Georgia Tech Bunger Henry Solar Roof Array

ENGINEERING PACKAGE

Project Tracking Number: 2017-PRF-1982
AiM Project Number: CEST-20-2017

Prepared For :	**Prepared By:**
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1. Overview

This Engineering Package includes:

1. STAMPED ELECTRICAL DESIGN: PROFICIENT ENGINEERING

    a. E-1: ELECTRICAL RISER, SPECIFICATIONS & GENERAL NOTES
    b. E-2: ELECTRICAL ROOF PLAN & WIRING SIZE TABLE

2. CODE SUMMARY: TRUE ENERGY USA / IBC/IFC/NEC/IECC CODE COMPLIANCE SUMMARY
3. DIMENSIONED ROOF MODULE LAYOUT
4. SOLARWORLD SW 280 MONO BLACK: DATA SHEET
5. SOLARWORLD SW 280 MONO BLACK: CSA GROUP / CERT. OF COMPLIANCE UL 1703
6. UNIRAC RM: DATA SHEET
7. UNIRAC RM 10: TUV / UL 2703 FIRE CERTIFICATION
8. ABB PVI-3.6: DATA SHEET
9. ABB PVI-3.6: CSA GROUP / UL 1741 CERTIFICATE OF COMPLIANCE
10. PE LETTER: STABILITY ENGINEERING / ROOF LOADS FOR BALLASTED ARRAY
11. PE LETTER: STABILITY ENGINEERING / WIND LOADS ON ARRAY
12. TIGO TS4-S: SAFETY/MONITORING DATA SHEET
13. ABB VSN800 WEATHER STATION DATA SHEET
14. ABB VSN700 DATA LOGGER DATA SHEET

ELECTRICAL SPECIFICATIONS

A. GENERAL

a) CONTRACTOR SHALL REFER TO ALL RELATED DOCUMENTS, ARCHITECTURAL, STRUCTURAL, CIVIL AND MEP DRAWINGS, AND FULLY UNDERSTAND THE SCOPE OF WORK AND CONDITION OF CONSTRUCTION.

b) THE WORK UNDER THIS SPECIFICATIONS AND DRAWINGS SHALL INCLUDE ALL LABOR.

c) ALL INSTALLATION OF DEVICES AND CONNECTION OF CONDUCTORS SHALL BE PERFORMED BY LICENSED AND SKILLED ELECTRICIAN OR JOURNEYMAN.

d) THE WORK INCLUDES, BUT NOT LIMITED TO:
1. THE COMPLETE ELECTRICAL DISTRIBUTION SYSTEM.
2. ROUGH-IN AND FINAL CONNECTIONS TO ALL DEVICES REQUIRING ELECTRICAL POWER, INCLUDING OWNER PROVIDED EQUIPMENT.

e) EACH CONTRACTOR SHALL OBTAIN ALL PERMITS AND INSPECTIONS REQUIRED BY THE REGULATORY AUTHORITIES. ALL FEES RELATED TO OBTAINING PERMITS AND INSPECTION SHALL BE PAID FOR BY EACH CONTRACTOR IN HIS TRADE.

f) ALL MATERIALS AND WORKMANSHIP SHALL COMPLY WITH LOCAL, COUNTY, STATE, AND NATIONAL CODES, SPECIFICATIONS, UTILITY COMPANY REQUIREMENTS AND ALL INDUSTRY STANDARDS.

g) ANY DIFFERENCES IN ABOVE MENTIONED REQUIREMENTS; THE MOST STERN SHALL OVERRULE ALL OTHERS.

h) THE MANUFACTURER'S PUBLISHED DIRECTIONS SHALL BE FOLLOWED IN THE DELIVERY, STORAGE, PROTECTION, INSTALLATION AND WIRING OF ALL EQUIPMENT AND MATERIAL.

j) THE DRAWINGS SHOW DIAGRAMMATICALLY THE LOCATIONS OF THE VARIOUS LINES, CONDUITS, AND EQUIPMENT AND THE METHOD OF CONNECTING AND CONTROLLING THEM. IT IS NOT INTENDED TO SHOW EVERY CONNECTION IN DETAIL AND ALL FITTINGS REQUIRED FOR A COMPLETE SYSTEM. THE SYSTEMS SHALL INCLUDE BUT ARE NOT LIMITED TO THE ITEMS SHOWN ON THE DRAWINGS. EXACT LOCATIONS OF THESE ITEMS SHALL BE DETERMINED BY REFERENCE TO THE GENERAL PLANS AND MEASUREMENTS AT THE BUILDING AND IN COOPERATION WITH THE OTHER SUBCONTRACTORS, AND IN ALL CASES, SHALL BE SUBJECT TO THE APPROVAL OF THE OWNER. THE OWNER RESERVES THE RIGHT TO MAKE ANY REASONABLE CHANGE IN THE LOCATION OF ANY PART OF THIS WORK WITHOUT ADDITIONAL COST TO THE OWNER.

k) CONTRACTOR SHALL COORDINATE AND VERIFY THE WORK WITH EXISTING CONDITIONS AND THE WORK OF OTHER TRADE PRIOR TO ANY FABRICATIONS OR INSTALLATION. IF THE LAYOUT OF THE EQUIPMENT ON DRAWINGS ARE IMPRACTICAL TO THE CONDITION IN FIELD, CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY PRIOR TO ANY FABRICATION OR INSTALLATION.

l) THE LINES INDICATING BRANCH CIRCUITS DO NOT REPRESENT THE ROUTING OF ELECTRICAL CONDUITS. THEY INDICATE THE LAYOUT AND CONTROL OF CIRCUITS.

B. PRODUCTS AND WORK

a) MATERIALS FURNISHED SHALL BE NEW AND BY STANDARD MANUFACTURERS AND MUST CONFORM TO THE NATIONAL BOARD OF FIRE UNDERWRITER'S REQUIREMENTS AND BEAR THE UNDERWRITER'S LABORATORIES' SEAL OF APPROVAL.

b) LISTED MANUFACTURERS, MODELS, OR CATALOGUE NUMBERS IN PART OR ALL SHALL ENTAIL TO INCLUDE THE PUBLISHED MANUFACTURERS DESCRIPTION AND SPECIFICATION.

c) CONTRACTOR SHALL NOT INTERPRET THAT THE LISTED MANUFACTURERS IN SPECIFICATIONS OR DRAWINGS TO EXCLUDE ALL OTHER MANUFACTURERS

d) CONTRACTOR SHALL MAKE CERTAIN THAT ALL EQUIPMENT FIT IN THE SPACE DESIGNATED AND DESIGNED FOR THE SURROUNDINGS IT OCCUPIES.

e) ALL HORIZONTAL RUNS OF CONDUITS SHALL BE SUPPORTED BY MEANS OF APPROVED HANGER FROM THE STRUCTURAL CEILING.

f) COORDINATE THE WORK UNDER THIS SECTION WITH ALL OTHER TRADES.

g) VERIFY ELECTRICAL RESISTANCE MEETS MANUFACTURER'S REQUIREMENTS.

C. EQUIPMENT GROUNDING CONDUCTOR

a) PER THE PROVISIONS OF NEC ARTICLE 690.45 AND 250.120(C), #6AWG GROUNDING CONDUCTORS ARE USED ON PV ARRAY INSTALLATIONS AS THE CONDUCTOR IS NOT PROTECTED FROM PHYSICAL DAMAGE IN THESE LOCATIONS. A SIZE #8AWG GROUNDING CONDUCTOR WOULD BE SUITABLE IF THE CONDUCTOR WAS SUITABLY PROTECTED.

