selected to pass a Factory Water Tightness Test ensuring product quality.

- C4 degree of protection according to ISO 12944. Up to C5-M optional.

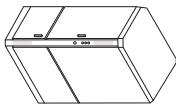


**Galvanized Steel | Stainless Steel (Optional)**

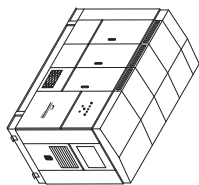
# PRODUCT RANGE



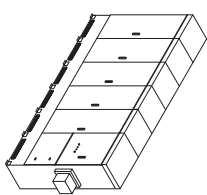
## ENERGY STORAGE



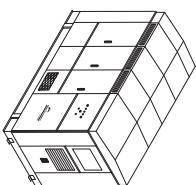
FREEMAO DD/DC  
500 kW - 3000 kW  
P. 15



FREEMAO PPSK  
1600 kW - 3800 kW  
480 Vdc - 690 Vdc  
P. 21

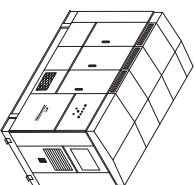


FREEMAO PCS  
1850 kW - 3800 kW  
370 Vdc - 690 Vdc  
P. 41



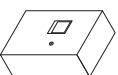
FREEMAO MULTI PCS  
1600 kW - 3800 kW  
480 Vdc - 690 Vdc  
P. 55

## POWER QUALITY



FREEMAO STATION  
SSTAT Compensator  
2300 VAc - 3800 VAc  
P. 67

## ACCESSORIES



POWER PLANT CONTROLLER  
P. 73

## FREEMAQ DC/DC

BI-DIRECTIONAL DC/DC CONVERTER



MODULAR DESIGN



OUTDOOR DURABILITY



CLIPPING RECOVERY CAPABILITY



FOR NEW AND EXISTING PLANTS



### THE MOST COST COMPETITIVE SOLUTION FOR SOLAR + STORAGE INSTALLATIONS

The new Power Electronics Freemaq DC/DC is a bi-directional DC converter designed to maximize the benefits of the large-scale solar plants with a solar-plus-storage approach, offering a cutting-edge technology product that is able to reduce the CAPEX of PV installations coupled with energy storage systems, avoiding the installation of an additional station with a dedicated MV transformer.

Following the Power Electronics philosophy, the Freemaq DC/DC is a modular outdoor solution available from 500kW to 3000kW, fully compatible with different battery technologies and manufacturers, with a voltage range up to 1500Vdc and the highest efficiency in the market. This product has been designed to be easily integrated with a Freesun Inverter in new or already installed PV power plants, being the most cost-competitive solution for battery storage systems paired with PV installations.

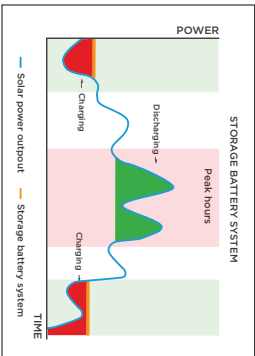
By coupling the Power Electronics Freemaq DC/DC converter with a Freesun solar inverter, it is possible to perform functions such as: energy shifting, ramp control rate, frequency response, and most importantly, clipping energy recovery, that will boost customer revenues.

## ENERGY STORAGE APPLICATIONS



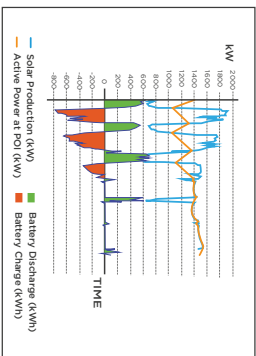
### LOAD LEVELING

Freemaq DC/DC series are able to store energy during periods of low demand from the grid, in order to later supply this energy when there is a higher demand. This has the benefit of selling the energy at a higher market price during peak periods. It also allows grid operators to supply electricity with a higher renewable origin. Since PV generation may not be at the same time as peak demand, this facilitates the flexibility and integration of renewable generation into the grid.



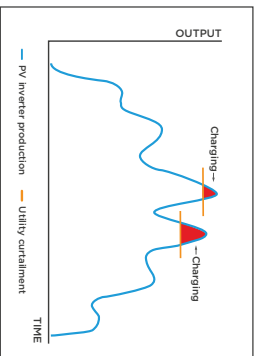
### RENEWABLE INTEGRATION

The Freemaq DC/DC series attenuates the intermittent nature of renewable energy sources, to provide a smoother power output. The Freemaq DC/DC controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array. The system monitors the PV inverter output to inject or consume power accordingly to ensure the output remains within the ramp requirements.



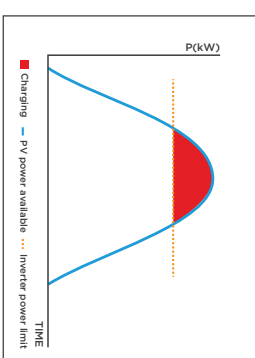
### UTILITY CURTAILMENT RECOVERY

Utility scale inverter production can be curtailed by the grid operator, due to the high energy sources penetration in the grid during certain periods. With this AC-coupled energy storage system, the excess energy from the PV field can be stored in the Battery Energy Storage System (BESS) and then delivered when needed.



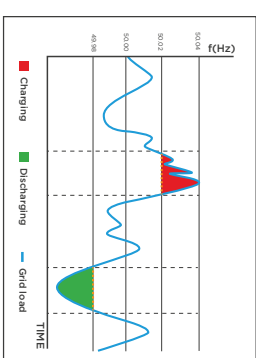
### CLIPPING RECOVERY

The Power Electronics Freemaq DC/DC gets the maximum revenues from the PV generator, by charging the battery storage system when the PV inverter is clipping the output power, due to the high DC/AC power ratios. This stored energy can be exported to the utility grid when the price per kWh is high.



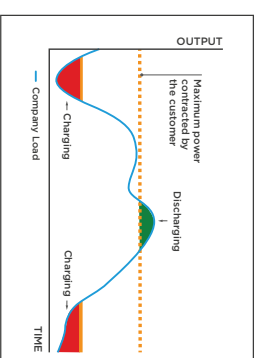
### FREQUENCY REGULATION SYSTEM

Freemaq DC/DC provides ability to regulate grid frequency in both directions. When there is a grid overfrequency (generation>demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation<demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.

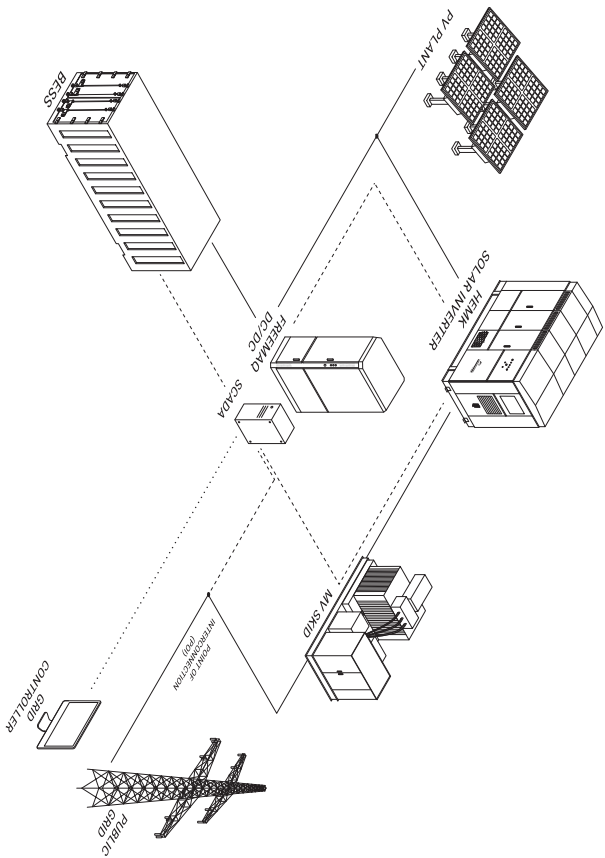


### PEAK POWER SHAVING

By delivering stored energy to the grid during periods of high demand, it reduces the burden on the distribution network and increases significantly its efficiency. Energy is stored during periods of low demand increasing the load on the grid. During peak periods this stored energy is then injected into the grid reducing the demand at this time. The result is a more flattened demand curve which means the grid can avoid switching on more expensive and polluting generators.



## CONFIGURATION



- Power connections
- Plant communications
- ..... Grid controller communication

## MODULAR DESIGN

Its unique modular design provides the flexibility needed to design your project, choosing the amount of storage power to be dispatched, according to the specific grid requirements.



From 500 kW to 3MW.

## TECHNICAL CHARACTERISTICS

| REFERENCE                    | FD0900  |
|------------------------------|---|
| <b>DC INPUT &amp; OUTPUT</b> | DC Rated Power (kW) @50°C: 500<br>DC PV Voltage Range (Vdc): 800 to 1310<br>DC ESS Voltage Range (Vdc): 700 to 1310<br>Maximum DC PV Input Voltage (Vdc): 1500<br>DC Voltage Ripple: <3%<br>Battery Technology: Compatible with all battery technologies  |
| <b>EFFICIENCY</b>            | Efficiency (Max): 98.5% (target)  |
| <b>CABINET</b>               | Max. Standby Consumption: < approx. 50W<br>Dimensions (mm): 1000x1200x1800<br>Cooling: Forced air<br>Enclosure Rating: NEMA 3R / IP54   |
| <b>CONNECTIONS</b>           | Number of connections: 3 positive / 3 negative<br>Terminals: Lugs Rated 90°C<br>Max. positive and negative input wire size: 750 kcmil / 380mm <sup>2</sup><br>Operating Temperature range: -35°C to 50°C<br>Relative Humidity: 4% to 95% non-condensing<br>Max. Altitude: 4000m, 20000m power derating<br>Audible Noise level: <79 dBA<br>Interfaces: <ul style="list-style-type: none"> <li>— Graphic display (Freeseun cabinet)</li> <li>— Emergency pushbutton and indicator lights</li> <li>— USB, RJ45 and RS-485</li> </ul> |
| <b>CONTROL INTERFACE</b>     | — Freeseun App<br>— Modbus TCP Modbus RTU<br>— Insulation monitoring device<br>— Built-in<br>— Optional<br>— Optional   |
| <b>PROTECTIONS</b>           | Communications Protocol: Freeseun App<br>Ground Fault Detection: Modbus TCP Modbus RTU<br>DC disconnection & protection (PV): Insulation monitoring device<br>DC disconnection: Built-in<br>Battery overvoltage protection: Optional<br>Safety Certification: UL-1741 (pending)   |
| <b>CERTIFICATIONS</b>        | UL-1741 (pending)   |

[1] For other range consult Power Electronics  
 [2] Heating resistors kit option below -20°C.

## FREEMAQ PCSK

UTILITY SCALE BATTERY INVERTER



POWER CONVERSION SYSTEM



FIELD REPLACEABLE UNITS



MODULAR DESIGN



1000L3



4 QUADRANT



3 LEVEL TOPOLOGY



IP65 AVAILABLE

### PROVEN HARDWARE AND ROBUST OUTDOOR DESIGN FEATURED WITH THE LATEST CONTROL

The Freemaq PCSK is a modular solution from 1600kW to 3800kW with configurable DC and AC voltages making it compatible with all battery technology and manufacturers. Power Electronics is a proven partner in the solar and energy storage market. The Power Electronics Freemaq PCSK offers proven hardware to meet storage and grid support challenges. The energy production industry is embracing renewable energy sources. However, high penetration creates power transmission instability challenges, thus Grid Operators require stringent dynamic and static grid support features for solar inverters and Power Conversion Systems (PCS).

The Freemaq PCSK can perform grid support functions such as: Peak Shaving, Ramp Rate Control, Frequency Regulation, Load Leveling and Voltage Regulation, controlled by a Power Plant Controller or SCADA. The Freemaq PCSK stations are turn-key solutions ready for connection to the battery container and MV power distribution wiring. Units are designed for concrete pads or piers, open skids or integrated into full container solutions.

### COMPACT DESIGN - EASY TO SERVICE

By providing full front access the Freemaq PCSK series simplifies the maintenance tasks, reducing the MTRR (and achieving a lower OPEX). The total access allows a fast swap of the FRUs without the need of qualified technical personnel.

With the Freemaq PCSK, Power Electronics offers its most compact solution, achieving 3.8MW in just 12ft long, reducing installation costs and labor time.



### STRING CONCEPT POWER STAGES

The Freemaq PCSK combines the advantages of a central inverter with the modularity of the string inverters. Its power stages are designed to be easily replaceable on the field without the need of advanced technical service personnel, providing a safe, reliable and fast Plug&Play assembly system. Following the modular philosophy of the Freemaq series, the unit is composed of 6 FRUs (field replaceable units), being able to work with up to 6 independent DC inputs.



### INNOVATIVE COOLING SYSTEM

Based on more than 3 years of experience with our MV Variable Speed Drive, the IC00L3 is the first air-cooling system allowing IP65 degree of protection in an outdoor converter. IC00L3 delivers a constant stream of clean air to the FRUs, being the most effective way of reaching up to IP65

degree of protection, without having to maintain cumbersome dust filters or having to use liquid-cooling systems, avoiding the commonly known inconveniences of it (complex maintenance, risk of leaks, higher number of components...), therefore resulting in an OPEX cost reduction.



### ACTIVE HEATING

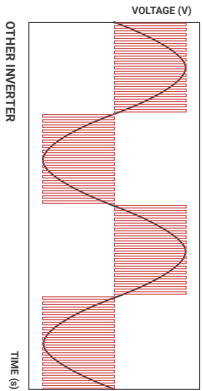
When the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

This autonomous heating system is the most efficient and homogenous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PREVENT**

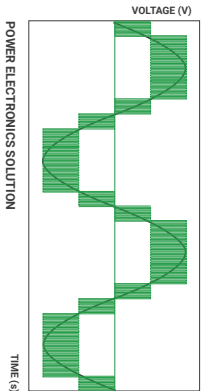
## MULTILEVEL TOPOLOGY

The multilevel IGBT topology is the most efficient approach to manage high DC link voltages and makes the difference in the 1,500 Vdc design. Power Electronics has many years of power design in both inverters and MV drives and the

Freemag PCSK design is the result of our experience with 3 level topologies. The 3 level IGBT topology reduces stage losses, increases inverter efficiency and minimizes total harmonic distortion.



TWO-LEVEL INVERTER

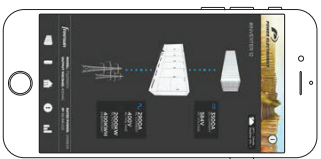


THREE-LEVEL INVERTER

## EASY TO MONITOR

The Freemag app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device. For detailed updates and information without the need to open cabinet doors.

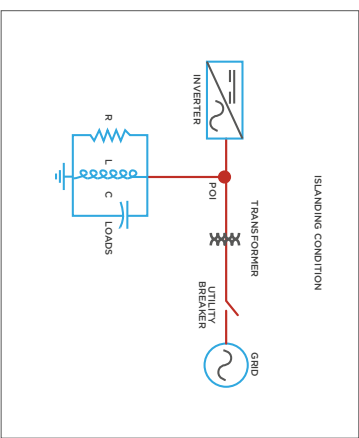
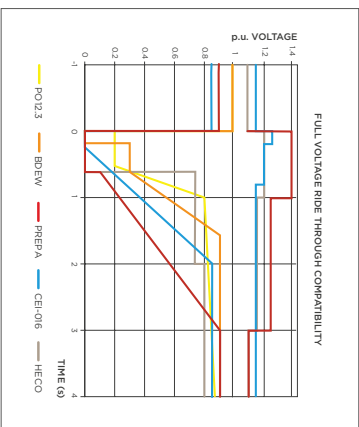
The app user-friendly interface allows quick and easy access to critical information (energy registers, production and events).



|                              |   |
|------------------------------|---|
| <b>AVAILABLE INFORMATION</b> | Grid and PV field data<br>Inverter and Power module data (Voltages, currents, power, temperatures, I/O status,...)<br>Weather conditions<br>Alarms and warnings events<br>Energy registers<br>Others. |
| <b>FEATURES</b>              | Easy Wireless connection<br>Comprehensive interface<br>Real time data<br>Save and copy settings.  |
| <b>LANGUAGE</b>              | English, Spanish  |
| <b>SYSTEM REQUIREMENTS</b>   | iOS or Android devices.   |
| <b>SETTINGS CONTROL</b>      | Yes   |

## DYNAMIC GRID SUPPORT

Freemag PCSK firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Antisliding active and reactive power curtailment...), and is compatible with all the specific requirements of the utilities.



### LVRT or ZVRT (Low Voltage Ride Through)

Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.

### Anti-Islanding

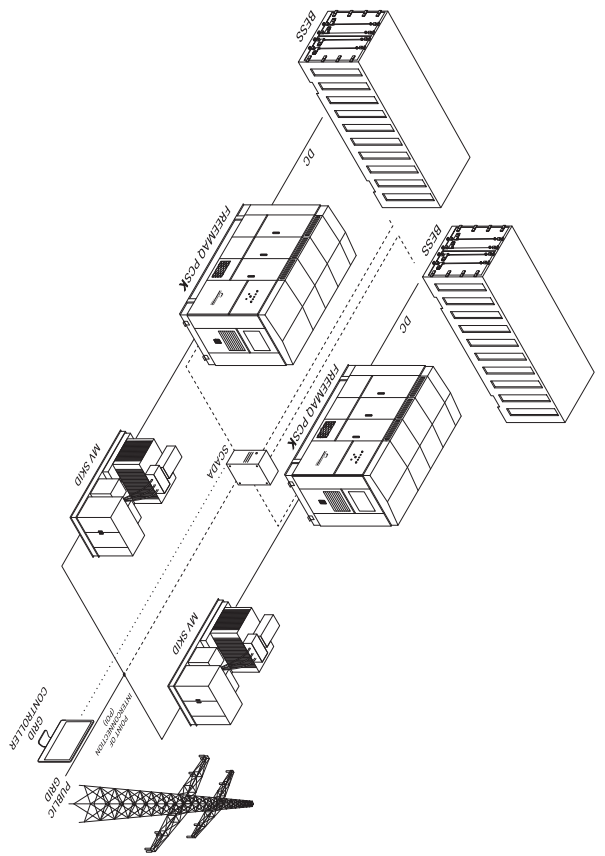
This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.