D. FIRE PENETRATIONS

a) EACH PENETRATION OF A FIRE RESISTANT RATED ASSEMBLY BY A PIPE, TUBE WIRE OR CONDUIT SHALL BE PROTECTED BY A THROUGH PENETRATION FIRE STOP SYSTEM THAT HAS BEEN TESTED ACCORDING TO ASTM E814 OR E199.

EQUIPMENT DATASHEETS AND PRODUCT CERTIFICATES

THE FOLLOWING LIST OF ENCLOSURES TO BE PROVIDED BY TRUE ENERGY, INC REPRESENTATIVE AS PART OF THIS PHOTOVOLTAIC PROJECT SUBMISSION:

CODE SUMMARY: TRUE ENERGY USA / IBC/IFC/NEC/IECC CODE COMPLIANCE SUMMARY

SOLARWORLD SW 280 MONO BLACK: DATA SHEET
SOLARWORLD SW 280 MONO BLACK: CSA GROUP / CERTIFICATE OF COMPLIANCE UL1703

UNIRAC RM: DATA SHEET
UNIRAC RM 10: TUV / UL 2703 FIRE CERTIFICATION

ABB PVI-3.6: DATA SHEET
ABB PVI-3.6: CSA GROUP / UL 1741 CERTIFICATE OF COMPLIANCE

PE LETTER: STABILITY ENGINEERING / ROOF LOADS FOR BALLASTED ARRAY
PE LETTER: STABILITY ENGINEERING / WIND LOADS ON ARRAY

TIGO TS4-S: SAFETY/MONITORING DATA SHEET

APPLICABLE CODES FOR COMPLIANCE

THIS PROJECT HAS BEEN DESIGNED TO AND SHALL BE INSTALLED TO THE FOLLOWING SPECIFIC PHOTOVOLTAIC CODE REQUIREMENTS:

APPLICABLE PHOTOVOLTAIC IBC 2012 CODES
IBC 1505.1 GENERAL.
IBC 1505.8 PHOTOVOLTAIC SYSTEMS.
IBC 1507.17 PHOTOVOLTAIC MODULES/SHINGLES AND MODULES.
IBC 1507.17.1 MATERIAL STANDARDS.
IBC 1509.7 PHOTOVOLTAIC PANELS AND MODULES.
1509.7.1 WIND RESISTANCE.
IBC 1509.7.2 FIRE CLASSIFICATION.
IBC 1509.7.3 INSTALLATION.
IBC [BG] 1509.7.4 PHOTOVOLTAIC PANELS AND MODULES.
IBC 1509.8.1 AERIAL SUPPORTS.
IBC 1511.1 PHOTOVOLTAIC PANELS AND MODULES.
IBC 1511.1.1 PHOTOVOLTAIC PANELS AND MODULES.
IBC 1607 LIVE ROOF LOADS
IBC 1607.12 ROOF LOADS.
IBC 1609 DEAD LOADS
IBC 1609 WIND LOADS
IBC 1609.1: APPLICATIONS:

APPLICABLE PHOTOVOLTAIC IFC 2012 CODES
IFC SECTION 317: ROOFTOP GARDENS AND LANDSCAPED ROOFS
IFC 317.1 GENERAL.
IFC 317.2 THROUGH 317.5 AND SECTIONS 1 505.0 AND 1507.16 OF THE INTERNATIONAL BUILDING CODE.

IFC 317.2 ROOFTOP GARDEN OR LANDSCAPED ROOF SIZE.
IFC 317.3 ROOFTOP STRUCTURE AND EQUIPMENT CLEARANCE.
IFC 317.4 VEGETATION.
IFC [A] 105.7.13 SOLAR PHOTOVOLTAIC POWER SYSTEMS.
IFC 601.2 PERMITS.
IFC 605.11 SOLAR PHOTOVOLTAIC POWER SYSTEMS.
IFC 605.11.1 MARKING.
IFC 605.11.1.1 MATERIALS.
IFC 605.11.1.2 MARKING CONTENT.
IFC 605.11.1.3 MAIN SERVICE DISCONNECT.
IFC 605.11.1.4 LOCATION OF MARKING.
IFC 605.11.2 LOCATIONS OF DC CONDUCTORS.
IFC 605.11.3 ACCESS AND PATHWAYS.
IFC 605.11.3.1 ROOF ACCESS POINTS.
IFC 605.11.3.2 RESIDENTIAL SYSTEMS FOR ONE- AND TWO FAMILY DWELLINGS.
IFC 605.11.3.2.1 RESIDENTIAL BUILDINGS WITH HIP ROOF LAYOUTS. N/A
IFC 605.11.3.2.2 RESIDENTIAL BUILDINGS WITH A SINGLE RIDGE. N/A
IFC 605.11.3.2.3 RESIDENTIAL BUILDINGS WITH ROOF HIPS AND VALLEYS. : N/A
IFC 605.11.3.2.4 RESIDENTIAL BUILDING SMOKE VENTILATION. N/A
IFC 605.11.3.3 OTHER THAN RESIDENTIAL BUILDINGS.
IFC 605.11.3.3.1 ACCESS.
IFC 605.11.3.3.2 PATHWAYS.
IFC 605.11.3.3.3 SMOKE VENTILATION.
IFC 605.11.4 GROUND-MOUNTED PHOTOVOLTAIC ARRAYS.

APPLICABLE NFPA 70: NEC 2014 CODES
NEC 690.1 GENERAL (SCOPE)
NEC 690.2 DEFINITIONS
NEC 690.3 OTHER ARTICLES
NEC 690.4 GENERAL REQUIREMENTS
NEC 690.4 (B) EQUIPMENT.
NEC 690.4 (C) QUALIFIED PERSONS.
NEC 690.4 (D) MULTIPLE INVERTERS.
NEC 690.5 GROUND FAULT PROTECTION.
NEC 690.6 ALTERNATING CURRENT (AC) MODULES: N/A
NEC 690.7 MAXIMUM VOLTAGE
NEC 690.8 CIRCUIT SIZING AND CURRENT
NEC 690.8 A. CALCULATION OF MAXIMUM CIRCUIT CURRENT
NEC 690.8 B. CONDUCTOR AMPACITY:
NEC 690.9 OVERCURRENT PROTECTION
NEC 690.9 (A) CIRCUITS AND EQUIPMENT
NEC 690.9 (B) OVERCURRENT DEVICE RATINGS
NEC 690.9 (C) DIRECT-CURRENT RATING
NEC 690.9 (D) PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUITS
NEC 690.9 (E) POWER TRANSFORMERS.
NEC 690.9 (E) SERIES OVERCURRENT PROTECTION.
NEC 690.10 STAND-ALONE SYSTEMS: N/A
NEC 690.11 ARC-FAULT CIRCUIT PROTECTION (DIRECT CURRENT)
NEC 690.12 RAPID SHUTDOWN OF PV SYSTEMS ON BUILDINGS
NEC 690.13 BUILDING OR OTHER STRUCTURE SUPPLIED BY A PHOTOVOLTAIC SYSTEM, DC CONDUCTOR DISCONNECT
NEC 690.13 (A) LOCATION.
NEC 690.13 (B) MARKING.
NEC 690.13 (C) SUITABLE FOR USE.
NEC 690.13 (D) MAXIMUM NUMBER OF DISCONNECTS.
NEC 690.13 (E) GROUPING
NEC 690.15(A) UTILITY INTERACTIVE INVERTERS MOUNTED IN NOT-READILY ACCESSIBLE LOCATIONS. N/A
NEC 690.15(B) EQUIPMENT
NEC 690.15(C) DIRECT CURRENT COMBINER DISCONNECTS. N/A
NEC 690.16 FUSES
NEC 690.17 DISCONNECT TYPE
NEC 690.17(A) MANUALLY OPERABLE
NEC 690.17(B) SIMULTANEOUS OPENING OF POLES
NEC 690.17(C) EXTERNALLY OPERABLE
NEC 690.17(D) DISCONNECTION OF GROUNDED CONDUCTOR.
NEC 690.17(E) INTERRUPTING RATING.
NEC 690.18 INSTALLATION AND SERVICE OF AN ARRAY
NEC 690.31 WIRING METHODS
NEC 690.32 COMPONENT INTERCONNECTIONS
NEC 690.33 CONNECTORS
NEC 690.33 (A) CONFIGURATION.
NEC 690.33 (B) GUARDING.
NEC 690.33 (C) TYPE.
NEC 690.33 (D) GROUNDING MEMBER.
NEC 690.33 (E) INTERRUPTION OF CIRCUIT.
NEC 690.34 ACCESS TO BOXES
NEC 690.35 UNGROUNDED PHOTOVOLTAIC SYSTEMS
NEC 690.35 (A) DISCONNECTS
NEC 690.35 (B) OVERCURRENT PROTECTION
NEC 690.35 (C) GROUND FAULT PROTECTION
NEC 690.35 (D) CONDUCTORS
NEC 690.35 (E) BATTERY SYSTEM: N/A
NEC 690.35 (F) MARKING.
NEC 690.35 (G) EQUIPMENT.
NEC 690.41 SYSTEM GROUNDING
NEC 690.42 POINT OF SYSTEM GROUNDING CONNECTION
NEC 690.43 EQUIPMENT GROUNDING
NEC 690.43 (A) EQUIPMENT GROUNDING
NEC 690.43 (B) EQUIPMENT GROUNDING CONDUCTOR REQUIRED.
NEC 690.43 (C) STRUCTURE AS EQUIPMENT GROUNDING CONDUCTOR.
NEC 690.43 (D) PHOTOVOLTAIC MOUNTING SYSTEMS AND DEVICES.
NEC 690.43 (E) PHOTOVOLTAIC MOUNTING SYSTEMS AND DEVICES.
NEC 690.43 (F) ALL CONDUCTORS TOGETHER.
NEC 690.45 SIZE OF EQUIPMENT GROUNDING CONDUCTORS.
NEC 690.46 ARRAY EQUIPMENT GROUNDING CONDUCTORS.
NEC 690.47 GROUNDING ELECTRODE SYSTEM.
NEC 690.48 CONTINUITY OF EQUIPMENT GROUNDING SYSTEM.
NEC 690.49 CONTINUITY OF PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUIT GROUNDED CONDUCTORS.
NEC 690.50 EQUIPMENT BONDING JUMPERS.
NEC 690.51 MODULES.
NEC 690.52 ALTERNATING CURRENT PHOTOVOLTAIC
NEC 690.53 DIRECT-CURRENT PHOTOVOLTAIC POWER SOURCE:
NEC 690.54 INTERACTIVE SYSTEM POINT OF INTERCONNECTION
NEC 690.55 PHOTOVOLTAIC POWER SYSTEM EMPLOYING ENERGY STORAGE:
NEC 690.56 IDENTIFICATION OF POWER SOURCES.
NEC 690.56 (A) FACILITIES WITH STAND ALONE SYSTEM. N/A
NEC 690.56 (B) FACILITIES WITH UTILITY SERVICES AND PV SYSTEMS.
NEC 690.56 (C) FACILITIES WITH RAPID SHUTDOWN.
NEC 690.57 LOAD DISCONNECT. N/A
NEC 690.60 IDENTIFIED INTERACTIVE EQUIPMENT.

GENERAL NOTES

1) ALL INSTALLATIONS ARE TO BE IN STRICT ACCORDANCE WITH ARTICLE 690 OF THE LATEST ACCEPTED EDITION OF THE NATIONAL ELECTRICAL CODE (NFPA 70).

2) FOR KEYNOTES WITH LETTER DESIGNATIONS, SEE CONDUCTOR SIZING TABLES SHEET E-2.

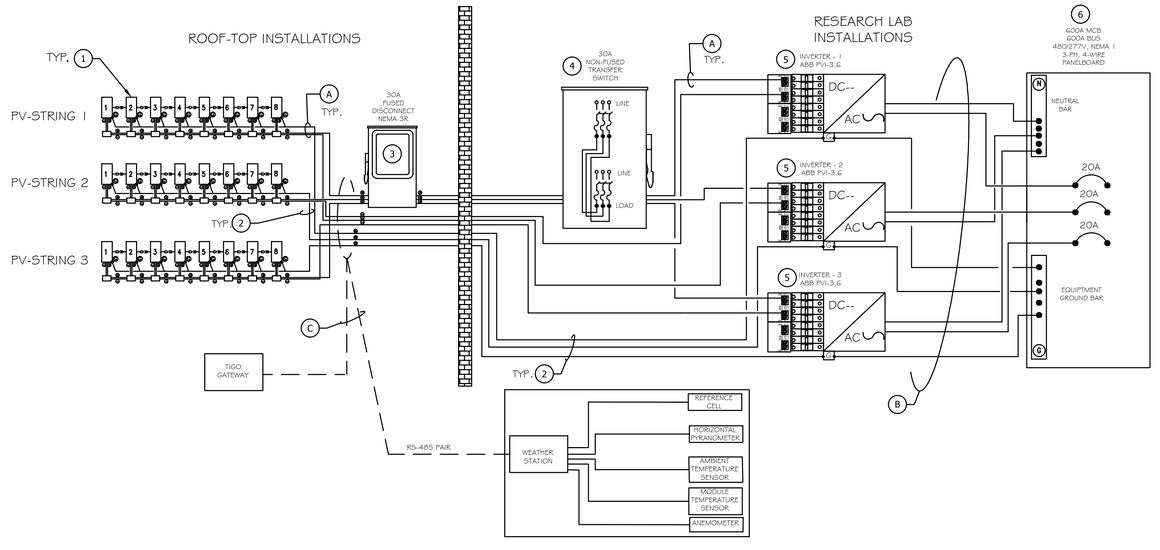
KEYNOTES

1. 280W MODULES INCLUDES #10AWG (UL 600V). DO NOT REMOVE THE QUICK CONNECTS AS THE MODULE WARRANTY AND UL LISTING MAY BE INVALIDATED.
2. USE MODULE GROUNDING METHODS AND SPECIFIED GROUNDING LOCATIONS PER MANUFACTURER'S INSTALLATION MANUAL AND WARRANTY. THE MODULE EQUIPMENT GROUNDS SHALL GROUND ALL THE EQUIPMENT AND SHALL TERMINATE IN THE INVERTER CABINET.
3. SOLAR DISCONNECT, PROVIDE 30A, 600ADC RATED NEMA 3R NON-FUSED DISCONNECT. LABEL FRONT OF DISCONNECT WITH SIGNAGE STATING "SOLAR ARRAY DISCONNECT".
4. MANUAL TRANSFER SWITCH. 3-POLE, NON-FUSED, 600VDC RATED, NEMA 1, DOUBLE THROW DEVICE. SQUARE D MODEL DTU361 OR SIMILAR.
5. STRING INVERTER, ABB MODEL PVI-3.6-OUTD-US. INVERTER MEETS UL 1741 AND TO HAVE INTEGRAL ANTI-ISLANDING PROTECTION FEATURES AND CONNECTION UNIT WITH INTEGRATED DISCONNECT AND FUSES. PROVIDE (3) SETS OF 20A 600 VDC RATED FUSES AT DC POSITIVE AND DC NEGATIVE STRING INPUTS. HOUSING TO BE FULLY WEATHERPROOF.
6. EXISTING 600A MCB PANELBOARD NEMA 1 WITH (3) 20A 1-POLE BREAKERS RATED 277V. BREAKERS ARE TO BE BACK-FED RATED.