**BATTERY ENERGY STORAGE SYSTEM**

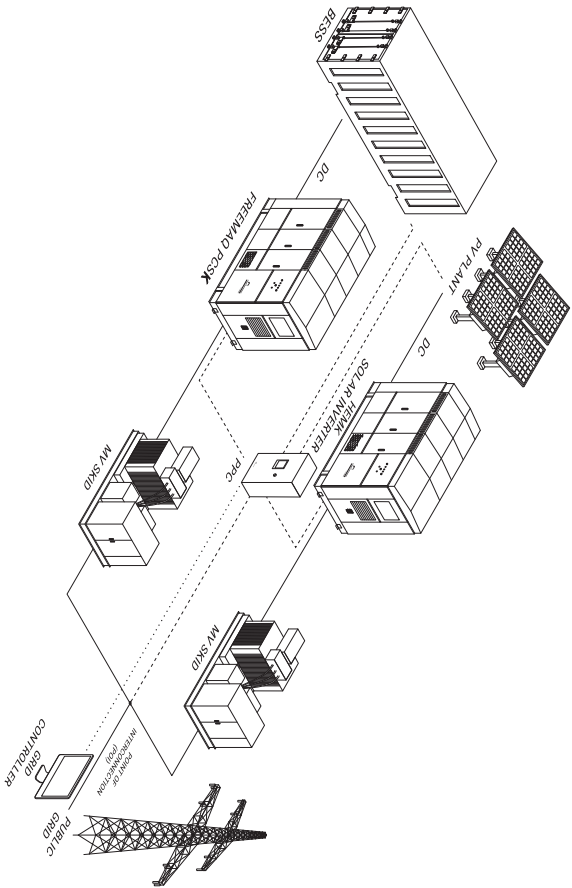
A BESS comprises a battery container connected to a Freemaq PCSK (Power Conversion System) that follows the instruction of the main governor of the plant, the PPC (Power Plant Controller) or SCADA.

EXAMPLE 1



— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

EXAMPLE 2



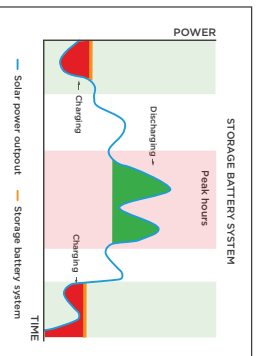
— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

## ENERGY STORAGE APPLICATIONS



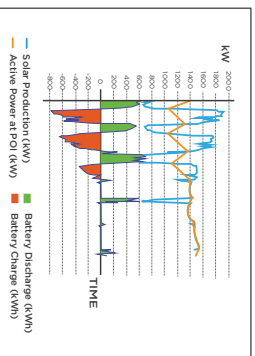
### LOAD LEVELING

Freemaq PCSK series are able to store energy during periods of low demand from the grid, in order to later supply this energy when there is a higher demand. This has the benefit of selling the energy at a higher market price during peak periods. It also allows grid operators to supply electricity with a higher renewable origin. Since PV generation may not be at the same time as peak demand, this facilitates the flexibility and integration of renewable generation into the grid.



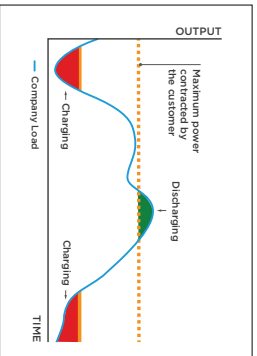
### RENEWABLE INTEGRATION

The Freemaq PCSK series attenuates the intermittent nature of renewable energy sources, to provide a smoother power output. The Freemaq PCSK controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array. The system monitors the PV inverter output to inject or consume power accordingly to ensure the output remains within the ramp requirements.



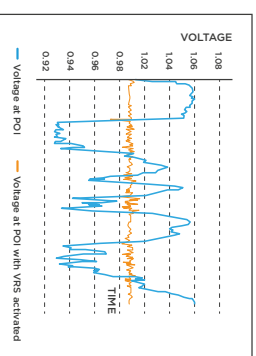
### PEAK POWER SHAVING

By delivering stored energy to the grid during periods of high demand, it reduces the burden on the distribution network and increases significantly its efficiency. Energy is stored instead of injected into the grid during periods of low demand, which as a result increases the load on the grid. However, during peak periods this stored energy is then injected into the grid, which reduces the demand at this time. The result is a more flattened demand curve which means the grid can avoid switching on more expensive and polluting generators.



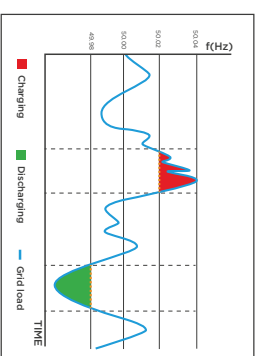
### GRID SUPPORT

Freemaq PCSK series helps the integration of renewable sources, by helping to maintain grid stability and power quality. It can help support the grid voltage by generating capacitive or inductive current. Other features include Voltage Control, Reactive Power Control and Fault Ride Through Support.



### FREQUENCY REGULATION SYSTEM

Freemaq PCSK provides ability to regulate grid frequency in both directions. When there is a grid over-frequency (generation>demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation<demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.



## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 690V

| NUMBER OF MODULES        | FRAME 1                                       |   | FRAME 2   |   |
|--------------------------|---|---|---|---|
|                          | 4   | 6   | 4   | 6   |
| REFERENCES               | FP2300K                                       | FP3450K   | FP2300K   | FP3450K   |
| AC                       | AC Output Power (kVA/kW) @50°C <sup>[1]</sup> | 2300  | 3450  | 2300  |
|                          | AC Output Power (kVA/kW) @25°C <sup>[1]</sup> | 2530  | 3800  | 2530  |
|                          | Max. AC Output Current (A) @50°C              | 1925  | 2887  | 1925  |
|                          | Max. AC Output Current (A) @25°C              | 2117  | 3175  | 2117  |
|                          | Overload capacity <sup>[2]</sup>              | 110% (depending on preload conditions)                                | 110% (depending on preload conditions)                                | 110% (depending on preload conditions)                                |
|                          | Operating Grid Voltage (VAC)                  | 690V ±10% <sup>[4]</sup>  | 690V ±10% <sup>[4]</sup>  | 50/60 Hz  |
|                          | Operating Grid Frequency (Hz)                 | 50/60 Hz  | 50/60 Hz  | < 3% per IEEE519  |
|                          | Current Harmonic Distortion (THD)             | 0.5 leading, 0.5 lagging  | 0.5 leading, 0.5 lagging  | 0.5 leading, 0.5 lagging  |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      | > 0.99  | > 0.99  | > 0.99  |
|                          | Reactive power compensation                   | Four quadrant operation   | Four quadrant operation   | Four quadrant operation   |
| DC                       | DC Voltage Range (Full power)                 | 976V-1310V  | 976V-1310V  | 1500V   |
|                          | Maximum DC voltage                            | 1500V   | 1500V   | < 3%  |
| DC                       | DC Voltage Ripple                             | < 3%  | < 3%  | < 3%  |
|                          | Max. DC continuous current (A)                | 2646  | 3969  | 2646  |
| DC                       | Battery Technology                            | All type of batteries (BMS required)                                  | All type of batteries (BMS required)                                  | All type of batteries (BMS required)                                  |
|                          | Battery Connections                           | Up to 18 positive and 18 negative connections                         | Up to 18 positive and 18 negative connections                         | Up to 18 positive and 18 negative connections                         |
| EFFICIENCY & AUX. SUPPLY | Efficiency (Max) (%)                          | 98.8%   | 98.8%   | 98.8%   |
|                          | Max. Standby Consumption                      | < approx. 50W/per module  | < approx. 50W/per module  | < approx. 50W/per module  |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7   | 12 x 7 x 7  | 9 x 7 x 7   |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2   | 3.7 x 2.2 x 2.2   | 2.7 x 2.2 x 2.2   |
|                          | Weight (lbs)                                  | 1080/2.65   | 1543/2.36   | 1080/2.65   |
| ENVIRONMENT              | Weight (kg)                                   | 4900  | 7000  | 4900  |
|                          | Type of ventilation                           | Forced air cooling  | Forced air cooling  | Forced air cooling  |
|                          | Degree of protection                          | NEMA 3R / IP54 / (IP65 Optional)                                      | NEMA 3R / IP54 / (IP65 Optional)                                      | NEMA 3R / IP54 / (IP65 Optional)                                      |
| CONTROL INTERFACE        | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) |
|                          | Relative Humidity                             | 4% to 100% / Condensing   | 4% to 100% / Condensing   | 4% to 100% / Condensing   |
|                          | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                            | 2000m / >2000m power derating (Max. 4000m)                            | 2000m / >2000m power derating (Max. 4000m)                            |
|                          | Noise level <sup>[5]</sup>                    | < 79 dBA  | < 79 dBA  | < 79 dBA  |
|                          | Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display       | Graphic Display (inside cabinet) / Optional Freesun App display       | Graphic Display (inside cabinet) / Optional Freesun App display       |
| PROTECTIONS              | Communication protocol                        | Modbus TCP  | Modbus TCP  | Modbus TCP  |
|                          | Power Plant Controller                        | Optional. Third party SCADA systems supported                         | Optional. Third party SCADA systems supported                         | Optional. Third party SCADA systems supported                         |
|                          | Keyed ON/OFF switch                           | Standard  | Standard  | Standard  |
|                          | Digital I/O                                   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   |
|                          | Analog I/O                                    | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   |
| CERTIFICATIONS           | Ground Fault Protection                       | Insulation monitoring device  | Insulation monitoring device  | Insulation monitoring device  |
|                          | Humidity control                              | Active Heating  | Active Heating  | Active Heating  |
|                          | General AC Protection & Discom.               | Circuit Breaker   | Circuit Breaker   | Circuit Breaker   |
|                          | General DC Protection & Discom.               | Fuses + Contactors  | Fuses + Contactors  | Fuses + Contactors  |
| CERTIFICATIONS           | Overvoltage Protection                        | AC and DC protection (Type 2)   | AC and DC protection (Type 2)   | AC and DC protection (Type 2)   |
|                          | Safety  | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       |
|                          | Utility interconnect                          | UL1741SA / IEEE1547.1   | UL1741SA / IEEE1547.1   | UL1741SA / IEEE1547.1   |

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(kW))

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 660V

| NUMBER OF MODULES        | FRAME 1                                       |   | FRAME 2   |   |
|--------------------------|---|---|---|---|
|                          | 4   | 6   | 4   | 6   |
| REFERENCES               | FP2200K                                       | FP3300K   | FP2200K   | FP3300K   |
| AC                       | AC Output Power (kVA/kW) @50°C <sup>[1]</sup> | 2200  | 3300  | 2200  |
|                          | AC Output Power (kVA/kW) @25°C <sup>[1]</sup> | 2420  | 3630  | 2420  |
|                          | Max. AC Output Current (A) @50°C              | 1925  | 2887  | 1925  |
|                          | Max. AC Output Current (A) @25°C              | 2117  | 3175  | 2117  |
|                          | Overload capacity <sup>[2]</sup>              | 110% (depending on preload conditions)                                | 110% (depending on preload conditions)                                | 110% (depending on preload conditions)                                |
|                          | Operating Grid Voltage (VAC)                  | 660V ±10% <sup>[4]</sup>  | 660V ±10% <sup>[4]</sup>  | 50/60 Hz  |
|                          | Operating Grid Frequency (Hz)                 | 50/60 Hz  | 50/60 Hz  | < 3% per IEEE519  |
|                          | Current Harmonic Distortion (THD)             | 0.5 leading, 0.5 lagging  | 0.5 leading, 0.5 lagging  | 0.5 leading, 0.5 lagging  |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      | > 0.99  | > 0.99  | > 0.99  |
|                          | Reactive power compensation                   | Four quadrant operation   | Four quadrant operation   | Four quadrant operation   |
| DC                       | DC Voltage Range (Full power)                 | 934V-1310V  | 934V-1310V  | 1300V   |
|                          | Maximum DC voltage                            | 1300V   | 1300V   | < 3%  |
| DC                       | DC Voltage Ripple                             | < 3%  | < 3%  | < 3%  |
|                          | Max. DC continuous current (A)                | 2646  | 3969  | 2646  |
| DC                       | Battery Technology                            | All type of batteries (BMS required)                                  | All type of batteries (BMS required)                                  | All type of batteries (BMS required)                                  |
|                          | Battery Connections                           | Up to 18 positive and 18 negative connections                         | Up to 18 positive and 18 negative connections                         | Up to 18 positive and 18 negative connections                         |
| EFFICIENCY & AUX. SUPPLY | Efficiency (Max) (%)                          | 98.8%   | 98.8%   | 98.8%   |
|                          | Max. Standby Consumption                      | < approx. 50W/per module  | < approx. 50W/per module  | < approx. 50W/per module  |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7   | 12 x 7 x 7  | 9 x 7 x 7   |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2   | 3.7 x 2.2 x 2.2   | 2.7 x 2.2 x 2.2   |
|                          | Weight (lbs)                                  | 1080/2.65   | 1543/2.36   | 1080/2.65   |
| ENVIRONMENT              | Weight (kg)                                   | 4900  | 7000  | 4900  |
|                          | Type of ventilation                           | Forced air cooling  | Forced air cooling  | Forced air cooling  |
|                          | Degree of protection                          | NEMA 3R / IP54 / (IP65 Optional)                                      | NEMA 3R / IP54 / (IP65 Optional)                                      | NEMA 3R / IP54 / (IP65 Optional)                                      |
| CONTROL INTERFACE        | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) | -35°C <sup>[4]</sup> to +60°C / -50°C / Active Power derating (<50°C) |
|                          | Relative Humidity                             | 4% to 100% / Condensing   | 4% to 100% / Condensing   | 4% to 100% / Condensing   |
|                          | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                            | 2000m / >2000m power derating (Max. 4000m)                            | 2000m / >2000m power derating (Max. 4000m)                            |
|                          | Noise level <sup>[5]</sup>                    | < 79 dBA  | < 79 dBA  | < 79 dBA  |
|                          | Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display       | Graphic Display (inside cabinet) / Optional Freesun App display       | Graphic Display (inside cabinet) / Optional Freesun App display       |
| PROTECTIONS              | Communication protocol                        | Modbus TCP  | Modbus TCP  | Modbus TCP  |
|                          | Power Plant Controller                        | Optional. Third party SCADA systems supported                         | Optional. Third party SCADA systems supported                         | Optional. Third party SCADA systems supported                         |
|                          | Keyed ON/OFF switch                           | Standard  | Standard  | Standard  |
|                          | Digital I/O                                   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   |
|                          | Analog I/O                                    | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   | Optional <sup>[6]</sup>   |
| CERTIFICATIONS           | Ground Fault Protection                       | Insulation monitoring device  | Insulation monitoring device  | Insulation monitoring device  |
|                          | Humidity control                              | Active Heating  | Active Heating  | Active Heating  |
|                          | General AC Protection & Discom.               | Circuit Breaker   | Circuit Breaker   | Circuit Breaker   |
|                          | General DC Protection & Discom.               | Fuses + Contactors  | Fuses + Contactors  | Fuses + Contactors  |
| CERTIFICATIONS           | Overvoltage Protection                        | AC and DC protection (Type 2)   | AC and DC protection (Type 2)   | AC and DC protection (Type 2)   |
|                          | Safety  | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2       |
|                          | Utility interconnect                          | UL1741SA / IEEE1547.1   | UL1741SA / IEEE1547.1   | UL1741SA / IEEE1547.1   |

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(kW))

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 645V

| NUMBER OF MODULES        | FRAME 1                                       |                 | FRAME 2  |                                   |
|--------------------------|---|-----------------|--|-----------------------------------|
|                          | 4   | 6               | 6  | 6                                 |
| REFERENCES               | FP2150K                                       | FP3225K         | FP3225K  | FP3225K                           |
| AC                       | AC Output Power (KVA/KW) @50°C <sup>[1]</sup> | 2150            | 2150   | 3725                              |
|                          | AC Output Power (KVA/KW) @25°C <sup>[1]</sup> | 2365            | 2365   | 3550                              |
|                          | Max. AC Output Current (A) @50°C              | 1925            | 1925   | 2887                              |
|                          | Max. AC Output Current (A) @25°C              | 2117            | 2117   | 3175                              |
|                          | Overload capacity <sup>[2]</sup>              | 110%            | 110%   | (depending on preload conditions) |
|                          | Operating Grid Voltage (VAC)                  |                 | 645V ±10% <sup>[4]</sup>   | 50/60 Hz                          |
|                          | Operating Grid Frequency (Hz)                 |                 | 50/60 Hz   | < 3% per IEEE519                  |
|                          | Current Harmonic Distortion (THD)             |                 | 0.5 leading, 0.5 lagging   |                                   |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      |                 | 0.5 leading, 0.5 lagging   |                                   |
|                          | Reactive power compensation                   |                 | Four quadrant operation  |                                   |
| DC                       | DC Voltage Range (Full power)                 | 1500V           | 913V-1310V   | 1500V                             |
|                          | Maximum DC voltage                            |                 | < 3%   |                                   |
|                          | DC Voltage Ripple                             |                 | 2646   | 3969                              |
| EFFICIENCY & AUX. SUPPLY | Max. Standby Consumption                      |                 | < approx. 50W/per module   |                                   |
|                          | Efficiency (Max) (%)                          |                 | Up to 18 positive and 18 negative connections                        | 98.8%                             |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7       | 12 x 7 x 7   |                                   |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2 | 3.7 x 2.2 x 2.2  |                                   |
|                          | Weight (lbs)                                  | 10802.65        | 15432.36   |                                   |
| ENVIRONMENT              | Type of ventilation                           |                 | Forced air cooling   |                                   |
|                          | Degree of protection                          |                 | NEMA 3R / IP54 / (IP65 Optional)                                     |                                   |
|                          | Permissible Ambient Temperature               |                 | -35°C <sup>[4]</sup> to +60°C; -50°C / Active Power derating (<50°C) |                                   |
| CONTROL INTERFACE        | Interface                                     |                 | Graphic Display (inside cabinet) / Optional Freesun App display      |                                   |
|                          | Communication protocol                        |                 | Modbus TCP   |                                   |
|                          | Power Plant Controller                        |                 | Optional Third party SCADA systems supported                         |                                   |
|                          | Keyed ON/OFF switch                           |                 | Standard   |                                   |
|                          | Digital I/O                                   |                 | Optional <sup>[3]</sup>  |                                   |
|                          | Analog I/O                                    |                 | Optional <sup>[3]</sup>  |                                   |
|                          | Ground Fault Protection                       |                 | Insulation monitoring device   |                                   |
|                          | Humidity control                              |                 | Active Heating   |                                   |
|                          | General AC Protection & Discom.               |                 | Circuit Breaker  |                                   |
|                          | General DC Protection & Discom.               |                 | Fuses + Contactors   |                                   |
| CERTIFICATIONS           | Overvoltage Protection                        |                 | AC and DC protection (Type 2)  |                                   |
|                          | Safety  |                 | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |                                   |
|                          | Utility interconnect                          |                 | UL1741SA / IEEE1547.1  |                                   |