PV STRING SIZING EQUATIONS AND DATA

PV STRING SIZING
I_{SC} X 1.56 = 15.17 AMPS
CONDUCTOR DERATED FOR
LOCAL STATISTICALLY HIGH
TEMPERATURE OF 39°C = 0.88

V_{OC}: 39.50 V DC
OF MODULES PER STRING: 8
RECORD LOW TEMP: -10°C
TEMP. COEFF. OF V_{OC}: -0.32% PER DEGREE CELSIUS
STC TEMP: 25°C
TEMP CORRECTED FOR RECORD LOW: -36°C
(-0.32% * -35)+1 = 1.12
39.50 VDC * 1.12 = 44.24 V DC @ RECORD LOW -10°C
44.24 V_{OC} X 8 MODULES PER STRING= 353.92 V_{OC} @ RECORD LOW -10°C



1 / E-1 ELECTRICAL THREE-LINE DIAGRAM – ROOF INSTALLATION
SCALE: NONE

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FOR CONSTRUCTION

DRAWN BY: HL/MM/DA
CHECKED BY: BA/RK

ISSUE / REVISIONS:

DATE	DESCRIPTION
10/27/2016	PERMIT SET

SHEET NAME:
ELECTRICAL RISER, SPECIFICATIONS & GENERAL NOTES

SHEET NUMBER:
E-1

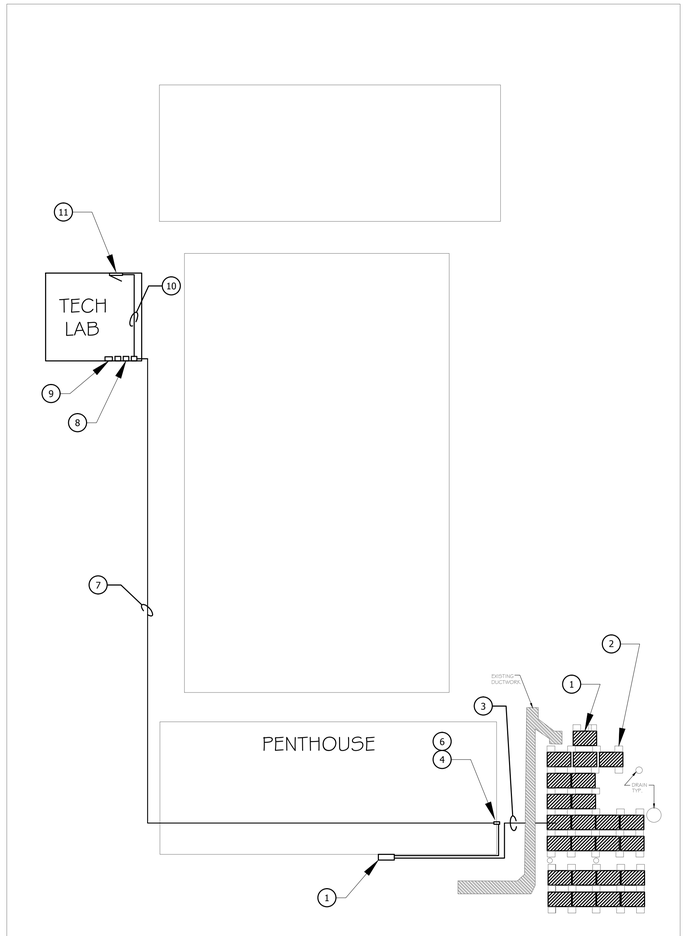
10/27/2016

TABLE A: OUTPUT CIRCUIT CONDUCTOR AND CONDUIT IDENTIFICATION

CONDUCTOR LOCATIONS 'A'	1.56@Isc (A)	Imp (A)	Voc (VDC) Max	Vmp (VDC)	CONDUCTOR LENGTH, LONGEST STRING (FT)	VOLTAGE DROP (%)	CURRENT CARRYING CONDUCTOR SIZE	CONDUCTOR TYPE	GROUNDING CONDUCTOR	CONDUIT
PV STRING 1	15.2	8.09	249.6	36.1	260.00	3.19	#10	#10AWG 600V	#6 AWG	FREE AIR, 2" CONDUIT
PV STRING 2	15.2	8.09	249.6	36.1	250.00	3.06	#10	#10AWG 600V	#6 AWG	FREE AIR, 2" CONDUIT
PV STRING 3	15.2	8.09	249.6	36.1	275.00	3.37	#10	#10AWG 600V	#6 AWG	FREE AIR, 2" CONDUIT
					Average Voltage Drop	3.21				

TABLE B: AC CONDUCTOR AND CONDUIT IDENTIFICATION

CONDUCTOR LOCATION	NOMINAL VOLTAGE (VAC)	PHASES	GENERATION CAPACITY (A)	CURRENT CARRYING CONDUCTOR SIZE	# CONDUCTORS PER PHASE	CONDUCTOR TYPE	NEUTRAL CONDUCTOR SIZE	EQUIPMENT GROUNDING CONDUCTOR	CONDUIT
B - PV INV 1 TO PANELBOARD	277	1	16	12	1	THWN-2 CU	12	#12 THWN-2 CU	1/2" EMT
B - PV INV 2 TO PANELBOARD	277	1	16	12	1	THWN-2 CU	12	#12 THWN-2 CU	1/2" EMT
B - PV INV 2 TO PANELBOARD	277	1	16	12	1	THWN-2 CU	12	#12 THWN-2 CU	1/2" EMT
C	DATA	N/A	N/A	RS-485	N/A	RS-485	N/A	CAT 5E	3/4" EMT



1 / E-2 ROOF INSTALLATION – BUNGER HENRY BUILDING
SCALE: 1/16" = 1'-0"

GENERAL NOTES

PER THE CODE REQUIREMENTS OF IFC 605.11.1.3, A 4'-0" MINIMUM PATHWAY IS REQUIRED BETWEEN THE PARAPET AND PHOTOVOLTAIC ARRAYS. THE ARRAY CONFIGURATIONS AND LAYOUTS SHOWN ON THIS DRAWING ARE DIAGRAMMATIC IN NATURAL ONLY, AND SOME LAYOUT CHANGES MAYBE REQUIRED TO MEET THESE PATHWAY CLEARANCES.

KEYNOTES

1. MODULE ARRAY, ROOF-MOUNTED, STRING OF 8.
2. APPROXIMATE LOCATION OF WEATHER STATION
3. CONDUIT RUN ON ROOF-TOP. MAINTAIN AT LEAST 4'-6" MINIMUM CLEARANCE ABOVE ROOF STRUCTURE USING RUBBER WEDGE SUPPORTS.
4. PENETRATION OF (2) CONDUITS (POWER & DATA) THROUGH WALL INTO PENTHOUSE AREA.
5. LOCATION OF 30A DC DISCONNECT.
6. CONDUITS TRANSITION VERTICALLY FROM PENTHOUSE TO 2ND FLOOR.
7. CONDUITS TRANSITION HORIZONTALLY ALONG UNDERSIDE OF CEILING IN SECOND FLOOR CORRIDOR.
8. APPROXIMATE LOCATION OF (3) INVERTER INSTALLATIONS.
9. APPROXIMATE LOCATION OF 30A MANUAL TRANSFER SWITCH.
10. CONDUIT RUN FROM OUTPUT OF INVERTERS TO EXISTING 600A PANELBOARD.
11. APPROXIMATE LOCATION OF EXISTING 600A PANELBOARD.

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FOR CONSTRUCTION

DRAWN BY: HL/MM/DA
CHECKED BY: BA/RK

ISSUE / REVISIONS:

DATE	DESCRIPTION
10/27/2016	PERMIT SET

SHEET NAME:
ELECTRICAL ROOF PLAN & WIRE SIZING TABLE

SHEET NUMBER:
E-2

10/27/2016

APPLICABLE CODE LIST
(IBC 2012, IFC 2012, IECC 2009, NFPA 70 2014)

PROJECT:	Bunger Henry Solar Roof Array	CONTRACTOR:	TRUE ENERGY USA
TRACKING NO.	2017-PRF-1982	CONTACT:	Stefan King
PROJECT NO:	CEST-20-2017	EMAILPHONE	sking@trueenergy-usa.com / 678-520-0033
CHANGEID:	GT2016116-1	DATE:	11/30/2016

APPLICABLE PHOTOVOLTAIC IBC 2012 CODES

IBC 1505.1 General.
Roof assemblies shall be divided into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E108 or UL 790. In addition, fire-retardant-treated wood roof coverings shall be tested in accordance with ASTM D2898. The minimum roof coverings installed on buildings shall comply with Table CS502.1 (IBC 1505.1) based on the type of construction of the building.

Exception: Skylights and sloped glazing that comply with (IBC Chapter 24) or (IBC Section 2610).

COMPLIANCE: SolarWorld SW 280 Modules have a Class A Fire Rating as certified UL 1703 Type 1 (datasheet and certification provided). UNIRAC RM Ballasted Roof Mounting System has UL 2703 certification for Class A Fire Rating.

IBC 1505.8 Photovoltaic Systems. Rooftop installed photovoltaic systems that are adhered to or attached to the roof covering of photovoltaic modules/shingles installed as roof coverings shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1

COMPLIANCE: PV System is not adhered or attached to the roof covering or installed as a roof covering however it is still classified as Class A Fire rated in accordance with Section 1505.1

IBC 1507.17 Photovoltaic Modules/Shingles and modules. The installation of photovoltaic modules/shingles shall comply with the provisions of this section.

COMPLIANCE: NOT APPLICABLE. Applies to direct attached photovoltaic shingle systems. Section 1509.7 for Rooftop mounted photovoltaic systems applies to the this system

IBC 1507.17.1 Material standards. Photovoltaic modules/shingles shall be listed and labeled in accordance with UL 1703.

COMPLIANCE: SolarWorld SW 280 Modules have a Class A Fire Rating as certified UL 1703 Type 1 (datasheet and certification provided). UNIRAC RM Ballasted Roof Mounting System has UL 2703 certification for Class A Fire Rating.

IBC 1509.7 Photovoltaic panels and modules. Rooftop-mounted *photovoltaic panels* and *modules* shall be designed in accordance with this section.

COMPLIANCE: See Below:

1509.7.1 Wind resistance. Rooftop-mounted *photovoltaic panels* and *modules* shall be designed for component and cladding wind loads in accordance with Chapter 16 using an effective wind area based on the dimensions of a single unit frame.

COMPLIANCE: PE Stamped Structural Design was evaluated wind loads based on ASCE 7 in accordance with IBC Chapter 16. PE letters from the manufacturer and from an independent structural PE are provided.

IBC 1509.7.2 Fire classification. Rooftop-mounted *photovoltaic panels* and *modules* shall have the fire classification in accordance with Section 1505.

COMPLIANCE: SolarWorld SW 280 Modules have a Class A Fire Rating as certified UL 1703 Type 1 (datasheet and certification provided). UNIRAC RM Ballasted Roof Mounting System has UL 2703 certification for Class A Fire Rating.

IBC 1509.7.3 Installation. Rooftop-mounted *photovoltaic panels* and *modules* shall be installed in accordance with the manufacturer's instructions.

COMPLIANCE: Modules and racking will be installed according to manufacturers instructions. Installation will be performed by a NABCEP Certified Installation Professional

IBC [BG] 1509.7.4 Photovoltaic panels and modules. Photovoltaic panels and modules mounted on top of a roof shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacturers installation instructions.

COMPLIANCE: SolarWorld SW 280 Modules have a Class A Fire Rating as certified UL 1703 Type 1 (datasheet and certification provided). Modules and racking will be installed according to manufacturers instructions. Installation will be performed by a NABCEP Certified Installation Professional.

IBC 1509.8.1 Aerial Supports. Aerial supports shall be constructed of non-combustible materials.

Exception Aerial supports not greater than 12 feet in height as measured from roof deck to the highest point on the aerial supports shall be permitted to be constructed of combustible materials.

COMPLIANCE: The weather station to be installed adjacent to the array will be under 12 feet in height so the exception applies to weather station aerial post.

IBC 1511.1 Photovoltaic panels and modules. Photovoltaic panels and modules installed upon a roof or as an integral part of a roof assembly shall comply with the requirements of [this code] and the International Fire Code.

COMPLIANCE: SolarWorld SW 280 Modules have a Class A Fire Rating as certified UL 1703 Type 1 (datasheet and certification provided). SEE Next Section referring to IFC 2012 COMPLIANCE.

IBC 1511.1.1 Photovoltaic panels and modules. The structural frame and roof construction supporting the load imposed upon the roof by the photovoltaic panels/modules shall comply with the requirements of Table 601.

COMPLIANCE: Existing roof structure has been load evaluated by structural PE.

CHAPTER 16

IBC 1607 LIVE ROOF LOADS

IBC 1607.12 Roof loads.
The structural supports of roofs and marquees shall be designed to resist wind and, where applicable, snow and earthquake loads. in addition to the dead load of construction and appropriate live loads as prescribed in this section, or as set forth in Table 1607.1. The live loads acting on a sloping surface shall be assumed to act vertically on the horizontal projection of the surface.

IBC 1609 DEAD LOADS

IBC 1609 WIND LOADS

IBC 1609.1: Applications: Buildings structures and parts thereof shall be designed to withstand the minimum wind loads prescribed herein. Decreases in wind loads shall not be made for the effect of shielding other by other structures.

PE Stamped Structural Design has evaluated roof loading and wind loads based on ASCE 7 as specified in IBC 2012 Chapter 16. Evaluated for: ASCE 7-10; Wind Speed: 115 mph; Wind exposure : B.

See PE Letters for Roof Loading and Wind Loads.

APPLICABLE PHOTOVOLTAIC IFC 2012 CODES

IFC SECTION 317: ROOFTOP GARDENS AND LANDSCAPED ROOFS

IFC 317.1 General. Rooftop gardens and landscaped roofs shall be installed and maintained in accordance with Sections IFC 317.2 through 317.5 and Sections 1 505.0 and 1507.16 of the International Building Code.

IFC 317.2 Rooftop garden or landscaped roof size. Rooftop garden or landscaped roof areas shall not exceed 15,625 square feet (1 ,450m2) in size for any single area with a maximum dimension of 125 feet (39m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a Class A rated roof system complying with ASTM E 108 or UL 790 shall be provided between adjacent rooftop gardens or landscaped roof areas.

IFC 317.3 Rooftop structure and equipment clearance. For all vegetated roofing systems abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1.8 m) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports, and building service equipment.

IFC 317.4 Vegetation. ...

COMPLIANCE: Section 317 if NOT APPLICABLE since there is no vegetation, landscaping or rooftop gardens on the Bunger Henry building.

IFC [A] 105.7.13 Solar photovoltaic power systems. A construction permit is required to install or modify solar photovoltaic power systems.

COMPLIANCE: Permitting in process

IFC 601.2 Permits. Permits shall be obtained for refrigeration systems, battery systems and solar photovoltaic power systems as set forth in Sections 105.6 and 105.7.