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 630V

| NUMBER OF MODULES        | FRAME 1                                       |                 | FRAME 2  |                                   |
|--------------------------|---|-----------------|--|-----------------------------------|
|                          | 4   | 6               | 6  | 6                                 |
| REFERENCES               | FP2100K                                       | FP3100K         | FP3100K  | FP3100K                           |
| AC                       | AC Output Power (KVA/KW) @50°C <sup>[1]</sup> | 2100            | 2100   | 3150                              |
|                          | AC Output Power (KVA/KW) @25°C <sup>[1]</sup> | 2310            | 2310   | 3465                              |
|                          | Max. AC Output Current (A) @50°C              | 1925            | 1925   | 2887                              |
|                          | Max. AC Output Current (A) @25°C              | 2117            | 2117   | 3175                              |
|                          | Overload capacity <sup>[2]</sup>              | 11.0%           | 11.0%  | (depending on preload conditions) |
|                          | Operating Grid Voltage (VAC)                  |                 | 630V ±10% <sup>[4]</sup>   | 50/60 Hz                          |
|                          | Operating Grid Frequency (Hz)                 |                 | 50/60 Hz   | < 3% per IEEE519                  |
|                          | Current Harmonic Distortion (THD)             |                 | 0.5 leading, 0.5 lagging   |                                   |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      |                 | 0.5 leading, 0.5 lagging   |                                   |
|                          | Reactive power compensation                   |                 | Four quadrant operation  |                                   |
| DC                       | DC Voltage Range (Full power)                 | 1500V           | 991V-1310V   | 1500V                             |
|                          | Maximum DC voltage                            |                 | < 3%   |                                   |
|                          | DC Voltage Ripple                             |                 | 2646   | 3969                              |
| EFFICIENCY & AUX. SUPPLY | Max. Standby Consumption                      |                 | < approx. 50W/per module   |                                   |
|                          | Efficiency (Max) (%)                          |                 | Up to 18 positive and 18 negative connections                        | 98.8%                             |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7       | 12 x 7 x 7   |                                   |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2 | 3.7 x 2.2 x 2.2  |                                   |
|                          | Weight (lbs)                                  | 10802.65        | 15432.36   |                                   |
| ENVIRONMENT              | Type of ventilation                           |                 | Forced air cooling   |                                   |
|                          | Degree of protection                          |                 | NEMA 3R / IP54 / (IP65 Optional)                                     |                                   |
|                          | Permissible Ambient Temperature               |                 | -35°C <sup>[4]</sup> to +60°C; -50°C / Active Power derating (<50°C) |                                   |
| CONTROL INTERFACE        | Interface                                     |                 | Graphic Display (inside cabinet) / Optional Freesun App display      |                                   |
|                          | Communication protocol                        |                 | Modbus TCP   |                                   |
|                          | Power Plant Controller                        |                 | Optional Third party SCADA systems supported                         |                                   |
|                          | Keyed ON/OFF switch                           |                 | Standard   |                                   |
|                          | Digital I/O                                   |                 | Optional <sup>[3]</sup>  |                                   |
|                          | Analog I/O                                    |                 | Optional <sup>[3]</sup>  |                                   |
|                          | Ground Fault Protection                       |                 | Insulation monitoring device   |                                   |
|                          | Humidity control                              |                 | Active Heating   |                                   |
|                          | General AC Protection & Discom.               |                 | Circuit Breaker  |                                   |
|                          | General DC Protection & Discom.               |                 | Fuses + Contactors   |                                   |
| CERTIFICATIONS           | Overvoltage Protection                        |                 | AC and DC protection (Type 2)  |                                   |
|                          | Safety  |                 | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |                                   |
|                          | Utility interconnect                          |                 | UL1741SA / IEEE1547.1  |                                   |

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(KW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(KW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 615V

| NUMBER OF MODULES        | FRAME 1                                       |  | FRAME 2          |         |
|--------------------------|---|--|------------------|---------|
|                          | 4   | 6  | 4                | 6       |
| REFERENCES               | FP2050K                                       | FP3075K  | FP2000K          | FP3075K |
| AC                       | AC Output Power (KVA/KW) @50°C <sup>[1]</sup> | 2050   | 3075             | 3075    |
|                          | AC Output Power (KVA/KW) @25°C <sup>[1]</sup> | 2255   | 3380             | 3380    |
|                          | Max. AC Output Current (A) @50°C              | 1925   | 2887             | 2887    |
|                          | Max. AC Output Current (A) @25°C              | 2117   | 3175             | 3175    |
|                          | Overload capacity <sup>[2]</sup>              | 110% (depending on preload conditions)                               |                  |         |
|                          | Operating Grid Voltage (VAC)                  | 615V ±10% <sup>[4]</sup>   | 50/60 Hz         |         |
|                          | Operating Grid Frequency (Hz)                 | 50/60 Hz   | < 3% per IEEE519 |         |
|                          | Current Harmonic Distortion (THD)             | 0.5 leading, 0.5 lagging   |                  |         |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      | 0.5 leading, 0.5 lagging   |                  |         |
| DC                       | Reactive power compensation                   | Four quadrant operation  |                  |         |
|                          | DC Voltage Range (Full power)                 | 820V-1310V   |                  |         |
|                          | Maximum DC voltage                            | 1500V  |                  |         |
|                          | DC Voltage Ripple                             | < 3%   |                  |         |
|                          | Max. DC continuous current (A)                | 2646   | 3969             |         |
|                          | Battery Technology                            | All type of batteries (BMS required)                                 |                  |         |
|                          | Battery Connections                           | Up to 18 positive and 18 negative connections                        |                  |         |
|                          | Efficiency (Max) (%)                          | 98.8%  |                  |         |
| EFFICIENCY & AUX. SUPPLY | Max. Standby Consumption                      | < approx. 50W/per module   |                  |         |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7  | 12 x 7 x 7       |         |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2  | 3.7 x 2.2 x 2.2  |         |
|                          | Weight (lbs)                                  | 1080/2.65  | 1543/2.36        |         |
|                          | Weight (kg)                                   | 4900   | 7000             |         |
| ENVIRONMENT              | Type of ventilation                           | Forced air cooling   |                  |         |
|                          | Degree of protection                          | NEMA 3R / IP54 / (IP65 Optional)                                     |                  |         |
|                          | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C, -50°C / Active Power derating (<50°C) |                  |         |
|                          | Relative Humidity                             | 4% to 100% Condensing  |                  |         |
|                          | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                           |                  |         |
|                          | Noise level <sup>[5]</sup>                    | < 79 dBA   |                  |         |
| CONTROL INTERFACE        | Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display      |                  |         |
|                          | Communication protocol                        | Modbus TCP   |                  |         |
|                          | Power Plant Controller                        | Optional. Third party SCADA systems supported                        |                  |         |
|                          | Keypad ON/OFF switch                          | Standard   |                  |         |
|                          | Digital I/O                                   | Optional <sup>[6]</sup>  |                  |         |
|                          | Analog I/O                                    | Optional <sup>[6]</sup>  |                  |         |
| PROTECTIONS              | Ground Fault Protection                       | Insulation monitoring device   |                  |         |
|                          | Humidity control                              | Active Heating   |                  |         |
|                          | General AC Protection & Discom.               | Circuit Breaker  |                  |         |
|                          | General DC Protection & Discom.               | Fuses + Contactors   |                  |         |
| CERTIFICATIONS           | Overvoltage Protection                        | AC and DC protection (Type 2)  |                  |         |
|                          | Safety  | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |                  |         |
|                          | Utility interconnect                          | UL1741SA / IEEE1547.1  |                  |         |

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(KW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 600V

| NUMBER OF MODULES        | FRAME 1                                       |  | FRAME 2          |         |
|--------------------------|---|--|------------------|---------|
|                          | 4   | 6  | 4                | 6       |
| REFERENCES               | FP2000K                                       | FP3000K  | FP2000K          | FP3000K |
| AC                       | AC Output Power (KVA/KW) @50°C <sup>[1]</sup> | 2000   | 3000             | 3000    |
|                          | AC Output Power (KVA/KW) @25°C <sup>[1]</sup> | 2200   | 3300             | 3300    |
|                          | Max. AC Output Current (A) @50°C              | 1925   | 2887             | 2887    |
|                          | Max. AC Output Current (A) @25°C              | 2117   | 3175             | 3175    |
|                          | Overload capacity <sup>[2]</sup>              | 110% (depending on preload conditions)                               |                  |         |
|                          | Operating Grid Voltage (VAC)                  | 600V ±10% <sup>[4]</sup>   | 50/60 Hz         |         |
|                          | Operating Grid Frequency (Hz)                 | 50/60 Hz   | < 3% per IEEE519 |         |
|                          | Current Harmonic Distortion (THD)             | 0.5 leading, 0.5 lagging   |                  |         |
|                          | Power Factor (cosine phi) <sup>[5]</sup>      | 0.5 leading, 0.5 lagging   |                  |         |
| DC                       | Reactive power compensation                   | Four quadrant operation  |                  |         |
|                          | DC Voltage Range (Full power)                 | 849V-1310V   |                  |         |
|                          | Maximum DC voltage                            | 1500V  |                  |         |
|                          | DC Voltage Ripple                             | < 3%   |                  |         |
|                          | Max. DC continuous current (A)                | 2646   | 3969             |         |
|                          | Battery Technology                            | All type of batteries (BMS required)                                 |                  |         |
|                          | Battery Connections                           | Up to 18 positive and 18 negative connections                        |                  |         |
|                          | Efficiency (Max) (%)                          | 98.8%  |                  |         |
| EFFICIENCY & AUX. SUPPLY | Max. Standby Consumption                      | < approx. 50W/per module   |                  |         |
| CABINET                  | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7  | 12 x 7 x 7       |         |
|                          | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2  | 3.7 x 2.2 x 2.2  |         |
|                          | Weight (lbs)                                  | 1080/2.65  | 1543/2.36        |         |
|                          | Weight (kg)                                   | 4900   | 7000             |         |
| ENVIRONMENT              | Type of ventilation                           | Forced air cooling   |                  |         |
|                          | Degree of protection                          | NEMA 3R / IP54 / (IP65 Optional)                                     |                  |         |
|                          | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C, -50°C / Active Power derating (<50°C) |                  |         |
|                          | Relative Humidity                             | 4% to 100% Condensing  |                  |         |
|                          | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                           |                  |         |
|                          | Noise level <sup>[5]</sup>                    | < 79 dBA   |                  |         |
| CONTROL INTERFACE        | Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display      |                  |         |
|                          | Communication protocol                        | Modbus TCP   |                  |         |
|                          | Power Plant Controller                        | Optional. Third party SCADA systems supported                        |                  |         |
|                          | Keypad ON/OFF switch                          | Standard   |                  |         |
|                          | Digital I/O                                   | Optional <sup>[6]</sup>  |                  |         |
|                          | Analog I/O                                    | Optional <sup>[6]</sup>  |                  |         |
| PROTECTIONS              | Ground Fault Protection                       | Insulation monitoring device   |                  |         |
|                          | Humidity control                              | Active Heating   |                  |         |
|                          | General AC Protection & Discom.               | Circuit Breaker  |                  |         |
|                          | General DC Protection & Discom.               | Fuses + Contactors   |                  |         |
| CERTIFICATIONS           | Overvoltage Protection                        | AC and DC protection (Type 2)  |                  |         |
|                          | Safety  | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |                  |         |
|                          | Utility interconnect                          | UL1741SA / IEEE1547.1  |                  |         |

[1] Values at 1,00Vdc, nom and cos φ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(KW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 530V

| NUMBER OF MODULES               | FRAME 1  |  | FRAME 2          |         |
|---------------------------------|--|--|------------------|---------|
|                                 | 4  | 6  | 4                | 6       |
| REFERENCES                      | FP1165K  | FP2650K  | FP1165K          | FP2650K |
| AC                              | AC Output Power (KVA/kW) @50°C <sup>[1]</sup>                        | 1765   | 2650             | 2650    |
|                                 | AC Output Power (KVA/kW) @25°C <sup>[1]</sup>                        | 1940   | 2915             | 2915    |
|                                 | Max. AC Output Current (A) @50°C                                     | 1925   | 2887             | 2887    |
|                                 | Max. AC Output Current (A) @25°C                                     | 2117   | 3175             | 3175    |
|                                 | Overload capacity <sup>[2]</sup>                                     | 110% (depending on preload conditions)                         |                  |         |
|                                 | Operating Grid Voltage (VAC)   | 530V ±10% <sup>[4]</sup>                                       | 50/60 Hz         |         |
|                                 | Operating Grid Frequency (Hz)  | 50/60 Hz   | < 3% per IEEE519 |         |
|                                 | Current Harmonic Distortion (THD)                                    | 0.5 leading, 0.5 lagging                                       | < 3% per IEEE519 |         |
|                                 | Power Factor (cosine phi) <sup>[5]</sup>                             | 0.5 leading, 0.5 lagging                                       | < 3% per IEEE519 |         |
|                                 | Reactive power compensation  | Four quadrant operation  |                  |         |
| DC                              | DC Voltage Range (Full power)  | 750V-1310V   | 750V-1310V       |         |
|                                 | Maximum DC voltage   | 1500V  | 1500V            |         |
| DC Voltage Ripple               |  | < 3%   |                  |         |
| Max. DC continuous current (A)  | 2646   | 3969   |                  |         |
| Battery Technology              | All type of batteries (BMS required)                                 |  |                  |         |
| Battery Connections             | Up to 18 positive and 18 negative connections                        |  |                  |         |
| Efficiency (Max) (η)            | 98.8%  |  |                  |         |
| EFFICIENCY & AUX. SUPPLY        | Max. Standby Consumption   | < approx. 50W/per module                                       |                  |         |
| CABINET                         | Dimensions (WxDxH) (ft)  | 9 x 7 x 7  | 12 x 7 x 7       |         |
|                                 | Dimensions (WxDxH) (m)   | 2.7 x 2.2 x 2.2  | 3.7 x 2.2 x 2.2  |         |
|                                 | Weight (lbs)   | 1080/2.65  | 1543/2.36        |         |
| Weight (kg)                     | 4900   | 7000   |                  |         |
| ENVIRONMENT                     | Type of ventilation  | Forced air cooling   |                  |         |
| Degree of protection            | NEMA 3R / IP54 / (IP65 Optional)                                     |  |                  |         |
| Permissible Ambient Temperature | -35°C <sup>[4]</sup> to +60°C, -50°C / Active Power derating (<50°C) |  |                  |         |
| Relative Humidity               | 4% to 100% Condensing  |  |                  |         |
| Max. Altitude (above sea level) | 2000m / >2000m power derating (Max. 4000m)                           |  |                  |         |
| Noise level <sup>[5]</sup>      | < 79 dBA   |  |                  |         |
| CONTROL INTERFACE               | Interface  | Graphic Display (inside cabinet) / Optional Fresun App display |                  |         |
| Communication protocol          | Modbus TCP   |  |                  |         |
| Power Plant Controller          | Optional Third party SCADA systems supported                         |  |                  |         |
| Keypad ON/OFF switch            | Standard   |  |                  |         |
| Digital I/O                     | Optional <sup>[6]</sup>  |  |                  |         |
| Analog I/O                      | Optional <sup>[6]</sup>  |  |                  |         |
| PROTECTIONS                     | Ground Fault Protection  | Insulation monitoring device                                   |                  |         |
| Humidity control                | Active Heating   |  |                  |         |
| General AC Protection & Discom. | Circuit Breaker  |  |                  |         |
| General DC Protection & Discom. | Fuses + Contactors   |  |                  |         |
| Overvoltage Protection          | AC and DC protection (Type 2)  |  |                  |         |
| Safety                          | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |  |                  |         |
| Utility interconnect            | UL1741SA / IEEE1547.1  |  |                  |         |

[1] Values at 1,00Vdc/room and cosφ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(kW))

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 500V

| NUMBER OF MODULES               | FRAME 1  |  | FRAME 2          |         |
|---------------------------------|--|--|------------------|---------|
|                                 | 4  | 6  | 4                | 6       |
| REFERENCES                      | FP1165K  | FP2500K  | FP1165K          | FP2500K |
| AC                              | AC Output Power (KVA/kW) @50°C <sup>[1]</sup>                        | 1665   | 2500             | 2500    |
|                                 | AC Output Power (KVA/kW) @25°C <sup>[1]</sup>                        | 1830   | 2750             | 2750    |
|                                 | Max. AC Output Current (A) @50°C                                     | 1925   | 2887             | 2887    |
|                                 | Max. AC Output Current (A) @25°C                                     | 2117   | 3175             | 3175    |
|                                 | Overload capacity <sup>[2]</sup>                                     | 110% (depending on preload conditions)                         |                  |         |
|                                 | Operating Grid Voltage (VAC)   | 500V ±10% <sup>[4]</sup>                                       | 50/60 Hz         |         |
|                                 | Operating Grid Frequency (Hz)  | 50/60 Hz   | < 3% per IEEE519 |         |
|                                 | Current Harmonic Distortion (THD)                                    | 0.5 leading, 0.5 lagging                                       | < 3% per IEEE519 |         |
|                                 | Power Factor (cosine phi) <sup>[5]</sup>                             | 0.5 leading, 0.5 lagging                                       | < 3% per IEEE519 |         |
|                                 | Reactive power compensation  | Four quadrant operation  |                  |         |
| DC                              | DC Voltage Range (Full power)  | 709V-1310V   | 709V-1310V       |         |
|                                 | Maximum DC voltage   | 1300V  | 1300V            |         |
| DC Voltage Ripple               |  | < 3%   |                  |         |
| Max. DC continuous current (A)  | 2646   | 3969   |                  |         |
| Battery Technology              | All type of batteries (BMS required)                                 |  |                  |         |
| Battery Connections             | Up to 18 positive and 18 negative connections                        |  |                  |         |
| Efficiency (Max) (η)            | 98.8%  |  |                  |         |
| EFFICIENCY & AUX. SUPPLY        | Max. Standby Consumption   | < approx. 50W/per module                                       |                  |         |
| CABINET                         | Dimensions (WxDxH) (ft)  | 9 x 7 x 7  | 12 x 7 x 7       |         |
|                                 | Dimensions (WxDxH) (m)   | 2.7 x 2.2 x 2.2  | 3.7 x 2.2 x 2.2  |         |
|                                 | Weight (lbs)   | 1080/2.65  | 1543/2.36        |         |
| Weight (kg)                     | 4900   | 7000   |                  |         |
| ENVIRONMENT                     | Type of ventilation  | Forced air cooling   |                  |         |
| Degree of protection            | NEMA 3R / IP54 / (IP65 Optional)                                     |  |                  |         |
| Permissible Ambient Temperature | -35°C <sup>[4]</sup> to +60°C, -50°C / Active Power derating (<50°C) |  |                  |         |
| Relative Humidity               | 4% to 100% Condensing  |  |                  |         |
| Max. Altitude (above sea level) | 2000m / >2000m power derating (Max. 4000m)                           |  |                  |         |
| Noise level <sup>[5]</sup>      | < 79 dBA   |  |                  |         |
| CONTROL INTERFACE               | Interface  | Graphic Display (inside cabinet) / Optional Fresun App display |                  |         |
| Communication protocol          | Modbus TCP   |  |                  |         |
| Power Plant Controller          | Optional Third party SCADA systems supported                         |  |                  |         |
| Keypad ON/OFF switch            | Standard   |  |                  |         |
| Digital I/O                     | Optional <sup>[6]</sup>  |  |                  |         |
| Analog I/O                      | Optional <sup>[6]</sup>  |  |                  |         |
| PROTECTIONS                     | Ground Fault Protection  | Insulation monitoring device                                   |                  |         |
| Humidity control                | Active Heating   |  |                  |         |
| General AC Protection & Discom. | Circuit Breaker  |  |                  |         |
| General DC Protection & Discom. | Fuses + Contactors   |  |                  |         |
| Overvoltage Protection          | AC and DC protection (Type 2)  |  |                  |         |
| Safety                          | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-1, IEC62109-2      |  |                  |         |
| Utility interconnect            | UL1741SA / IEEE1547.1  |  |                  |         |

[1] Values at 1,00Vdc/room and cosφ= 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-I(S(KVA))-P(kW))

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCSK 480V

| NUMBER OF MODULES              | FRAME 1                                       |  | FRAME 2         |                 |
|--------------------------------|---|--|-----------------|-----------------|
|                                | 4   | 6  | 6               | 6               |
| REFERENCES                     | FP1600K                                       |  | FP2400K         |                 |
| AC                             | AC Output Power (KVA/kW) @50°C <sup>[1]</sup> | 1600   | 2400            | 2400            |
|                                | AC Output Power (KVA/kW) @25°C <sup>[1]</sup> | 1760   | 2640            | 2640            |
|                                | Max. AC Output Current (A) @50°C              | 1925   | 2887            | 2887            |
|                                | Max. AC Output Current (A) @25°C              | 2117   | 3175            | 3175            |
|                                | Overload capacity <sup>[2]</sup>              | 110% (depending on preload conditions)                               |                 |                 |
|                                | Operating Grid Voltage (VAC)                  | 480V ±10% <sup>[4]</sup>   |                 |                 |
|                                | Operating Grid Frequency (Hz)                 | 50/60 Hz   |                 |                 |
|                                | Current Harmonic Distortion (THD)             | < 3% per IEC61819  |                 |                 |
|                                | Power Factor (cosine phi) <sup>[5]</sup>      | 0.5 leading, 1.5 lagging   |                 |                 |
|                                | Reactive power compensation                   | Four quadrant operation  |                 |                 |
| DC                             | DC Voltage Range (full power)                 | 6.99V-1310V  |                 |                 |
|                                | Maximum DC voltage                            | 1500V  |                 |                 |
|                                | DC Voltage Ripple                             | < 3%   |                 |                 |
| Max. DC continuous current (A) | 2646  |  |                 |                 |
| Battery Technology             | All type of batteries (BMS required)          |  |                 |                 |
| Battery Connections            | Up to 18 positive and 18 negative connections |  |                 |                 |
| Efficiency (Max) (%)           | 98.8%   |  |                 |                 |
| EFFICIENCY & AUX. SUPPLY       | Max. Standby Consumption                      | < approx. 50W/per module   |                 |                 |
|                                | Dimensions (WxDxH) (ft)                       | 9 x 7 x 7  | 12 x 7 x 7      | 12 x 7 x 7      |
|                                | Dimensions (WxDxH) (m)                        | 2.7 x 2.2 x 2.2  | 3.7 x 2.2 x 2.2 | 3.7 x 2.2 x 2.2 |
| CABINET                        | Weight (lbs)                                  | 10802.65   | 15432.36        | 15432.36        |
|                                | Weight (kg)                                   | 4900   | 7000            | 7000            |
|                                | Type of ventilation                           | Forced air cooling   |                 |                 |
| ENVIRONMENT                    | Degree of protection                          | NEMA 3R / IP54 / (IP55 Optional)                                     |                 |                 |
|                                | Permissible Ambient Temperature               | -35°C <sup>[6]</sup> to +60°C, -50°C / Active Power derating (<50°C) |                 |                 |
|                                | Relative Humidity                             | 4% to 100%, Condensing   |                 |                 |
|                                | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                           |                 |                 |
|                                | Noise level <sup>[3]</sup>                    | < 79 dBA   |                 |                 |
| CONTROL INTERFACE              | Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display      |                 |                 |
|                                | Communication protocol                        | Modbus TCP   |                 |                 |
|                                | Power Plant Controller                        | Optional, Third party SCADA systems supported                        |                 |                 |
|                                | Keypad ON/OFF switch                          | Standard   |                 |                 |
|                                | Digital I/O                                   | Optional <sup>[8]</sup>  |                 |                 |
| PROTECTIONS                    | Analog I/O                                    | Optional <sup>[8]</sup>  |                 |                 |
|                                | Ground Fault Protection                       | Insulation monitoring device   |                 |                 |
|                                | Humidity control                              | Active Heating   |                 |                 |
|                                | General AC Protection & Discom.               | Circuit Breaker  |                 |                 |
|                                | General DC Protection & Discom.               | Fuses + Contactors   |                 |                 |
| CERTIFICATIONS                 | Overvoltage Protection                        | AC and DC protection (Type 2)  |                 |                 |
|                                | Safety  | UL1741, CSA 22.2 No.107-1-01, UL62109-1, IEC62109-2                  |                 |                 |
|                                | Utility interconnect                          | UL1741SA / IEC61847.1  |                 |                 |

[1] Values at 1,00Vac/room and cosφ= 1

Consult Power Electronics for derating curves

[2] Consult P-Q charts available: Q(KVA)-S(KVA)-P(KW))

[3] Consult Power Electronics for other configurations

[4] Heating resistors kit option below 20°C.

[5] Readings taken 1 meter from the back of the unit.

## FREEMAQ PCS

UTILITY SCALE BATTERY INVERTER



POWER CONVERSION SYSTEM



AUTOMATIC REDUNDANT  
POWER MODULE SYSTEM



MODULAR DESIGN



1000V



4 QUADRANT



3 LEVEL TOPOLOGY

### PROVEN HARDWARE AND ROBUST OUTDOOR DESIGN FEATURED WITH THE LATEST CONTROL

The Freemaq PCS is a modular solution from 690kW to 3000kW with configurable DC and AC voltages making it compatible with all battery technology and manufacturers. Power Electronics is a proven partner in the solar and energy storage market. The Power Electronics Freemaq PCS offers proven hardware to meet storage and grid support challenges. The energy production industry is embracing renewable energy sources. However, high penetration creates power transmission instability challenges, thus Grid Operators require stringent dynamic and static grid support features for solar inverters and Power Conversion Systems (PCS).

The Freemaq PCS can perform grid support functions such as: Peak Shaving, Ramp Rate Control, Frequency Regulation, Load Leveling and Voltage Regulation, controlled by a Power Plant Controller or SCADA.

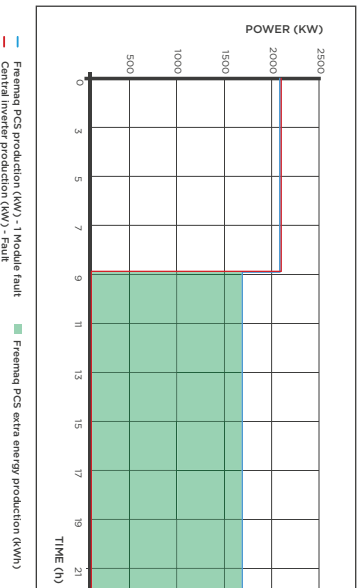
The Freemaq PCS stations are turn-key solutions ready for connection to the battery container and MV power distribution wiring. Units are designed for concrete pads, open skids or integrated into full container solutions.



## AUTOMATIC REDUNDANT POWER MODULE SYSTEM

Freemaq PCS is a modular central battery inverter based on an Automatic Redundant Power Module (up to 400kVA per stage). If there is a fault in one power module, it is taken offline and its output power is distributed evenly among the remaining functioning modules. All power modules work in parallel controlled by a dual redundant main control.

As the main governor of the system it is responsible for the battery charge / discharge, synchronization sequence and overall protection. The automatic redundant capability based on our industrial systems is able to shift the main control in the event of a fault, restoring the backup control and restarting the station to guarantee high availability.



## VAR SUPPORT

The Freemaq PCS inverter can provide reactive power at any time in order to stabilize the grid conditions. The inverter can respond to an external dynamic signal, a Power Plant Controller command or a pre-set reactive power level (kVAR).

## ACTIVE HEATING

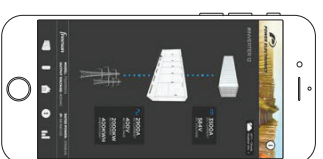
In cold conditions, and when the unit is not working, the inverter can import a small amount of power from the grid to keep the inverter internal ambient temperature above -20°C, without using external resistors.

This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters' availability and reducing maintenance. **Patented**

## EASY TO MONITOR

The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors. The app user friendly interface allows quick and easy access to critical information (energy registers, production and events).

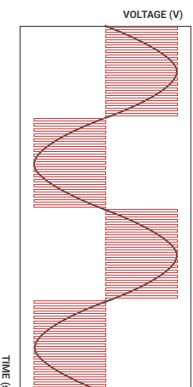
Available for Apple and Android



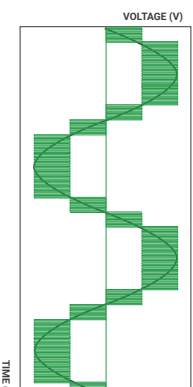
## MULTILEVEL TOPOLOGY

The multilevel IGBT topology makes the difference when the DC voltage is above 1000V, being the most efficient way to manage high DC link voltages. Based in our long IGBT experience components used in our Solar and Industrial division,

the Freemaq PCS takes profit of the three level IGBT topology reducing the power stage losses, increasing the efficiency and offering a very low total harmonic distortion.



TWO-LEVEL INVERTER



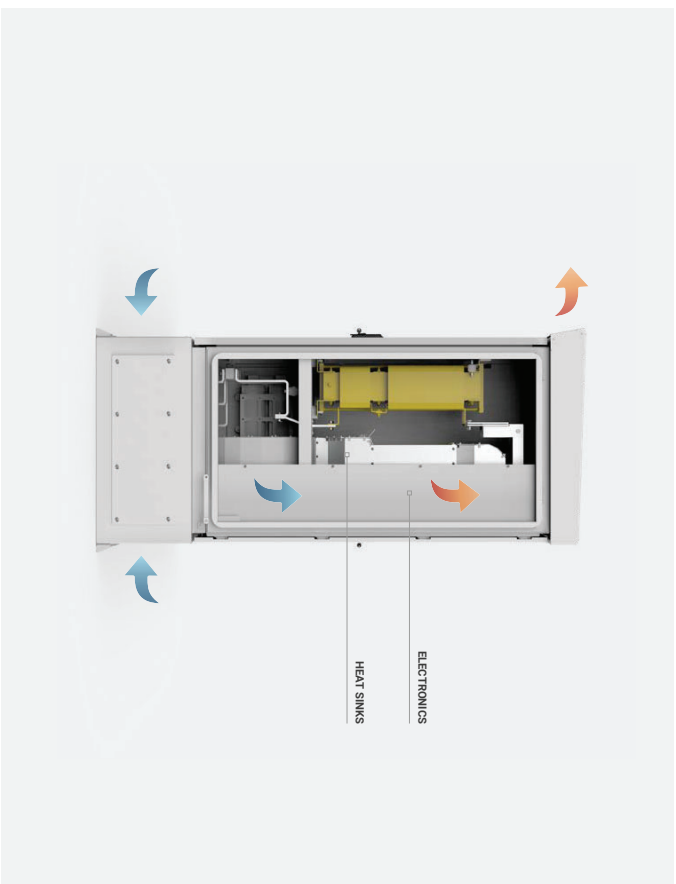
THREE-LEVEL INVERTER

## REVOLUTIONARY COOLING SYSTEM

The Power Electronics Freemaq PCS series includes the innovative and sophisticated iCOOL V performance that allows Freemaq PCS to work up to 50°C at nominal power. The cooling system iCOOL V smartly cools the inverter, regulating the cooling system capacity depending on the data from the temperature sensors.

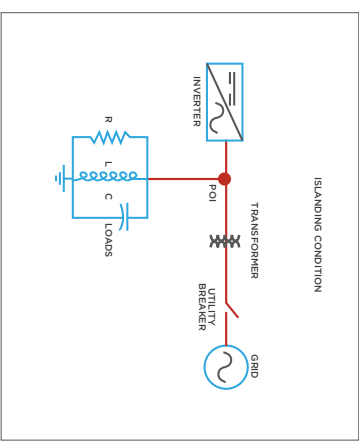
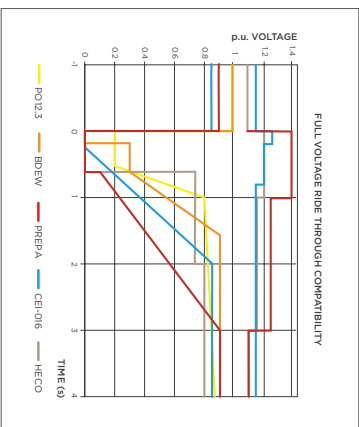
Freemaq PCS modules are divided into two main areas: clean area (electronics) and hot area (heat sink). The electronics are totally sealed and use a temperature control low flow cooling system that reduces filters clogging and maintenance intervals. The hot area integrates a speed controlled fan for each module, simplifying the cooling system and reducing the maintenance tasks.

Furthermore, due to the modular topology, the iCOOL V reduces the Standby consumption at low capacity to the maximum, boosting the cooling capacity for the installations situated up to 4000 meters above sea level. (patent pending)



## DYNAMIC GRID SUPPORT

Freemaq PCS firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment...), and is compatible with all the specific requirements of the utilities.



### LVRT or ZVRT (Low Voltage Ride Through)

Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.

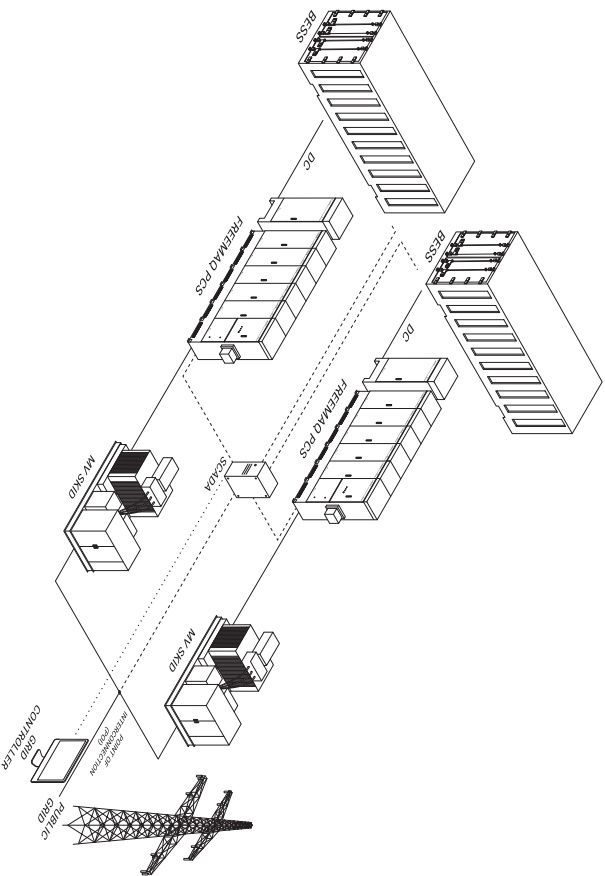
### Anti-islanding

This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

**BATTERY ENERGY STORAGE SYSTEM**

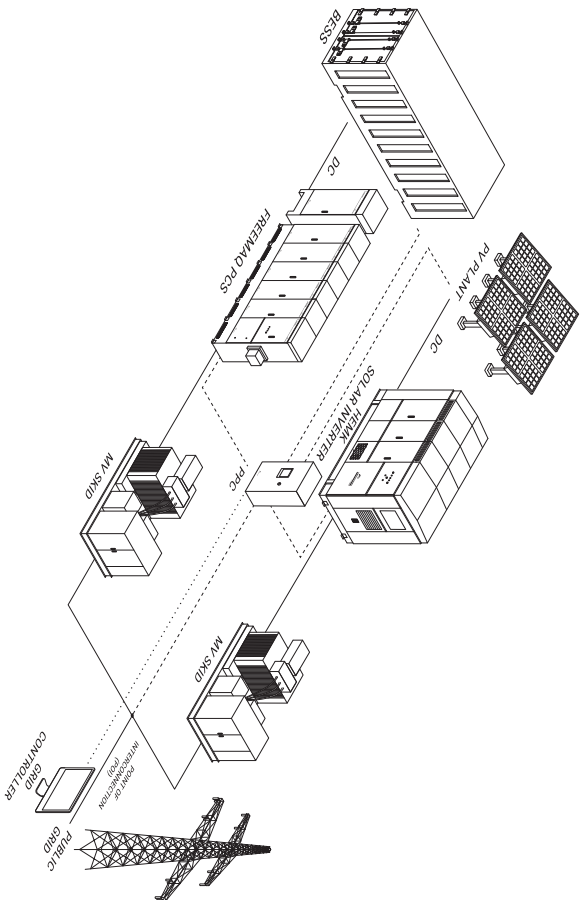
A BESS comprises a battery container connected to a Freemaq PCS (Power Conversion System) that follows the instruction of the main governor of the plant, the PPC (Power Plant Controller) or SCADA.

EXAMPLE 1



— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

EXAMPLE 2



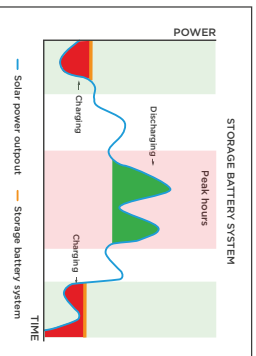
— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

## ENERGY STORAGE APPLICATIONS



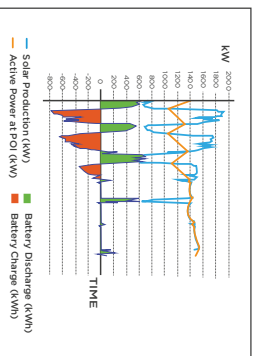
### LOAD LEVELING

Freemaq PCS series are able to store energy during periods of low demand from the grid, in order to later supply this energy when there is a higher demand. This has the benefit of selling the energy at a higher market price during peak periods. It also allows grid operators to supply electricity with a higher renewable origin. Since PV generation may not be at the same time as peak demand, this facilitates the flexibility and integration of renewable generation into the grid.