COMPLIANCE: Permitting in process

IFC 605.11 Solar photovoltaic power systems. Solar photovoltaic power systems shall be installed in accordance with Sections 605.11.1 through 605.11.2, the International Building Code or International Residential Code, and NFPA 70.

Array installation and all electrical work will be performed by a NABCEP Certified Solar Installation Professional and Certified Master Electrician.

605.11 Solar photovoltaic power systems. Solar photovoltaic power systems shall be installed in accordance with Sections 605.11.1 through 605.11.4, the International Building Code and NFPA 70.

Exception: Detached, non-habitable Group U structures including, but not limited to, parking shade structures, carports, solar trellises and similar structures shall not be subject to the requirements of this section.

COMPLIANCE: EE Stamped Electrical Plans are engineered to NFPA 70 (NEC 2014) and IBC 2012.

605.11.1 Marking. Marking is required on interior and exterior direct-current (DC) conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects.

COMPLIANCE: All interior and exterior direct-current (DC) conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects. This compliance will adhere to NFPA 70 (NEC 2014) and IBC 2012.

605.11.1.1 Materials. The materials used for marking shall be reflective, weather resistant and suitable for the environment. Marking as required in Sections 605 .11.1.2 through 605.11.1.4 shall have all letters capitalized with a minimum height of 3/ 8 inch (9.5 mm) white on red background.

COMPLIANCE: Will Use Avery Dennison® T-1000-A & W-1000-A Series Engineering Grade Beaded Retroreflective Film. Data Sheet Attached. With RED background and reflective White lettering.

605.11.1.2 Marking content. The marking shall contain the words "WARNING: PHOTOVOLTAIC POWER SOURCE."

COMPLIANCE: The Following Labels will be used.

5¾" X 1⅛"

605.11.1.3 Main service disconnect. The marking shall be placed adjacent to the main service disconnect in a location clearly visible from the location where the disconnect is operated.

COMPLIANCE: Markings will be provided ad all disconnects including the Main Service Disconnect as required by NFPA 70. AC DISCONNECT and DC DISCONNECT Markings will be provided.

605.11.1.4 Location of marking. Marking shall be placed on interior and exterior DC conduit, raceways, enclosures and cable assemblies every 10 feet (3048 mm), within 1 foot (305 mm) of turns or bends and within 1 foot (305 mm) above and below penetrations of roof/ceiling assemblies, walls or barriers.

COMPLIANCE: YES, WILL DO...

605.11.2 Locations of DC conductors. Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. Conduit runs between sub arrays and to DC combiner boxes shall be installed in a manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes shall be located such that conduit runs are minimized in the pathways between arrays. DC wiring shall be installed in metallic conduit or raceways when located within enclosed spaces in a building. Conduit shall run along the bottom of load bearing members.

COMPLIANCE: Georgia Tech Engineering has approved the conduit runs as meeting these requirements. All DC wiring from the array to the building and inside the building will be contained in metallic conduit and be run accordingly.

605.11.3 Access and pathways. Roof access, pathways, and spacing requirements shall be provided in accordance with Sections 605.11.3.1 through 605.11.3.3.3.

Exceptions:

1. Residential structures shall be designed so that each photovoltaic array is no greater than 150 feet (45 720 mm) by 150 feet (45 720 mm) in either axis.

2. Panels/modules shall be permitted to be located up to the roof ridge where an alternative ventilation method approved by the fire chief has been provided or where the fire chief has determined vertical ventilation techniques will not be employed.

605.11.3.1 Roof access points. Roof access points shall be located in areas that do not require the placement of ground ladders over openings such as windows or doors, and located at strong points of building construction in locations where the access point does not conflict with overhead obstructions such as tree limbs, wires, or signs.

COMPLIANCE: Array does not interfere with any access points.

605.11.3.2 Residential systems for one- and two family dwellings. Access to residential systems for one- and two-family dwellings shall be provided in accordance with Sections 605.11.3.2.1 through 605.11.3.2.4.

605.11.3.2.1 Residential buildings with hip roof layouts. **COMPLIANCE: N/A - NON-RESIDENTIAL**

605.11.3.2.2 Residential buildings with a single ridge. **COMPLIANCE: N/A - NON-RESIDENTIAL**

605.11.3.2.3 Residential buildings with roof hips and valleys. **COMPLIANCE: N/A - NON-RESIDENTIAL**

605.11.3.2.4 Residential building smoke ventilation. **COMPLIANCE: N/A - NON-RESIDENTIAL**

605.11.3.3 Other than residential buildings. Access to systems for occupancies other than one- and two family dwellings shall be provided in accordance with Sections 605.11.3.3.1 through 605.11.3.3.3.

Exception: Where it is determined by the fire code official that the roof configuration is similar to that of a one- or two-family dwelling, the residential access and ventilation requirements in Sections 605.11.3.2.1 through 605.11.3.2.4 shall be permitted to be used.

605.11.3.3.1 Access. There shall be a minimum 6-foot-wide (1829 mm) clear perimeter around the edges of the roof.

Exception: Where either axis of the building is 250 feet (76 200 mm) or less, there shall be a minimum 4-foot-wide (1290 mm) clear perimeter around the edges of the roof.

COMPLIANCE: Building is less than 250 feet in east-west direction so 4ft clear perimeter is acceptable.

605.11.3.3.2 Pathways. The solar installation shall be designed to provide designated pathways. The pathways shall meet the following requirements:
1. The pathway shall be over areas capable of supporting the live load of fire fighters accessing the roof.

COMPLIANCE: Existing perimeter pathway around the outside edge is preserved. Entire roof will support live load.

2. The centerline axis pathways shall be provided in both axes of the roof. Centerline axis pathways shall run where the roof structure is capable of supporting the live load of fire fighters accessing the roof.

COMPLIANCE: Existing perimeter pathway around the outside edge is preserved, this provides access in both axis directions. Entire roof will support live load.

3. Shall be a straight line not less than 4 feet (1290 mm) clear to skylights or ventilation hatches.

COMPLIANCE: Access from permiter pathway to skylight near array is clear and greater than 4ft wide.

4. Shall be a straight line not less than 4 feet (1290 mm) clear to roof standpipes.

COMPLIANCE: No Standpipes in array area.

5. Shall provide not less than 4 feet (1290 mm) clear around roof access hatch with at least one not less than 4 feet (1290 mm) clear pathway to parapet or roof edge.

COMPLIANCE: Array will not affect roof access hatch or doorway.

605.11.3.3.3 Smoke ventilation. The solar installation shall be designed to meet the following requirements:

1. Arrays shall be no greater than 150 feet (45 720 mm) by 150 feet (45 720 mm) in distance in either axis in order to create opportunities for fire department smoke ventilation operations.

COMPLIANCE: Array is less than 150 feet.

2. Smoke ventilation options between array sections shall be one of the following:
   2.1. A pathway 8 feet (2438 mm) or greater in width.
   2.2. A 4-foot (1290 mm) or greater in width pathway and bordering roof skylights or smoke and heat vents.

2.3. A 4-foot (1290 mm) or greater in width pathway and bordering 4-foot by 8-foot (1290 mm by 2438 mm) "venting cutouts" every 20 feet (6096 mm) on alternating sides of the pathway.

COMPLIANCE: Only one array section, no need to pathways between array sections.

605.11.4 Ground-mounted photovoltaic arrays. Ground-mounted photovoltaic arrays shall comply with Sections 605.11 through 605.11.2 and this section. Setback requirements shall not apply to ground-mounted, free-standing photovoltaic arrays. A clear, brush-free area of 10 feet (3048 mm) shall be required for ground mounted photovoltaic arrays.