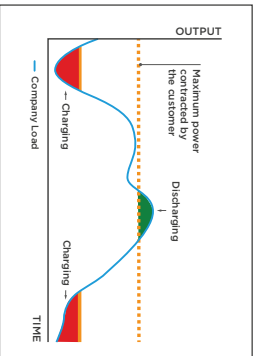
### RENEWABLE INTEGRATION

The Freemaq PCS series attenuates the intermittent nature of renewable energy sources, to provide a smoother power output. The Freemaq PCS controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array. The system monitors the PV inverter output to inject or consume power accordingly to ensure the output remains within the ramp requirements.



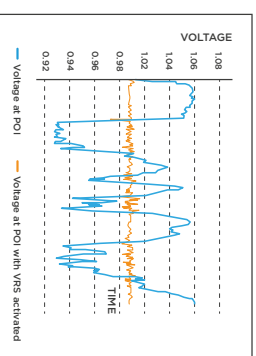
### PEAK POWER SHAVING

By delivering stored energy to the grid during periods of high demand, it reduces the burden on the distribution network and increases significantly its efficiency. Energy is stored instead of injected into the grid during periods of low demand, which as a result increases the load on the grid. However, during peak periods this stored energy is then injected into the grid, which reduces the demand at this time. The result is a more flattened demand curve which means the grid can avoid switching on more expensive and polluting generators.



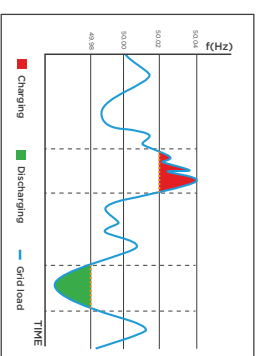
### GRID SUPPORT

Freemaq PCS series helps the integration of renewable sources, by helping to maintain grid stability and power quality. It can help support the grid voltage by generating capacitive or inductive current. Other features include Voltage Control, Reactive Power Control and Fault Ride Through Support.



### FREQUENCY REGULATION SYSTEM

Freemaq PCS provides ability to regulate grid frequency in both directions. When there is a grid over-frequency (generation>demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation<demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.



## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 690V

| NUMBER OF MODULES                               | FRAME 3           | FRAME 4           | FRAME 5   | FRAME 6           | FRAME 7           |
|---|-------------------|-------------------|---|-------------------|-------------------|
|   | 3                 | 4                 | 5   | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP1290C           | FP1720C           | FP2150C   | FP2580C           | FP3000C           |
| <b>AC</b>                                       |                   |                   |   |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 1290              | 1720              | 2150  | 2580              | 3000              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1530              | 2040              | 2550  | 3060              | 3500              |
| Max. AC Output Current (A) @50°C                | 1080              | 1440              | 1800  | 2160              | 2510              |
| Max. AC Output Current (A) @25°C                | 1280              | 1705              | 2135  | 2560              | 2930              |
| Overload capacity <sup>[2]</sup>                |                   |                   | 120% (depending on preload conditions) <sup>[3]</sup>   |                   |                   |
| Operating Grid Voltage (VAC)                    |                   |                   | 690V ±10% <sup>[4]</sup>  |                   |                   |
| Operating Grid Frequency (Hz)                   |                   |                   | 50/60 Hz  |                   |                   |
| Current Harmonic Distortion (THD)               |                   |                   | < 3% per IEC619   |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        |                   |                   | 0.0 lagging ... 0.0 leading   |                   |                   |
| Reactive power compensation                     |                   |                   | Four quadrant operation   |                   |                   |
| DC Voltage Range (full power)                   |                   |                   | 976V-1310V  |                   |                   |
| Maximum DC voltage                              |                   |                   | 1500V   |                   |                   |
| DC Voltage Ripple                               |                   |                   | < 3%  |                   |                   |
| Max. DC continuous current (A)                  | 1600              | 2135              | 2665  | 3200              | 3660              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320              | 3100              | 3880  | 4650              | 5450              |
| Battery Technology                              |                   |                   | all type of batteries (BMS required)  |                   |                   |
| Number of separate DC inputs                    |                   |                   | 1 DC input per inverter <sup>[7]</sup>  |                   |                   |
| Battery Connections                             |                   |                   | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |                   |                   |   |                   |                   |
| Efficiency (Max) (η)                            |                   |                   | < approx. 50W/module  |                   |                   |
| Max. Standby Consumption (VA) (W)               | 2400              | 3200              | 4000  | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5" | 147.6x327.2x86.5" | 175.7x327.2x86.5"   | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x945x2198     | 3751x945x2198     | 4464x945x2198   | 5177x945x2198     | 5890x945x2198     |
| Weight (lbs)                                    | 5809              | 7253              | 8697  | 10141             | 11585             |
| Weight (kg)                                     | 2635              | 3290              | 3945  | 4600              | 5255              |
| Air Flow  |                   |                   | Bottom intake. Exhaust top rear vent  |                   |                   |
| Type of ventilation                             |                   |                   | Forced air cooling  |                   |                   |
| Degree of protection                            |                   |                   | NEMA 3R / IP54  |                   |                   |
| Permissible Ambient Temperature                 |                   |                   | -35°C <sup>[8]</sup> to +60°C / +50°C / Active Power derating (-5/50°C)                                 |                   |                   |
| Relative Humidity                               |                   |                   | 4% to 100% Condensing   |                   |                   |
| Max. Altitude (above sea level)                 |                   |                   | 2000m / >2000m power derating (Max. 4000m)  |                   |                   |
| Noise level <sup>[9]</sup>                      |                   |                   | < 79 dBA  |                   |                   |
| <b>CONTROL INTERFACE</b>                        |                   |                   |   |                   |                   |
| Interface                                       |                   |                   | Graphic Display (inside cabinet) / Optional Freesun App display   |                   |                   |
| Communication protocol                          |                   |                   | Modbus TCP  |                   |                   |
| Power Plant Controller                          |                   |                   | Optional. Third party SCADA systems supported   |                   |                   |
| Keyed ON/OFF switch                             |                   |                   | Standard  |                   |                   |
| Digital I/O                                     |                   |                   | Optional <sup>[1]</sup>   |                   |                   |
| Analog I/O                                      |                   |                   | Optional <sup>[1]</sup>   |                   |                   |
| Ground Fault Protection                         |                   |                   | Insulation monitoring device  |                   |                   |
| Humidity control                                |                   |                   | Active Heating  |                   |                   |
| General AC Protection & Disconn.                |                   |                   | Circuit Breaker   |                   |                   |
| General DC Protection & Disconn.                |                   |                   | External Disconnecting Unit Cabinet   |                   |                   |
| Overvoltage Protection                          |                   |                   | AC and DC protection (Type 2)   |                   |                   |
| <b>CERTIFICATIONS</b>                           |                   |                   |   |                   |                   |
| Safety  |                   |                   | UL 1741, CSA 22.2 No.1071-1.01, UL62109-1, IEC62109-1, IEC62109-2                                       |                   |                   |
| Utility interconnect                            |                   |                   | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                   |                   |

[1] Values at 1,00Vdc, nom and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 645V

| NUMBER OF MODULES                               | FRAME 3           | FRAME 4           | FRAME 5   | FRAME 6           | FRAME 7           |
|---|-------------------|-------------------|---|-------------------|-------------------|
|   | 3                 | 4                 | 5   | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP1200C           | FP1600C           | FP2000C   | FP2400C           | FP2800C           |
| <b>AC</b>                                       |                   |                   |   |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 1200              | 1600              | 2000  | 2400              | 2800              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1430              | 2040              | 2550  | 3060              | 3500              |
| Max. AC Output Current (A) @50°C                | 1075              | 1430              | 1790  | 2150              | 2505              |
| Max. AC Output Current (A) @25°C                | 1280              | 1710              | 2140  | 2560              | 2995              |
| Overload capacity <sup>[2]</sup>                |                   |                   | 120% (depending on preload conditions) <sup>[3]</sup>   |                   |                   |
| Operating Grid Voltage (VAC)                    |                   |                   | 645V ±10% <sup>[4]</sup>  |                   |                   |
| Operating Grid Frequency (Hz)                   |                   |                   | 50/60 Hz  |                   |                   |
| Current Harmonic Distortion (THD)               |                   |                   | < 3% per IEC619   |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        |                   |                   | 0.0 lagging ... 0.0 leading   |                   |                   |
| Reactive power compensation                     |                   |                   | Four quadrant operation   |                   |                   |
| DC Voltage Range (full power)                   |                   |                   | 913V-1310V  |                   |                   |
| Maximum DC voltage                              |                   |                   | 1500V   |                   |                   |
| DC Voltage Ripple                               |                   |                   | < 3%  |                   |                   |
| Max. DC continuous current (A)                  | 1600              | 2135              | 2665  | 3200              | 3660              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320              | 3100              | 3880  | 4650              | 5450              |
| Battery Technology                              |                   |                   | all type of batteries (BMS required)  |                   |                   |
| Number of separate DC inputs                    |                   |                   | 1 DC input per inverter <sup>[7]</sup>  |                   |                   |
| Battery Connections                             |                   |                   | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |                   |                   |   |                   |                   |
| Efficiency (Max) (η)                            |                   |                   | < approx. 50W/module  |                   |                   |
| Max. Standby Consumption (VA) (W)               | 2400              | 3200              | 4000  | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5" | 147.6x327.2x86.5" | 175.7x327.2x86.5"   | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x945x2198     | 3751x945x2198     | 4464x945x2198   | 5177x945x2198     | 5890x945x2198     |
| Weight (lbs)                                    | 5809              | 7253              | 8697  | 10141             | 11585             |
| Weight (kg)                                     | 2635              | 3290              | 3945  | 4600              | 5255              |
| Air Flow  |                   |                   | Bottom intake. Exhaust top rear vent  |                   |                   |
| Type of ventilation                             |                   |                   | Forced air cooling  |                   |                   |
| Degree of protection                            |                   |                   | NEMA 3R / IP54  |                   |                   |
| Permissible Ambient Temperature                 |                   |                   | -35°C <sup>[8]</sup> to +60°C / +50°C / Active Power derating (-5/50°C)                                 |                   |                   |
| Relative Humidity                               |                   |                   | 4% to 100% Condensing   |                   |                   |
| Max. Altitude (above sea level)                 |                   |                   | 2000m / >2000m power derating (Max. 4000m)  |                   |                   |
| Noise level <sup>[9]</sup>                      |                   |                   | < 79 dBA  |                   |                   |
| <b>CONTROL INTERFACE</b>                        |                   |                   |   |                   |                   |
| Interface                                       |                   |                   | Graphic Display (inside cabinet) / Optional Freesun App display   |                   |                   |
| Communication protocol                          |                   |                   | Modbus TCP  |                   |                   |
| Power Plant Controller                          |                   |                   | Optional. Third party SCADA systems supported   |                   |                   |
| Keyed ON/OFF switch                             |                   |                   | Standard  |                   |                   |
| Digital I/O                                     |                   |                   | Optional <sup>[1]</sup>   |                   |                   |
| Analog I/O                                      |                   |                   | Optional <sup>[1]</sup>   |                   |                   |
| Ground Fault Protection                         |                   |                   | Insulation monitoring device  |                   |                   |
| Humidity control                                |                   |                   | Active Heating  |                   |                   |
| General AC Protection & Disconn.                |                   |                   | Circuit Breaker   |                   |                   |
| General DC Protection & Disconn.                |                   |                   | External Disconnecting Unit Cabinet   |                   |                   |
| Overvoltage Protection                          |                   |                   | AC and DC protection (Type 2)   |                   |                   |
| <b>CERTIFICATIONS</b>                           |                   |                   |   |                   |                   |
| Safety  |                   |                   | UL 1741, CSA 22.2 No.1071-1.01, UL62109-1, IEC62109-1, IEC62109-2                                       |                   |                   |
| Utility interconnect                            |                   |                   | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                   |                   |

[1] Values at 1,00Vdc, nom and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 600V

| NUMBER OF MODULES                               | FRAME 3           | FRAME 4   | FRAME 5              | FRAME 6           | FRAME 7           |
|---|-------------------|---|----------------------|-------------------|-------------------|
|   | 3                 | 4   | 5                    | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP1100C           | FP1475C   | FP1830C              | FP2225C           | FP2600C           |
| <b>AC</b>                                       |                   |   |                      |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 1100              | 1475  | 1850                 | 2225              | 2600              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1335              | 1780  | 2225                 | 2660              | 3110              |
| Max. AC Output Current (A) @50°C                | 1060              | 1420  | 1780                 | 2140              | 2500              |
| Max. AC Output Current (A) @25°C                | 1285              | 1715  | 2140                 | 2560              | 2995              |
| Overload capacity <sup>[2]</sup>                |                   | 120% (depending on preload conditions) <sup>[3]</sup>   |                      |                   |                   |
| Operating Grid Voltage (VAC)                    |                   | 600V ±10% <sup>[4]</sup>  |                      |                   |                   |
| Operating Grid Frequency (Hz)                   |                   | 50/60 Hz  |                      |                   |                   |
| Current Harmonic Distortion (THD)               |                   | < 3% per IEC619   |                      |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        |                   | 0.0 lagging ... 0.0 leading   |                      |                   |                   |
| Reactive power compensation                     |                   | Four quadrant operation   |                      |                   |                   |
| DC Voltage Range (full power)                   |                   | 849V-1310V  |                      |                   |                   |
| Maximum DC voltage                              |                   | 1500V   |                      |                   |                   |
| DC Voltage Ripple                               |                   | < 3%  |                      |                   |                   |
| Max. DC continuous current (A)                  | 1605              | 2140  | 2675                 | 3195              | 3740              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320              | 3100  | 3880                 | 4650              | 5450              |
| Battery Technology                              |                   | all type of batteries (BMS required)  |                      |                   |                   |
| Number of separate DC inputs                    |                   | 1 DC input per inverter <sup>[7]</sup>  |                      |                   |                   |
| Battery Connections                             |                   | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                      |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |                   |   |                      |                   |                   |
| Efficiency (Max) (η)                            |                   |   | < approx. 50W/module |                   |                   |
| Max. Standby Consumption (VA) (W)               | 2400              | 3200  | 4000                 | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5" | 147.6x327.2x86.5"   | 175.7x327.2x86.5"    | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x845x2198     | 3751x845x2198   | 4464x845x2198        | 5177x845x2198     | 5890x845x2198     |
| Weight (lbs)                                    | 5809              | 7253  | 8697                 | 10141             | 11585             |
| Weight (kg)                                     | 2635              | 3290  | 3945                 | 4600              | 5255              |
| Air Flow  |                   | Bottom intake. Exhaust top rear vent  |                      |                   |                   |
| Type of ventilation                             |                   | Forced air cooling  |                      |                   |                   |
| Degree of protection                            |                   | NEMA 3R / IP54  |                      |                   |                   |
| Permissible Ambient Temperature                 |                   | -35°C <sup>[8]</sup> to +60°C, >50°C / Active Power derating (<50°C)                                    |                      |                   |                   |
| Relative Humidity                               |                   | 4% to 100% Condensing   |                      |                   |                   |
| Max. Altitude (above sea level)                 |                   | 2000m / >2000m power derating (Max. 4000m)  |                      |                   |                   |
| Noise level <sup>[9]</sup>                      |                   | < 79 dBA  |                      |                   |                   |
| <b>CONTROL INTERFACE</b>                        |                   |   |                      |                   |                   |
| Interface                                       |                   | Graphic Display (inside cabinet) / Optional Freesun App display   |                      |                   |                   |
| Communication protocol                          |                   | Modbus TCP  |                      |                   |                   |
| Power Plant Controller                          |                   | Optional. Third party SCADA systems supported   |                      |                   |                   |
| Keyed ON/OFF switch                             |                   | Standard  |                      |                   |                   |
| Digital I/O                                     |                   | Optional <sup>[1]</sup>   |                      |                   |                   |
| Analog I/O                                      |                   | Optional <sup>[1]</sup>   |                      |                   |                   |
| Ground Fault Protection                         |                   | Insulation monitoring device  |                      |                   |                   |
| Humidity control                                |                   | Active Heating  |                      |                   |                   |
| General AC Protection & Disconn.                |                   | Circuit Breaker   |                      |                   |                   |
| General DC Protection & Disconn.                |                   | External Disconnecting Unit Cabinet   |                      |                   |                   |
| Overvoltage Protection                          |                   | AC and DC protection (Type 2)   |                      |                   |                   |
| <b>CERTIFICATIONS</b>                           |                   |   |                      |                   |                   |
| Safety  |                   | UL 1741, CSA 22.2 No.1071-1.01, UL62109-1, IEC62109-1, IEC62109-2                                       |                      |                   |                   |
| Utility interconnect                            |                   | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                      |                   |                   |

[1] Values at 1,00Vdc, nom and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 530V

| NUMBER OF MODULES                               | FRAME 3           | FRAME 4   | FRAME 5              | FRAME 6           | FRAME 7           |
|---|-------------------|---|----------------------|-------------------|-------------------|
|   | 3                 | 4   | 5                    | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP0990C           | FP1320C   | FP1650C              | FP1980C           | FP2310C           |
| <b>AC</b>                                       |                   |   |                      |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 990               | 1320  | 1650                 | 1980              | 2310              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1180              | 1575  | 1970                 | 2360              | 2755              |
| Max. AC Output Current (A) @50°C                | 1080              | 1440  | 1795                 | 2155              | 2515              |
| Max. AC Output Current (A) @25°C                | 1285              | 1715  | 2145                 | 2570              | 3000              |
| Overload capacity <sup>[2]</sup>                |                   | 120% (depending on preload conditions) <sup>[3]</sup>   |                      |                   |                   |
| Operating Grid Voltage (VAC)                    |                   | 530V ±10% <sup>[4]</sup>  |                      |                   |                   |
| Operating Grid Frequency (Hz)                   |                   | 50/60 Hz  |                      |                   |                   |
| Current Harmonic Distortion (THD)               |                   | < 3% per IEC619   |                      |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        |                   | 0.0 lagging ... 0.0 leading   |                      |                   |                   |
| Reactive power compensation                     |                   | Four quadrant operation   |                      |                   |                   |
| DC Voltage Range (full power)                   |                   | 750V-1310V  |                      |                   |                   |
| Maximum DC voltage                              |                   | 1500V   |                      |                   |                   |
| DC Voltage Ripple                               |                   | < 3%  |                      |                   |                   |
| Max. DC continuous current (A)                  | 1605              | 2145  | 2680                 | 3210              | 3750              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320              | 3100  | 3880                 | 4650              | 5450              |
| Battery Technology                              |                   | all type of batteries (BMS required)  |                      |                   |                   |
| Number of separate DC inputs                    |                   | 1 DC input per inverter <sup>[7]</sup>  |                      |                   |                   |
| Battery Connections                             |                   | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                      |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |                   |   |                      |                   |                   |
| Efficiency (Max) (η)                            |                   |   | < approx. 50W/module |                   |                   |
| Max. Standby Consumption (VA) (W)               | 2400              | 3200  | 4000                 | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5" | 147.6x327.2x86.5"   | 175.7x327.2x86.5"    | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x845x2198     | 3751x845x2198   | 4464x845x2198        | 5177x845x2198     | 5890x845x2198     |
| Weight (lbs)                                    | 5809              | 7253  | 8697                 | 10141             | 11585             |
| Weight (kg)                                     | 2635              | 3290  | 3945                 | 4600              | 5255              |
| Air Flow  |                   | Bottom intake. Exhaust top rear vent  |                      |                   |                   |
| Type of ventilation                             |                   | Forced air cooling  |                      |                   |                   |
| Degree of protection                            |                   | NEMA 3R / IP54  |                      |                   |                   |
| Permissible Ambient Temperature                 |                   | -35°C <sup>[8]</sup> to +60°C, >50°C / Active Power derating (<50°C)                                    |                      |                   |                   |
| Relative Humidity                               |                   | 4% to 100% Condensing   |                      |                   |                   |
| Max. Altitude (above sea level)                 |                   | 2000m / >2000m power derating (Max. 4000m)  |                      |                   |                   |
| Noise level <sup>[9]</sup>                      |                   | < 79 dBA  |                      |                   |                   |
| <b>CONTROL INTERFACE</b>                        |                   |   |                      |                   |                   |
| Interface                                       |                   | Graphic Display (inside cabinet) / Optional Freesun App display   |                      |                   |                   |
| Communication protocol                          |                   | Modbus TCP  |                      |                   |                   |
| Power Plant Controller                          |                   | Optional. Third party SCADA systems supported   |                      |                   |                   |
| Keyed ON/OFF switch                             |                   | Standard  |                      |                   |                   |
| Digital I/O                                     |                   | Optional <sup>[1]</sup>   |                      |                   |                   |
| Analog I/O                                      |                   | Optional <sup>[1]</sup>   |                      |                   |                   |
| Ground Fault Protection                         |                   | Insulation monitoring device  |                      |                   |                   |
| Humidity control                                |                   | Active Heating  |                      |                   |                   |
| General AC Protection & Disconn.                |                   | Circuit Breaker   |                      |                   |                   |
| General DC Protection & Disconn.                |                   | External Disconnecting Unit Cabinet   |                      |                   |                   |
| Overvoltage Protection                          |                   | AC and DC protection (Type 2)   |                      |                   |                   |
| <b>CERTIFICATIONS</b>                           |                   |   |                      |                   |                   |
| Safety  |                   | UL 1741, CSA 22.2 No.1071-1.01, UL62109-1, IEC62109-1, IEC62109-2                                       |                      |                   |                   |
| Utility interconnect                            |                   | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                      |                   |                   |

[1] Values at 1,00Vdc, nom and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 500V

| NUMBER OF MODULES                               | FRAME 3   | FRAME 4           | FRAME 5           | FRAME 6           | FRAME 7           |
|---|---|-------------------|-------------------|-------------------|-------------------|
|   | 3   | 4                 | 5                 | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP093BC   | FP1245C           | FP1560C           | FP1870C           | FP2180C           |
| <b>AC</b>                                       |   |                   |                   |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 935   | 1245              | 1560              | 1870              | 2180              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1115  | 1485              | 1855              | 2230              | 2600              |
| Max. AC Output Current (A) @50°C                | 1080  | 1440              | 1800              | 2160              | 2515              |
| Max. AC Output Current (A) @25°C                | 1285  | 1715              | 2140              | 2575              | 3000              |
| Overload capacity <sup>[2]</sup>                | 120% (depending on preload conditions) <sup>[3]</sup>   |                   |                   |                   |                   |
| Operating Grid Voltage (VAC)                    | 500V ±10% <sup>[4]</sup>  |                   |                   |                   |                   |
| Operating Grid Frequency (Hz)                   | 50/60 Hz  |                   |                   |                   |                   |
| Current Harmonic Distortion (THD)               | < 3% per IEC619   |                   |                   |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        | 0.0 lagging ... 0.0 lagging   |                   |                   |                   |                   |
| Reactive power compensation                     | Four quadrant operation   |                   |                   |                   |                   |
| DC Voltage Range (full power)                   | 708V-1310V  |                   |                   |                   |                   |
| Maximum DC voltage                              | 1500V   |                   |                   |                   |                   |
| DC Voltage Ripple                               | < 3%  |                   |                   |                   |                   |
| Max. DC continuous current (A)                  | 1600  | 2135              | 2665              | 3200              | 3660              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320  | 3100              | 3880              | 4650              | 5450              |
| Battery Technology                              | all type of batteries (BMS required)  |                   |                   |                   |                   |
| Number of separate DC inputs                    | 1 DC input per inverter <sup>[7]</sup>  |                   |                   |                   |                   |
| Battery Connections                             | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                   |                   |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |   |                   |                   |                   |                   |
| Efficiency (Max) (η)                            | 98%   |                   |                   |                   |                   |
| Max. Standby Consumption (VA) (W)               | < approx. 50W/per module  |                   |                   |                   |                   |
| Max. Power Consumption (VA) (W)                 | 2400  | 3200              | 4000              | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5"   | 147.6x327.2x86.5" | 175.7x327.2x86.5" | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x945x2198   | 3751x945x2198     | 4464x945x2198     | 5177x945x2198     | 5890x945x2198     |
| Weight (lbs)                                    | 5809  | 7253              | 8697              | 10141             | 11585             |
| Weight (kg)                                     | 2635  | 3290              | 3945              | 4600              | 5255              |
| Air Flow  | Bottom intake. Exhaust top rear vent  |                   |                   |                   |                   |
| Type of ventilation                             | Forced air cooling  |                   |                   |                   |                   |
| <b>ENVIRONMENT</b>                              |   |                   |                   |                   |                   |
| Degree of protection                            | NEMA 3R / IP54  |                   |                   |                   |                   |
| Permissible Ambient Temperature                 | -35°C <sup>[8]</sup> to +60°C, >50°C / Active Power derating (<50°C)                                    |                   |                   |                   |                   |
| Relative Humidity                               | 4% to 100% Condensing   |                   |                   |                   |                   |
| Max. Altitude (above sea level)                 | 2000m / >2000m power derating (Max. 4000m)  |                   |                   |                   |                   |
| Noise level <sup>[9]</sup>                      | < 79 dBA  |                   |                   |                   |                   |
| <b>CONTROL INTERFACE</b>                        |   |                   |                   |                   |                   |
| Interface                                       | Graphic Display (inside cabinet) / Optional Freesun App display   |                   |                   |                   |                   |
| Communication protocol                          | Modbus TCP  |                   |                   |                   |                   |
| Power Plant Controller                          | Optional. Third party SCADA systems supported   |                   |                   |                   |                   |
| Keyed ON/OFF switch                             | Standard  |                   |                   |                   |                   |
| Digital I/O                                     | Optional <sup>[1]</sup>   |                   |                   |                   |                   |
| Analog I/O                                      | Optional <sup>[1]</sup>   |                   |                   |                   |                   |
| <b>PROTECTIONS</b>                              |   |                   |                   |                   |                   |
| Ground Fault Protection                         | Insulation monitoring device  |                   |                   |                   |                   |
| Humidity control                                | Active Heating  |                   |                   |                   |                   |
| General AC Protection & Disconn.                | Circuit Breaker   |                   |                   |                   |                   |
| General DC Protection & Disconn.                | External Disconnecting Unit Cabinet   |                   |                   |                   |                   |
| Overvoltage Protection                          | AC and DC protection (Type 2)   |                   |                   |                   |                   |
| <b>CERTIFICATIONS</b>                           |   |                   |                   |                   |                   |
| Safety  | UL 1741, CSA 22.2 No.1071-1-01, UL62109-1, IEC62109-1, IEC62109-2                                       |                   |                   |                   |                   |
| Utility interconnect                            | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                   |                   |                   |                   |

[1] Values at 1,00Vdc/room and cosφ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## TECHNICAL CHARACTERISTICS

## FREEMAQ PCS 480V

| NUMBER OF MODULES                               | FRAME 3   | FRAME 4           | FRAME 5           | FRAME 6           | FRAME 7           |
|---|---|-------------------|-------------------|-------------------|-------------------|
|   | 3   | 4                 | 5                 | 6                 | 7                 |
| <b>REFERENCES</b>                               | FP900C  | FP1201C           | FP1500C           | FP1800C           | FP2100C           |
| <b>AC</b>                                       |   |                   |                   |                   |                   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup>   | 900   | 1200              | 1500              | 1800              | 2100              |
| AC Output Power (kVA/kW) @25°C <sup>[1]</sup>   | 1070  | 1425              | 1780              | 2140              | 2495              |
| Max. AC Output Current (A) @50°C                | 1085  | 1445              | 1805              | 2165              | 2525              |
| Max. AC Output Current (A) @25°C                | 1285  | 1715              | 2140              | 2575              | 3000              |
| Overload capacity <sup>[2]</sup>                | 120% (depending on preloaded conditions) <sup>[3]</sup>   |                   |                   |                   |                   |
| Operating Grid Voltage (VAC)                    | 480V ±10% <sup>[4]</sup>  |                   |                   |                   |                   |
| Operating Grid Frequency (Hz)                   | 50/60 Hz  |                   |                   |                   |                   |
| Current Harmonic Distortion (THD)               | < 3% per IEC619   |                   |                   |                   |                   |
| Power Factor (cosine phi) <sup>[5]</sup>        | 0.0 lagging ... 0.0 lagging   |                   |                   |                   |                   |
| Reactive power compensation                     | Four quadrant operation   |                   |                   |                   |                   |
| DC Voltage Range (full power)                   | 679V-1310V  |                   |                   |                   |                   |
| Maximum DC voltage                              | 1500V   |                   |                   |                   |                   |
| DC Voltage Ripple                               | < 3%  |                   |                   |                   |                   |
| Max. DC continuous current (A)                  | 1600  | 2135              | 2665              | 3200              | 3660              |
| Max. DC shortcircuit current (A) <sup>[6]</sup> | 2320  | 3100              | 3880              | 4650              | 5450              |
| Battery Technology                              | all type of batteries (BMS required)  |                   |                   |                   |                   |
| Number of separate DC inputs                    | 1 DC input per inverter <sup>[7]</sup>  |                   |                   |                   |                   |
| Battery Connections                             | FSDK style battery cabinet with 8 positive and 8 negative connections.<br>Larger FSDK cabinets optional |                   |                   |                   |                   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>             |   |                   |                   |                   |                   |
| Efficiency (Max) (η)                            | 98%   |                   |                   |                   |                   |
| Max. Standby Consumption (VA) (W)               | < approx. 50W/per module  |                   |                   |                   |                   |
| Max. Power Consumption (VA) (W)                 | 2400  | 3200              | 4000              | 4800              | 5600              |
| Dimensions [WxDxH] (inches)                     | 119.6x327.2x86.5"   | 147.6x327.2x86.5" | 175.7x327.2x86.5" | 203.8x327.2x86.5" | 231.9x327.2x86.5" |
| Dimensions [WxDxH] (mm)                         | 3038x945x2198   | 3751x945x2198     | 4464x945x2198     | 5177x945x2198     | 5890x945x2198     |
| Weight (lbs)                                    | 5809  | 7253              | 8697              | 10141             | 11585             |
| Weight (kg)                                     | 2635  | 3290              | 3945              | 4600              | 5255              |
| Air Flow  | Bottom intake. Exhaust top rear vent  |                   |                   |                   |                   |
| Type of ventilation                             | Forced air cooling  |                   |                   |                   |                   |
| <b>ENVIRONMENT</b>                              |   |                   |                   |                   |                   |
| Degree of protection                            | NEMA 3R / IP54  |                   |                   |                   |                   |
| Permissible Ambient Temperature                 | -35°C <sup>[8]</sup> to +60°C, >50°C / Active Power derating (<50°C)                                    |                   |                   |                   |                   |
| Relative Humidity                               | 4% to 100% Condensing   |                   |                   |                   |                   |
| Max. Altitude (above sea level)                 | 2000m / >2000m power derating (Max. 4000m)  |                   |                   |                   |                   |
| Noise level <sup>[9]</sup>                      | < 79 dBA  |                   |                   |                   |                   |
| <b>CONTROL INTERFACE</b>                        |   |                   |                   |                   |                   |
| Interface                                       | Graphic Display (inside cabinet) / Optional Freesun App display   |                   |                   |                   |                   |
| Communication protocol                          | Modbus TCP  |                   |                   |                   |                   |
| Power Plant Controller                          | Optional. Third party SCADA systems supported   |                   |                   |                   |                   |
| Keyed ON/OFF switch                             | Standard  |                   |                   |                   |                   |
| Digital I/O                                     | Optional <sup>[1]</sup>   |                   |                   |                   |                   |
| Analog I/O                                      | Optional <sup>[1]</sup>   |                   |                   |                   |                   |
| <b>PROTECTIONS</b>                              |   |                   |                   |                   |                   |
| Ground Fault Protection                         | Insulation monitoring device  |                   |                   |                   |                   |
| Humidity control                                | Active Heating  |                   |                   |                   |                   |
| General AC Protection & Disconn.                | Circuit Breaker   |                   |                   |                   |                   |
| General DC Protection & Disconn.                | External Disconnecting Unit Cabinet   |                   |                   |                   |                   |
| Overvoltage Protection                          | AC and DC protection (Type 2)   |                   |                   |                   |                   |
| <b>CERTIFICATIONS</b>                           |   |                   |                   |                   |                   |
| Safety  | UL 1741, CSA 22.2 No.1071-1-01, UL62109-1, IEC62109-1, IEC62109-2                                       |                   |                   |                   |                   |
| Utility interconnect                            | UL 1741SA-Sept. 2016 / IEEE 1547-1-2005   |                   |                   |                   |                   |

[1] Values at 1,00Vdc/room and cosφ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(WA)-S(KVA)-P(KW)

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below 20°C.

[6] Readings taken 1 meter from the back of the unit.

## FREEMAQ MULTI PCS

UTILITY SCALE MULTI PCS INVERTER



POWER CONVERSION SYSTEM



FIELD REPLACEABLE UNITS



IP65 AVAILABLE



MODULAR DESIGN



1C00L 3



4 QUADRANT



3 LEVEL TOPOLOGY

### TAKING ADVANTAGE OF THE MOST FLEXIBLE 1500V INVERTER PLATFORM

The Power Electronics Freemaq Multi PCS modular inverter architecture can be designed to support solar generation and energy storage in a single inverter, or even having individual battery systems. Each power module can be designated as either a power module to export PV power or as a bidirectional power module designed to support energy storage.

The Freemaq Multi PCS is the perfect solution for having a solar inverter with storage capabilities integrated, such as Peak Shaving, Ramp Rate control, Frequency Regulation and Load Leveling, without the need of an additional transformer.

Within this architecture, the AC bus is designed to match the minimum DC voltage on either the solar or battery system. In the DC side, the inputs for each power module are independent. The Power Electronics Multi PCS Inverter is available with 1 to 6 power modules dedicated to energy storage.



## COMPACT DESIGN - EASY TO SERVICE

By providing full front access the Freemaq Multi PCS series simplifies the maintenance tasks, reducing the MTTR (and achieving a lower OPEX). The total access allows a fast swap of the FRUs without the need of qualified technical personnel.

With the Freemaq Multi PCS, Power Electronics offers its most compact solution, achieving 3.8MW in just 1.2ft long, reducing installation costs and labor time.



## STRING CONCEPT POWER STAGES

The Freemaq Multi PCS combines the advantages of a central inverter with the modularity of the string inverters. Its power stages are designed to be easily replaceable on the field without the need of advanced technical service personnel, providing a safe, reliable and fast Plug&Play assembly system.

Following the modular philosophy of the Freemaq series, the Multi PCS is composed of 6 FRUs (field replaceable units), being able to work with up to 6 different DC inputs.



## INNOVATIVE COOLING SYSTEM

Based on more than 3 years of experience with our MV Variable Speed Drive, the IC00L3 is the first air-cooling system allowing IP65 degree of protection in an outdoor converter. IC00L3 delivers a constant stream of clean air to the FRUs, being the most effective way of reaching up to IP65

degree of protection, without having to maintain cumbersome dust filters or having to use liquid-cooling systems, avoiding the commonly known inconveniences of it (complex maintenance, risk of leaks, higher number of components...), therefore resulting in an OPEX cost reduction.



## VAR AT NIGHT

At night, the Freemaq Multi PCS inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

## ACTIVE HEATING

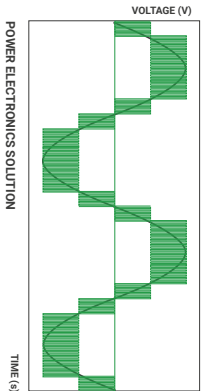
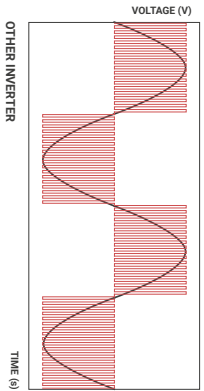
At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **patented**

## MULTILEVEL TOPOLOGY

The multilevel IGBT topology is the most efficient approach to manage high DC link voltages and makes the difference in the 1,500 Vdc design. Power Electronics has many years of power design in both inverters and MV drives and the

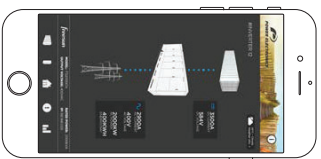
Freemaq Multi PCS design is the result of our experience with 3 level topologies. The 3 level IGBT topology reduces stage losses, increases inverter efficiency and minimizes total harmonic distortion.



## EASY TO MONITOR

The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors.