COMPLIANCE: Not a ground mounted array.

APPLICABLE NFPA 70: NEC 2014 CODES

NEC 690.1 GENERAL (Scope)

NEC 690.2 DEFINITIONS

NEC 690.3 OTHER ARTICLES

NEC 690.4 GENERAL REQUIREMENTS

NEC 690.4 (B) Equipment. **COMPLIANCE: All equipment is specifically designated for use in PV applications as evidenced by supplied equipment data sheets.**

NEC 690.4 (C) Qualified Persons: The installation of equipment and all associated wiring and interconnections shall be performed by qualified persons

COMPLIANCE: Array installation and all electrical work will be performed by a NABCEP Certified Solar Installation Professional and Certified Master Electrician.

NEC 690.4 (D) Multiple Inverters: **COMPLIANCE: multiple inverters are permitted which is good since we have multiple inverters. All Inverters are located in the same location and an AC and DC disconnecting means provided at that location integral to the inverters.**

NEC 690.5 Ground Fault Protection ... Ungrounded DC PV Arrays shall comply with 690.35.

COMPLIANCE: N/A - The PV ARRAY DC is an UNGROUNDED/floating array and adheres to NEC 690.35.

PV. Inverters have built in GFDI circuitry, All appropriate labels will be provided.

NEC 690.6 Alternating Current (AC) Modules

COMPLIANCE: N/A - DC MODULES are used in this array.

NEC 690.7 Maximum Voltage

COMPLIANCE: Maximum DC system voltage calculated by the EE and included in the stamped plans is: 353.92VDC

This is below the 600V rating so 1000VDC sections of NEC 690 do not apply.

V : 39.50 V DC

OF MODULES PER STRING: 8 RECORD LOW TEMP: -10°C

TEMP. COEFF. OF V : -0.32% PER DEGREE CELSIUS STC TEMP: 25°C TEMP CORRECTED FOR RECORD LOW: -36°C

(-0.32% * -35)+1 = 1.12 39.50 VDC * 1.12 = 44.24 V DC @ RECORD LOW -10°C 44.24 V X 8 MODULES PER STRING= **353.92 V**

NEC 690.8 Circuit Sizing and Current

NEC 690.8 A. Calculation of Maximum Circuit Current

(1) Photovoltaic Source Circuit Currents

COMPLIANCE: Engineering calculations are made according to this specification

PV Source Ciruit Current : 9.74(Isc) * 1.25 = 12.13A

(2) Photovoltaic Output Circuit Current.

COMPLIANCE: No combiners so output circuit current is the same as the source

(3) Inverter Output Circuit Current

COMPLIANCE: Inverter max continuous current is 16A as shown on inverter data sheet.

(4) Stand-alone Inverter Input Circuit Current

COMPLIANCE: Inverters are not stand-alone inverters.

(5) DC-DC Converter Output Current

COMPLIANCE: N/A

NEC 690.8 B. Conductor Ampacity: PV System Currents are considered to be continuous. Circuit conductors shall be sized to carry not less than the larger of 690.8.(B) (1) or (2)

COMPLIANCE:

Isc (9.74) X 1.56 = 15.17 AMPS

CONDUCTOR DERATED FOR LOCAL STATISTICALLY HIGH TEMPERATURE OF 39°C = 0.88

Conductor size for PV Source circuits 10 AWG PV WIRE.

NEC 690.9 Overcurrent Protection

NEC 690.9 (A) Circuits and Equipment ....

Exception: An overcurrent device shall not be required for PV modules or PV source circuit conductors sized in accordance with 690.8(B) where one of the following applies:

(a) There are no external sources such as parallel connected source circuits, batteries or backfeed from inverters.

COMPLIANCE: No overcurrent protection for PV source DC circuits since there are no parallel source circuits, batteries ot inverter backfeed as provided by the above exception. The ABB Inverter PV DC array inputs contain a 20A DC Fuse on both the positive and negative string input. Each AC Inverter output circuit is protected by a reverse feed compatible circuit breaker.

NEC 690.9 (B) Overcurrent Device Ratings

COMPLIANCE:

DC Array overcurrent. The max array current as calculated on section 690.8 (A) multiplied by 1.25 is 15.71AMPS so the 20A DC fuse on the ABB string inputs is correctly sized and adequately protects the #10 wire used for the string inputs.

AC Output Current: The max continuous current of 16A x 1.25 = 20A so the reverse feed circuit breakers that connect the inverter outputs to the main breaker will be 20A.

NEC 690.9 (C) Direct-Current Rating

COMPLIANCE: ABB Inverter uses 20A DC Rated fuses for the PV STRING input circuits.

NEC 690.9 (D) Photovoltaic Source and Output Circuits

COMPLIANCE: All required OCPD are accessible, the AC circuit breakers are in the backfed service panel and the DC string fuses are inside the ABB inverter.

NEC 690.9 (E) Power Transformers: COMPLIANCE: N/A - No transformers used.

NEC 690.9 (E) Series Overcurrent Protection. COMPLIANCE See NEC 690.35 for Ungrounded PV Arrrays.

NEC 690.10 Stand-Alone Systems: COMPLIANCE: N/A Grid Tied System

NEC 690.11 Arc-Fault Circuit Protection (Direct Current)

COMPLIANCE: the ABB PVI-3.6 Inverter Comes standard with DC Arc Fault Circuit Interruptor (AFCI) to comply with NEC 690.11. This circuitry is included in the PV inverter. See attached datasheet.

NEC 690.12 Rapid Shutdown of PV Systems on Buildings

COMPLIANCE: PE Stamped Electrical Design with PV DC and AC circuit, conduit and wire size provided. Rapid Shutdown is performed through the Tigo Rapid Shutdown Gateway that will be tied to building power system such that a shutdown of building power will shutdown the array.

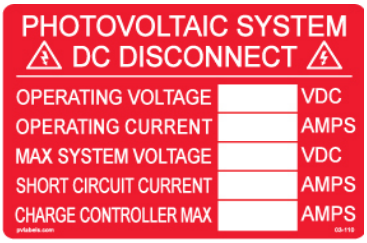
NEC 690.13 Building or Other Structure Supplied by a Photovoltaic System. DC Conductor Disconnect

NEC 690.13 (A) Location.

COMPLIANCE: DC Array Disconnect will be located near the array on the rooftop. A DC Disconnect is also provided in the inverter such that the array may be disconnected from either location.

NEC 690.13 (B) Marking.

COMPLIANCE: PV DC Disconnect will be marked with a label as shown below:



4" x 3"

NEC 690.13 (C) Suitable for Use.

COMPLIANCE: DC Disconnects are rated for their appropriate voltage/current ratings.

NEC 690.13 (D) Maximum Number of Disconnects.

COMPLIANCE: 3 DC Disconnects on inverters and 1 on the roof. This meets the 6 disconnect max.

NEC 690.13 (E) Grouping

COMPLIANCE: The 3 DC Disconnects provided by the 2 inverters are side by side in the target lab.

NEC 690.15 Disconnection of Photovoltaic Equipment

COMPLIANCE: PV Inverter AC Disconnects are provided via the 3 20A circuit breakers where the inverters connect to the service panel which is located in a readily accessible location.

NEC 690.15(A) Utility Interactive Inverters mounted in Not-Readily Accessible Locations.

COMPLIANCE: N/A The Inverters and disconnecting means are readily accessible on the lab on the main floor.

NEC 690.15(B) Equipment

COMPLIANCE: Tigo safety and monitoring devices mounted at the PV modules may be located on the PV Side of the PV disconnecting means

NEC 690.15(C) Direct Current Combiner Disconnects.