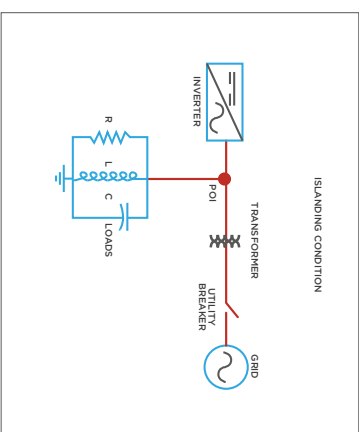
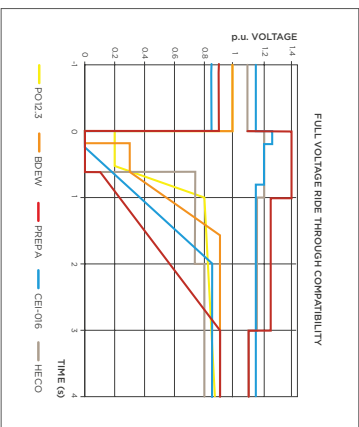
The app user-friendly interface allows quick and easy access to critical information (energy registers, production and events).



|                              |   |
|------------------------------|---|
| <b>AVAILABLE INFORMATION</b> | Grid and PV field data<br>Inverter and Power module data (Voltages, currents, power, temperatures, I/O status,...)<br>Weather conditions<br>Alarms and warnings events<br>Energy registers<br>Others. |
| <b>FEATURES</b>              | Easy Wireless connection<br>Comprehensive interface<br>Real time data<br>Save and copy settings.  |
| <b>LANGUAGE</b>              | English, Spanish  |
| <b>SYSTEM REQUIREMENTS</b>   | iOS or Android devices.   |
| <b>SETTINGS CONTROL</b>      | Yes   |

## DYNAMIC GRID SUPPORT

Freemaq Multi PCS firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-Islanding active and reactive power curtailment,...) and is compatible with all the specific requirements of the utilities.



### LVRT or ZVRT (Low Voltage Ride Through)

Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.

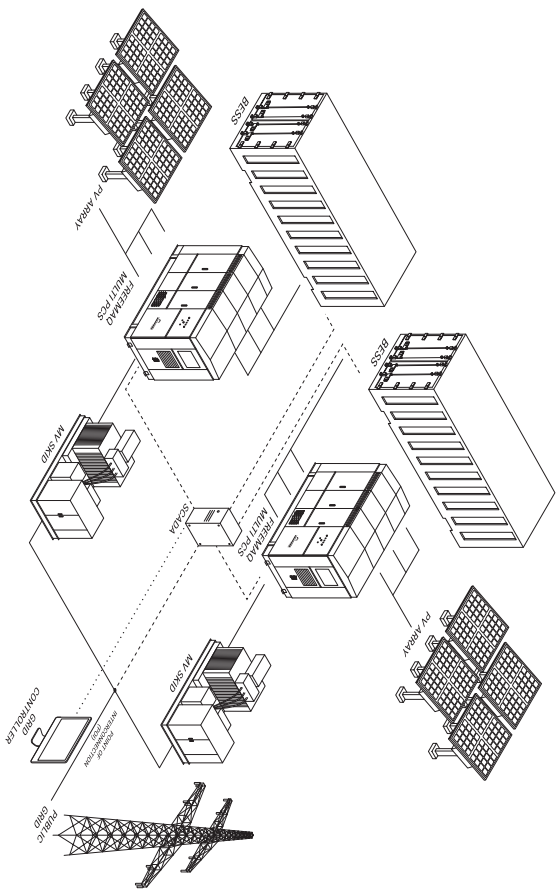
### Anti-islanding

This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

**BATTERY ENERGY STORAGE SYSTEM**

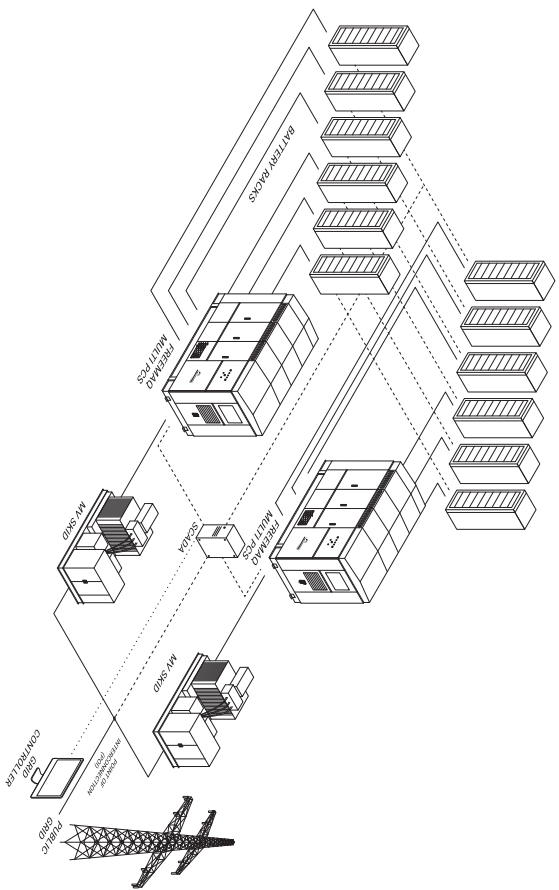
A BESS comprises a battery container connected to a FreeMaq Multi PCS (Power Conversion System) that follows the instruction of the main governor of the plant, the PPC (Power Plant Controller) or SCADA.

EXAMPLE 1



— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

EXAMPLE 2



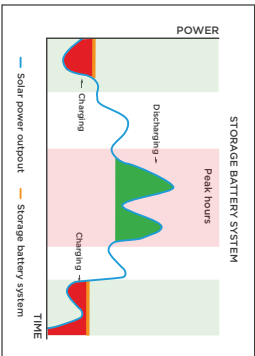
— Power connections  
 - - - Plant communications  
 ..... Grid controller communication

## ENERGY STORAGE APPLICATIONS



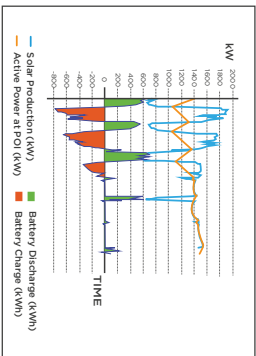
### LOAD LEVELING

Freemaq Multi PCS series are able to store energy during periods of low demand from the grid, in order to later supply this energy when there is a higher demand. This has the benefit of selling the energy at a higher market price during peak periods. It also allows grid operators to supply electricity with a higher renewable origin. Since PV generation may not be at the same time as peak demand, this facilitates the flexibility and integration of renewable generation into the grid.



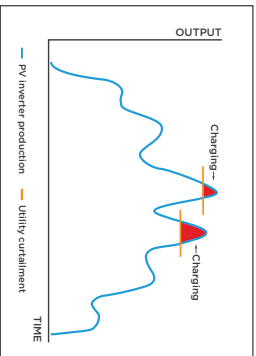
### RENEWABLE INTEGRATION

The Freemaq Multi PCS series attenuates the intermittent nature of renewable energy sources, to provide a smoother power output. The Freemaq Multi PCS controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array. The system monitors the PV inverter output to inject or consume power accordingly to ensure the output remains within the ramp requirements.



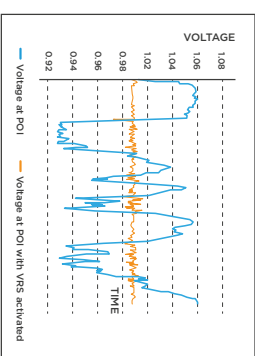
### UTILITY CURTAILMENT RECOVERY

Utility scale inverter production can be curtailed by the grid operator, due to the high energy sources penetration in the grid during certain periods. With this AC-coupled energy storage system, the excess energy from the PV field can be stored in the BESS and then delivered when needed.



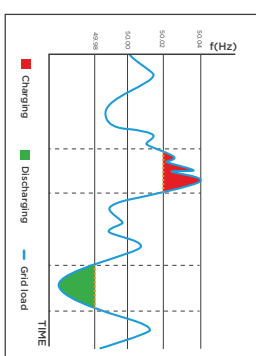
### GRID SUPPORT

Freemaq Multi PCS series helps the integration of renewable sources, by helping to maintain grid stability and power quality. It can help support the grid voltage by generating capacitive or inductive current. Other features include Voltage Control, Reactive Power Control and Fault Ride Through Support.



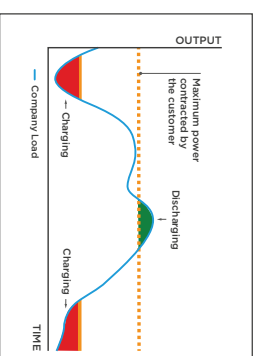
### FREQUENCY REGULATION SYSTEM

Freemaq Multi PCS provides ability to regulate grid frequency in both directions. When there is a grid over-frequency (generation>demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation<demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.



### PEAK POWER SHAVING

By delivering stored energy to the grid during periods of high demand, it reduces the burden on the distribution network and increases significantly its efficiency. Energy is stored instead of injected into the grid during periods of low demand, which as a result increases the load on the grid. However, during peak periods this stored energy is then injected into the grid, which reduces the demand at this time. The result is a more flattened demand curve which means the grid can avoid switching on more expensive and polluting generators.



## TECHNICAL CHARACTERISTICS

## FREEMAQ MULTI PCS 480V TO 615V

|                                     | 480V  | 500V  | 530V                     | 600V                        | 615V                      |
|-------------------------------------|---|---|--------------------------|-----------------------------|---------------------------|
| <b>AC</b>                           | AC Output Power (kVA/kW) @50°C <sup>[1]</sup> | 1600-2400   | 1666-2500                | 1765-2650                   | 2000-3000                 |
|                                     | Output Power (kVA/kW) @25°C <sup>[1]</sup>    | 1760-2640   | 1830-2730                | 1940-2915                   | 2200-3300                 |
|                                     | Operating Grid Frequency (Hz)                 |   |                          | 50/60 Hz                    |                           |
|                                     | Current Harmonic Distortion (THD)             |   |                          | < 3% per IEC61819           |                           |
|                                     | Power Factor (cosine phi) <sup>[2]</sup>      |   |                          | 0.0 leading ... 0.0 lagging |                           |
| <b>DC</b>                           | DC Voltage Range (Vdc)                        | 679-1310  | 708-1310                 | 750-1310                    | 849-1310                  |
|                                     | DC Voltage Ripple                             |   |                          | <3%                         |                           |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b> | Max. DC continuous current (A)                | 2645 - 3970 (depending on the PCS configuration)            |                          |                             |                           |
|                                     | Battery Technology                            | All type of batteries (BMS required)                        |                          |                             |                           |
|                                     | Number of separate DC inputs                  | Up to 6 <sup>[3]</sup>                                      |                          |                             |                           |
| <b>CABINET</b>                      | Efficiency (Max) (η)                          | 98% (preliminary)   |                          |                             |                           |
|                                     | Max. Standby Consumption                      | < approx. 50W/per module                                    |                          |                             |                           |
|                                     | Max. Power Consumption (VA) (W)               | 2400 - 5600 (depending on the PCS configuration)            |                          |                             |                           |
| <b>ENVIRONMENT</b>                  | External Auxiliary Supply                     | Optional  |                          |                             |                           |
|                                     | Dimensions [WxDxH] (l/mm)                     | Frame 1   | 9 x 7 x 7 / 27 x 22 x 22 | Frame 2                     | 12 x 7 x 7 / 37 x 22 x 22 |
|                                     | Weight (lbs/kg)                               | Frame 1   | 4900 - 10802/65          | Frame 2                     | 7000 - 15432/36           |
|                                     | Air Flow                                      | Bottom intake. Exhaust top vent                             |                          |                             |                           |
| <b>CONTROL INTERFACE</b>            | Type of ventilation                           | Forced air cooling  |                          |                             |                           |
|                                     | Degree of protection                          | IP54 / NEMA9R (65 Optional)                                 |                          |                             |                           |
|                                     | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C / >50°C Active Power derating |                          |                             |                           |
|                                     | Relative Humidity                             | 0% to 100% Non condensing                                   |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                  |                          |                             |                           |
|                                     | Noise level <sup>[5]</sup>                    | < 79 dBA  |                          |                             |                           |
|                                     | Interface                                     | Graphic Display (inside cabinet) / Optional FreeSun App     |                          |                             |                           |
|                                     | Communication protocol                        | Modbus TCP  |                          |                             |                           |
| <b>CONTROL INTERFACE</b>            | Power Plant Controller                        | Optional. Third party SCADA systems supported               |                          |                             |                           |
|                                     | Keyed ON/OFF switch                           | Standard  |                          |                             |                           |
|                                     | Digital I/O                                   | Optional <sup>[6]</sup>                                     |                          |                             |                           |
|                                     | Analog I/O                                    | Optional <sup>[6]</sup>                                     |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Ground Fault Protection                       | Insulation monitoring device                                |                          |                             |                           |
|                                     | Humidity control                              | Active Heating  |                          |                             |                           |
|                                     | General AC Protection & Disconn               | Circuit Breaker   |                          |                             |                           |
|                                     | General DC Protection & Disconn               | Contactor + Fuses   |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Overvoltage Protection                        | AC and DC protection (Type 2)                               |                          |                             |                           |

## TECHNICAL CHARACTERISTICS

## FREEMAQ MULTI PCS 630V TO 690V

|                                     | 630V  | 645V  | 660V                     | 690V                        |                           |
|-------------------------------------|---|---|--------------------------|-----------------------------|---------------------------|
| <b>AC</b>                           | AC Output Power (kVA/kW) @50°C <sup>[1]</sup> | 2100-3450   | 2150-3225                | 2200-3300                   |                           |
|                                     | Output Power (kVA/kW) @25°C <sup>[1]</sup>    | 2310-3465   | 2365-3550                | 2420-3630                   |                           |
|                                     | Operating Grid Frequency (Hz)                 |   |                          | 50/60 Hz                    |                           |
|                                     | Current Harmonic Distortion (THD)             |   |                          | < 3% per IEC61819           |                           |
|                                     | Power Factor (cosine phi) <sup>[2]</sup>      |   |                          | 0.0 leading ... 0.0 lagging |                           |
| <b>DC</b>                           | DC Voltage Range (Vdc)                        | 891-1310  | 919-1310                 | 994-1310                    |                           |
|                                     | DC Voltage Ripple                             |   |                          | <3%                         |                           |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b> | Max. DC continuous current (A)                | 2645 - 3970 (depending on the PCS configuration)            |                          |                             |                           |
|                                     | Battery Technology                            | All type of batteries (BMS required)                        |                          |                             |                           |
|                                     | Number of separate DC inputs                  | Up to 6 <sup>[3]</sup>                                      |                          |                             |                           |
| <b>CABINET</b>                      | Efficiency (Max) (η)                          | 98% (preliminary)   |                          |                             |                           |
|                                     | Max. Standby Consumption                      | < approx. 50W/per module                                    |                          |                             |                           |
|                                     | Max. Power Consumption (VA) (W)               | 2400 - 5600 (depending on the PCS configuration)            |                          |                             |                           |
| <b>ENVIRONMENT</b>                  | External Auxiliary Supply                     | Optional  |                          |                             |                           |
|                                     | Dimensions [WxDxH] (l/mm)                     | Frame 1   | 9 x 7 x 7 / 27 x 22 x 22 | Frame 2                     | 12 x 7 x 7 / 37 x 22 x 22 |
|                                     | Weight (lbs/kg)                               | Frame 1   | 4900 - 10802/65          | Frame 2                     | 7000 - 15432/36           |
|                                     | Air Flow                                      | Bottom intake. Exhaust top vent                             |                          |                             |                           |
| <b>CONTROL INTERFACE</b>            | Type of ventilation                           | Forced air cooling  |                          |                             |                           |
|                                     | Degree of protection                          | IP54 / NEMA9R (65 Optional)                                 |                          |                             |                           |
|                                     | Permissible Ambient Temperature               | -35°C <sup>[4]</sup> to +60°C / >50°C Active Power derating |                          |                             |                           |
|                                     | Relative Humidity                             | 0% to 100% Non condensing                                   |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Max. Altitude (above sea level)               | 2000m / >2000m power derating (Max. 4000m)                  |                          |                             |                           |
|                                     | Noise level <sup>[5]</sup>                    | < 79 dBA  |                          |                             |                           |
|                                     | Interface                                     | Graphic Display (inside cabinet) / Optional FreeSun App     |                          |                             |                           |
|                                     | Communication protocol                        | Modbus TCP  |                          |                             |                           |
| <b>CONTROL INTERFACE</b>            | Power Plant Controller                        | Optional. Third party SCADA systems supported               |                          |                             |                           |
|                                     | Keyed ON/OFF switch                           | Standard  |                          |                             |                           |
|                                     | Digital I/O                                   | Optional <sup>[6]</sup>                                     |                          |                             |                           |
|                                     | Analog I/O                                    | Optional <sup>[6]</sup>                                     |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Ground Fault Protection                       | Insulation monitoring device                                |                          |                             |                           |
|                                     | Humidity control                              | Active Heating  |                          |                             |                           |
|                                     | General AC Protection & Disconn               | Circuit Breaker   |                          |                             |                           |
|                                     | General DC Protection & Disconn               | Contactor + Fuses   |                          |                             |                           |
| <b>PROTECTIONS</b>                  | Overvoltage Protection                        | AC and DC protection (Type 2)                               |                          |                             |                           |

[1] Values at 1,00Vdc norm and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(kVA)-S(kVA)-P(kW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

[1] Values at 1,10Vdc norm and cos φ = 1.

[2] Consult Power Electronics for derating curves.

[3] Consult P-Q charts available: Q(kVA)-S(kVA)-P(kW)).

[4] Consult Power Electronics for other configurations.

[5] Heating resistors kit option below -20°C.

[6] Readings taken 1 meter from the back of the unit.

## FREEMAQ STATCOM

UTILITY SCALE STATIC COMPENSATOR

 FIELD REPLACEABLE UNITS

 MODULAR DESIGN

 iCOOL.3

 3 LEVEL TOPOLOGY

 IP65 AVAILABLE



### TAKING ADVANTAGE OF THE MOST FLEXIBLE 1500V INVERTER PLATFORM

Freemaq STATCOM is a high power, utility scale, modular static compensator. It is ideal for dynamic reactive response, VAR support and grid voltage stabilization in either industrial locations or distributed generators such as renewable energy plants. Its modular design and redundant topology make it the perfect solution for the most demanding installations. As an outdoor solution, it doesn't need to be installed in a technical room and neither does it need additional cooling thanks to its revolutionary iCOOL.3 system. It is available in 2 different frames ranging from 2300 KVAR to 3800 KVAR.

## COMPACT DESIGN - EASY TO SERVICE

By providing full front access the Freemaq Statcom series simplifies the maintenance tasks, reducing the MTTR (and achieving a lower OPEX). The total access allows a fast swap of the FRUs without the need of qualified technical personnel.

With the Freemaq Statcom, Power Electronics offers its most compact solution, achieving 3.8MW in just 1.2ft long, reducing installation costs and labor time.



## STRING CONCEPT POWER STAGES

The Freemaq Statcom combines the advantages of a central inverter with the modularity of the string inverters. Its power stages are designed to be easily replaceable on the field without the need of advanced technical service personnel, providing a safe, reliable and fast Plug&Play assembly system.



## INNOVATIVE COOLING SYSTEM

Based on more than 3 years of experience with our MV Variable Speed Drive, the IC00L3 is the first air-cooling system allowing IP65 degree of protection in an outdoor converter. IC00L3 delivers a constant stream of clean air to the FRUs, being the most effective way of reaching up to IP65

degree of protection, without having to maintain cumbersome dust filters or having to use liquid-cooling systems, avoiding the commonly known inconveniences of it (complex maintenance, risk of leaks, higher number of components...), therefore resulting in an OPEX cost reduction.



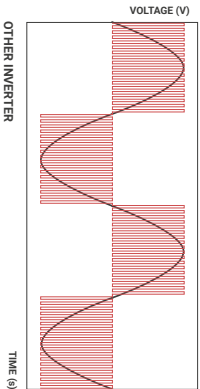
## ACTIVE HEATING

When the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

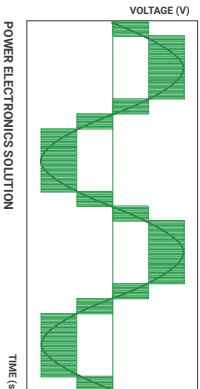
This autonomous heating system is the most efficient and homogenous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PERFORM**

## MULTILEVEL TOPOLOGY

The multilevel IGBT topology is the most efficient approach to manage high DC link voltages and makes the difference in the 1,500 Vdc design. Power Electronics has many years of power design in both inverters and MV drives and the



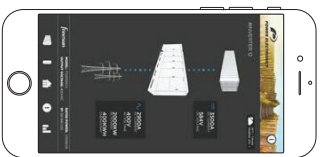
Freemaq Statcom design is the result of our experience with 3 level topologies. The 3 level IGBT topology reduces stage losses, increases inverter efficiency and minimizes total harmonic distortion.



## EASY TO MONITOR

The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors.

The app user-friendly interface allows quick and easy access to critical information (energy registers, production and events).



### AVAILABLE INFORMATION

Grid and PV field data  
Inverter and Power module data (Voltages, currents, power, temperatures, I/O status,...)  
Weather conditions  
Alarms and warnings events  
Energy registers  
Others.

### FEATURES

Easy Wireless connection  
Comprehensive interface  
Real time data  
Save and copy settings.

### LANGUAGE

English, Spanish

### SYSTEM REQUIREMENTS

iOS or Android devices.

### SETTINGS CONTROL

Yes

## TECHNICAL CHARACTERISTICS

## FREEMAQ STATCOM 690V

|   | FRAME 1<br>4  | FRAME 2<br>6   |
|---|---|--|
| <b>NUMBER OF MODULES</b>                      | <b>FT2300</b>   | <b>FT3450</b>  |
| <b>REFERENCES</b>                             | 2300  | 3450   |
| <b>AC</b>                                     | 1925  | 2887   |
| AC Output Power (kVA/kW) @50°C <sup>[1]</sup> |   | 690V ±1.10% <sup>[1]</sup>   |
| Max AC Output Current (A)@50°C                |   | 50/60 Hz   |
| Operating Grid Voltage (VAC)                  |   | < 3% per IEEE519   |
| Operating Grid Frequency (Hz)                 |   | 98.8%  |
| Current Harmonic Distortion (THD)             |   | < approx. 50W per module   |
| <b>EFFICIENCY &amp; AUX. SUPPLY</b>           |   |  |
| Efficiency (Max) (%)                          |   | 12 x 7 x 7   |
| <b>CABINET</b>                                |   |  |
| Max Standby Consumption                       | 9 x 7 x 7   | 3.7 x 2.2 x 2.2  |
| Dimensions (WxDxH) (ft)                       | 2.7 x 2.2 x 2.2   | 1.54x2.36  |
| Dimensions (WxDxH) (m)                        | 1080x2.65   | 7000   |
| Weight (lbs)                                  |   |  |
| Weight (kg)                                   |   |  |
| <b>ENVIRONMENT</b>                            |   |  |
| Type of ventilation                           | 4900  | Forced air cooling   |
| Degree of protection                          |   | NEMA 3R / IP54 / IP65 Optional                                       |
| Permissible Ambient Temperature               |   | -35°C <sup>[2]</sup> to +60°C, >50°C / Active Power derating (<50°C) |
| Relative Humidity                             |   | 4% to 100% Condensing  |
| Max Altitude (above sea level)                |   | 2000m / >2000m power derating (Max. 4000m)                           |
| Noise level <sup>[3]</sup>                    |   | < 79 dBA   |
| <b>CONTROL INTERFACE</b>                      |   |  |
| Interface                                     | Graphic Display (inside cabinet) / Optional Freesun App display |  |
| Communication protocol                        | Modbus TCP  |  |
| Power Plant Controller                        | Optional Third party SCADA systems supported                    |  |
| Keyed ON/OFF switch                           | Standard  |  |
| Digital I/O                                   | Optional  |  |
| Analog I/O                                    | Optional  |  |
| <b>PROTECTIONS</b>                            |   |  |
| Ground Fault Protection                       | Insulation monitoring device                                    |  |
| Humidity control                              | Active Heating  |  |
| General AC Protection & Discom.               | Circuit Breaker   |  |
| Overvoltage Protection                        | Type 2  |  |

[1] Values at 1,10kVdc, nom and cos φ= 1.  
Consult Power Electronics for derating curves.

[2] Heating kit option required below -20°C.

[3] Sound pressure level at a distance of 1m from the rear part.



# POWER PLANT CONTROLLER

POWER PLANT CONTROLLER



LOAD LEVELING



RENEWABLE INTEGRATION



UTILITY CURTAILMENT RECOVERY



CLIPPING RECOVERY



FREQUENCY REGULATION SYSTEM



PEAK POWER SHAVING

## ENHANCE THE DYNAMIC GRID SUPPORT OF YOUR PV PLANT

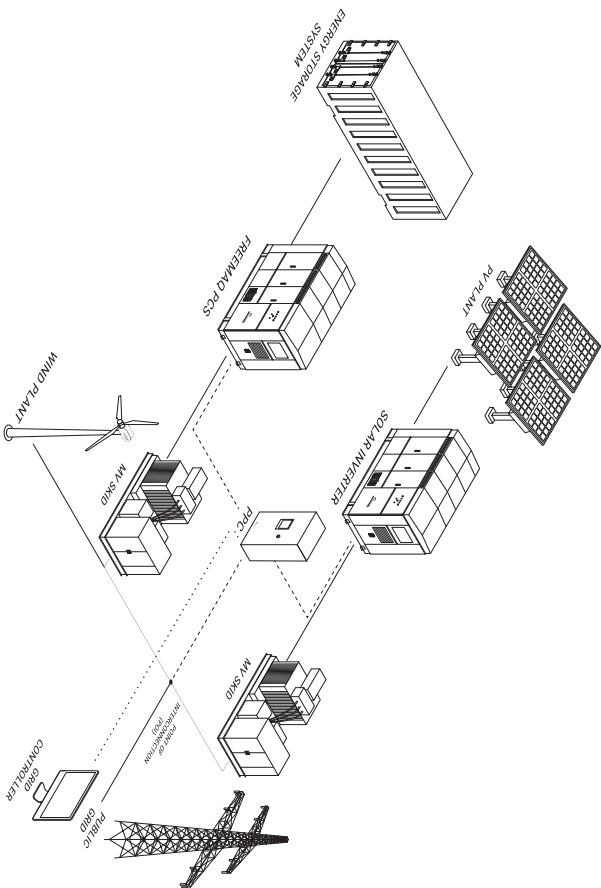
Power Electronics experience in integrating its products into different global electrical networks enables us to offer a set of solutions that can be customized to your requirements to control different sources of energy into the same grid.

The integration of an alternative power source creates an unprecedented opportunity to reduce operational costs to off grid industrial and commercial facilities.

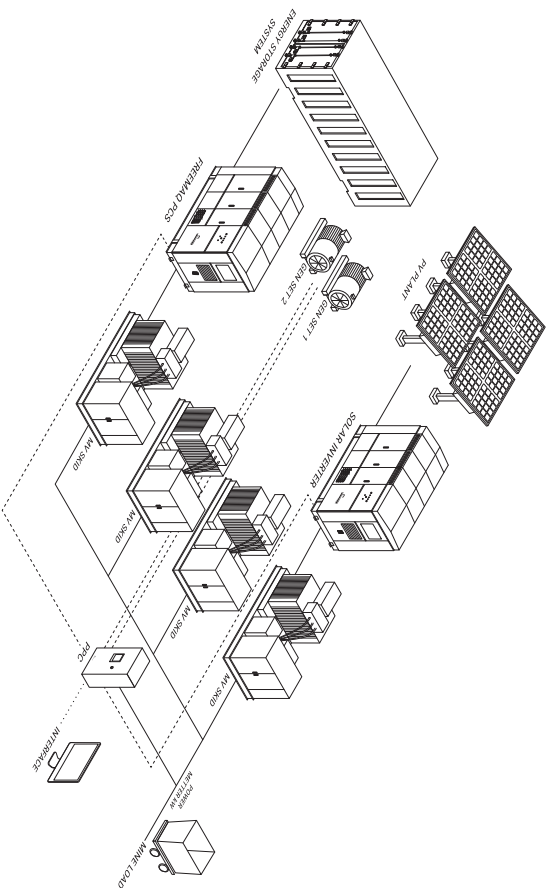
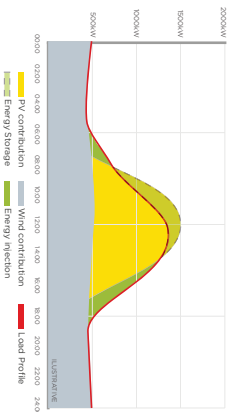
### POWER PLANT CONTROLLER

The Power Plant Controller (PPC) can be the main governor of the most complex Multi PCS systems by monitoring the point of interconnection (POI) and at the same time controlling the power generation and storage equipment. The PPC is equipped with the latest PLC based microprocessor that interacts through the programmable digital/

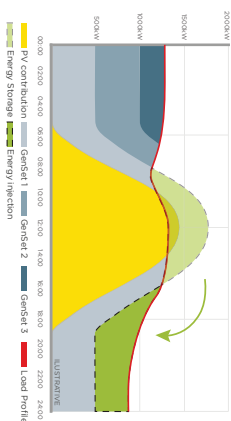
analogue signals and communication ports (Modbus TCP). The PPC together with the Freesun solar inverter or the Free-maq series can be customized for those countries (Puerto Rico, Hawaii,...) that require full compliance to stringent dynamic grid support response at POI.



- PPC main governor and interface of the system.
- Multiple renewable power sources: solar, wind, etc.
- Centralized dynamic grid support at POI.
- Power smoothing – Enable ramp rate control.
- Storage equipment control.



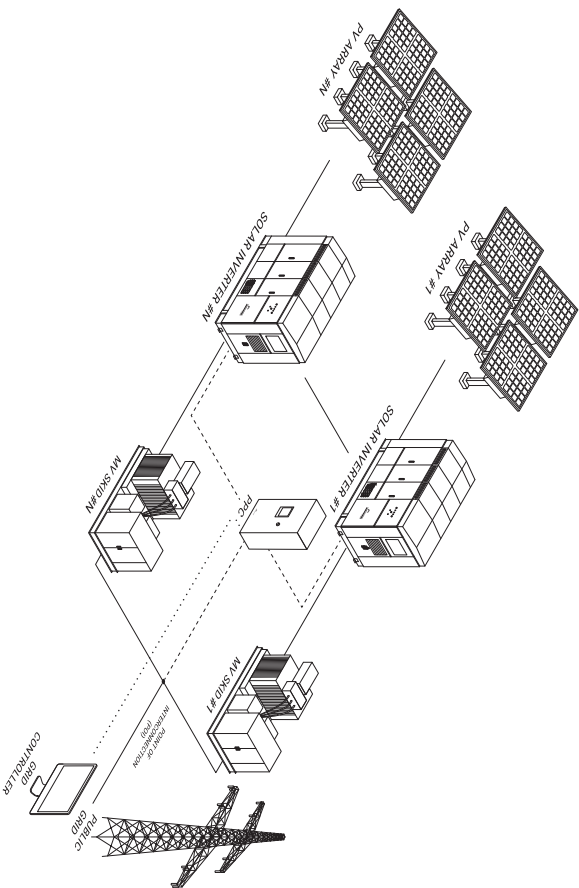
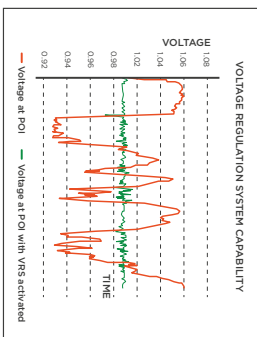
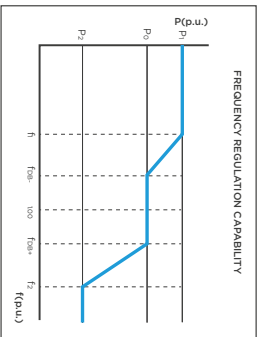
- PPC main governor and interface of the system.
- Multiple GenSets and storage equipment control.
- Centralized dynamic grid support at POI.
- Power shaping – Enhanced broad implementation of decentralized PV.
- Power smoothing – Enable ramp rate control.



## DYNAMIC GRID SUPPORT

The Power Electronics Power Plant Controller is a device used to manage PV plants in order to comply with all the utility and customer requirements, thanks to its fast and flexible control algorithms. The PPC helps the grid controller to manage the performance of the PV plant, guaranteeing grid quality requirements.

The PPC includes the latest utility interactive specifications to support the grid, by controlling the reactive and active power at the POI with a fast response time. This flexible plant control device allows the user to customize the unit, in order to comply with any grid code standards and regulations.



## TECHNICAL CHARACTERISTICS

## PPC

|   |  |  |
|---|--|--|
| <b>GENERAL DATA</b>                         | Dimensions (WxDxH) mm  | 415 x 230 x 515  |
|   | Weight (kg)  | 10   |
|   | Mounting system  | Wall mounted   |
|   | Compatible Inverters   | HE, HEC, HEM, HENK and Fraenqd PCS   |
|   | Power Supply   | 250W   |
| <b>I/O and COMMUNICATIONS<sup>[1]</sup></b> | 4 x Digital inputs   | Programmable inputs and active high (24Vdc), optically isolated                          |
|   | 1 x RS485 Port   | 3 wires (GND, A/B), Modbus RTU   |
|   | 1 x USB Port   | PC connectable using a master Modbus configurator (ModScan or similar), Reserved for TS. |
|   | 1 x CAN Port   | 3 wires (G, S, H), Modbus RTU  |
| <b>ENVIRONMENTAL CONDITIONS</b>             | 1 x Ethernet Port (RJ45)   | Modbus TCP/IP  |
|   | Operation Temperature  | 0~50°C (32~122°F)  |
|   | Storage temperature  | -20~80°C (-4~176°F)  |
|   | Humidity   | 5-95%, non-condensing  |
|   | Degree of protection   | IP42   |
| <b>CERTIFICATIONS</b>                       |  | CE   |
| <b>OTHERS</b>                               | Web interface for local and remote monitoring<br>Customized solution |  |

[1] Communication ports can be customised depending on PV plant design without prior notice

# REFERENCES

More than 12GW installed around the world.



AUSTRALIA  
Ballarat, 30MW  
FREEMAQ PCS



UNITED STATES  
Pima, 11MW  
FREEMAQ PCS



UNITED STATES  
Citrus, 2MW  
FREEMAQ DC/DC



UNITED STATES  
Visita, 43.2MW  
FREEMAQ PCS



UNITED STATES  
Caso Bay, 18MW  
FREEMAQ PCS

**WARRANTY**

Power Electronics (The Seller) warrants that their Energy Storage And Power Quality Products are free of faults and defects for a period of 3 years, valid from the date of delivery to the Buyer. It shall be understood that a product is free of faults and defects when its condition and performance is in compliance with its specification.

The warranty shall not extend to any Products whose defects are due to (i) careless or improper use, (ii) failure to observe the Seller's instructions regarding the transport, installation, functioning, maintenance and the storage of the Products, (iii) repairs or modifications made by the Buyer or third party without prior written authorization of the Seller, (iv) negligence during the implementation of authorized repairs or modifications, (v) if serial numbers are modified or illegible, (vi) anomalies caused by or connected to, the elements coupled directly by the Buyer or by the final customer, (vii) accidents or events that place the Product outside its storage and operational specification, (viii) continued use of the Products after identification of a fault or defect.

The warranty excludes components that must be replaced periodically such as fuses, lamps & air filters or consumable materials subject to normal wear and tear. The warranty excludes external parts that are not manufactured by the Seller under the brand of Power Electronics.

The Seller undertakes to replace or to repair, himself, at their discretion any Product or its part that demonstrates a fault or defect, which is in conformance with the aforementioned terms of the warranty. Reasonable costs associated with the disassembly/assembly, transport and customs of equipment will also be undertaken by the Seller except in cases of approved intervention by the Buyer and/or their representative where cost allocation has been previously agreed.

**ADDITIONAL WARRANTY**

Power Electronics stands by the quality and durability of our inverters. That is why we offer a comprehensive 3 year warranty on our equipment. As the inverter is the critical component of the installation, it must not shutdown.

This is why we have made it our top priority to create a robust and reliable product and give the best service and warranty along with it. To boost your confidence further in our products, Extended Warranty packages up to 20 years are also available.

In case of fault or defect, the Buyer shall notify the Seller in writing by using

the following contact email: [quality@power-electronics.com](mailto:quality@power-electronics.com), of the presence of any fault or defect within 15 days of the fault or defect event. The serial number of the defective product, plus a brief description of the fault must be included in the email. Failure to notify the Seller of fault or defect within this time period may result in the warranty becoming invalid.

In the event of replacement of defective Product or part thereof, the property of the Product or part shall be transferred to the Seller.

The Seller shall bear no liability for damages to property or third persons, even as manufacturer of the Products, other than that expressly provided by virtue of applicable mandatory law provisions. In any case, the Seller shall not be liable for indirect or consequential damages of whatsoever nature as, by way of example, production losses or unearned profits.

The Seller shall, at their discretion, forfeit all warranty rights of the Buyer if the total sum of the contract and payment has not been reached in accordance with the agreed conditions of the contract.

No other warranties, express or implied, are made with respect to the Products including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose.

In any case, the Buyer's right to damages shall be limited to a maximum amount equal to no more than the price obtained by the Seller of the faulty or defective Products.

These conditions shall apply to any repaired or replacement products. Notwithstanding the above, the replacement of a Product does not imply an extension of the term of warranty outside that of the original term.

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