COMPLIANCE: N/A, No combiners used

NEC 690.16 Fuses

COMPLIANCE: No Fuses on PV source or AC output circuits are utilized.

NEC 690.17 Disconnect Type

NEC 690.17(A) Manually Operable

COMPLIANCE: AC Disconnects are reverse feed rated circuit breakers. The DC Disconnect in the inverter is a PV specific integrated molded case switch marked for PV use.

NEC 690.17(B) Simultaneous opening of poles

COMPLIANCE: Each disconnect listed in the previous section will simultaneously disconnect all ungrounded connectors connected to the switch.

NEC 690.17(C) Externally operable

COMPLIANCE: DC and AC disconnect switches specified are externally operable and have visible indication through switch position as to the state of the switch (open or closed).

NEC 690.17(D) Disconnection of Grounded Conductor.

COMPLIANCE: No disconnects installed on grounded conductors except for the arc fault or ground fault protection circuitry which is in compliance with section 690.5 and 690.11.

NEC 690.17(E) Interrupting Rating.

COMPLIANCE: The disconnecting means are rated based on the maximum current and voltage of the connected circuit. The AC disconnect breakers are rated at 20A/277VAC. The inverter's internal DC disconnect is rated for 20A DC @ 600VDC per input string. The rooftop disconnect is rated for 30A@600VDC. The following label will be provided on the DC disconnect and DC transfer switch in the lab:

4" X 3"

NEC 690.18 Installation and Service of an Array

COMPLIANCE: Installation personnel are trained and certified to install the array correctly. Appropriate means will be used to ensure safe installation and servicing of the array.

NEC 690.31 Wiring Methods

COMPLIANCE: PE Stamped Electrical Design was draw in accordance with NEC wiring standards. Array installation

and all electrical work will be performed by a NABCEP Certified Solar Installation Professional and Certified Master Electrician. All conductors and conduit are determined based on NEC 2014 specifications. Appropriate labels specified in NEC 690 will be applied.

NEC 690.32 Component Interconnections

COMPLIANCE: PV Modules use 1000V PV wire per UL4703 with H4 connectors as do the Tigo Safety modules. All rooftop array wiring will use equivalent connectors to the PV system.

NEC 690.33 Connectors

NEC 690.33 (A) Configuration. COMPLIANCE: all PV source array equipment uses industry standard H4 connectors. These connectors are polarized and specifically for use in DC PV circuits.

NEC 690.33 (B) Guarding. COMPLIANCE: all PV source array equipment uses industry standard H4 connectors. These connectors have enclosed conductors that are not accessible to the person using the connector.

NEC 690.33 (C) Type. COMPLIANCE: all PV source array equipment uses industry standard H4 connectors. These connectors are latching type and require a specialized tool to open.

NEC 690.33 (D) Grounding member. COMPLIANCE: N/A no connectors with grounds are utilized.

NEC 690.33 (E) Interruption of Circuit. COMPLIANCE: all PV source array equipment uses industry standard H4 connectors. These connectors are latching type and require a specialized tool to open and are marked do not disconnect under load.

NEC 690.34 Access to Boxes

COMPLIANCE: All junction boxes and Tigo safety modules may be accessed by displacing the PV module covering the unit as allowed in this section.

NEC 690.35 Ungrounded Photovoltaic Systems

NEC 690.35 (A) Disconnects

COMPLIANCE: PV DC Disconnect complies with NEC 690 PART III as specified above.

NEC 690.35 (B) Overcurrent Protection

COMPLIANCE: PV DC Disconnect complies with NEC 690.9 as specified above.

NEC 690.35 (C) Ground Fault Protection

COMPLIANCE: ABB PVI-3.6 Inverter provides GFDI circuitry that detects ground faults in the dc current carrying conductors, indicates that a ground fault occurred and automatically disconnects all conductors. The device is listed for providing ground fault protection as evidenced by the UL 1741 certification.

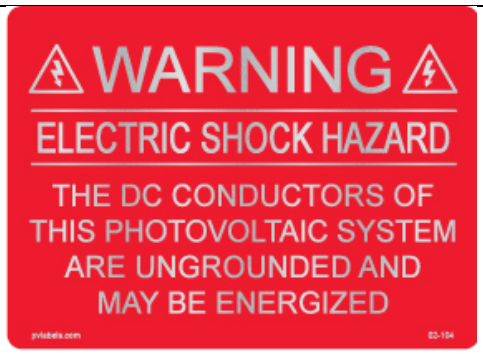
NEC 690.35 (D) Conductors

COMPLIANCE: Conductors used at the array in an exposed (not in conduit) are single conductor PV WIRE. All PV DC wiring within the building will be installed in metallic conduit.

NEC 690.35 (E) Battery System COMPLIANCE: N/A No Battery

NEC 690.35 (F) Marking.

COMPLIANCE: PV DC Disconnect, junction boxes and DC Transfer switch will be labeled with the following label.



4" X 3"

NEC 690.35 (G) Equipment. COMPLIANCE: The ABB PVI-3.6 Inverters used in this system are listed for ungrounded PV input circuits.

NEC 690.41 System Grounding COMPLIANCE: Ungrounded system complies with NEC 690.35

NEC 690.42 Point of System Grounding Connection COMPLIANCE: N/A Ungrounded PV Circuit

NEC 690.43 Equipment Grounding

NEC 690.43 (A) Equipment Grounding COMPLIANCE: All Exposed PV System non current carrying metallic components will be grounded in accordance with NEC 250. This includes PV Modules, PV Racking, Condit, disconnect, transfer switch and junction boxes.

NEC 690.43 (B) Equipment Grounding Conductor Required. COMPLIANCE: An EGC will be run along with the DC wiring from the array to the inverters in the lab. The grounding conductor requirements are specified in the stamped design.

NEC 690.43 (C) Structure as Equipment Grounding Conductor. COMPLIANCE: The UNIRAC RM ballasted racking system provides a PV Module bonding system that uses a chemical locking hex bolt providing a UL2703 certified grounding path from module to ballast bay.

NEC 690.43 (D) Photovoltaic Mounting Systems and Devices. COMPLIANCE: The UNIRAC RM ballasted racking system provides a PV Module bonding system that uses a chemical locking hex bolt providing a UL2703 certified grounding path from module to ballast bay. These systems are specifically developed, listed and certified for this purpose.

NEC 690.43 (E) Photovoltaic Mounting Systems and Devices. COMPLIANCE: The UNIRAC RM ballasted racking system provides a PV Module bonding system that uses a chemical locking hex bolt providing a UL2703 certified grounding path from module to ballast bay. These systems are specifically developed, listed and certified for the purpose of providing a bonded ground path between adjacent modules via the racking system that attaches to both modules.

NEC 690.43 (F) All Conductors Together. COMPLIANCE: The EGC for the array will be run in the same conduit as the PV circuit conductors.

NEC 690.45 Size of Equipment Grounding Conductors. COMPLIANCE: The EGC for the array will be a 6AWG wire which is much larger than required according to section 250.122.

NEC 690.46 Array Equipment Grounding Conductors. COMPLIANCE: The 6WG wire is compliant in size for both free air EGC and when installed in a conduit.

NEC 690.47 Grounding Electrode System. COMPLIANCE: The system EGC will be attached to the buildings existing equipment grounding system according the NEC 690.47(C)(3).

NEC 690.48 Continuity of Equipment Grounding System. COMPLIANCE: A continuous system ground conductor will be run such that removal of an piece of equipment will not interrupt the grounding of other system components.

NEC 690.49 Continuity of Photovoltaic Source and Output Circuit Grounded Conductors. COMPLIANCE: In the event that an inverter is removed, a bonding jumper will be provided.

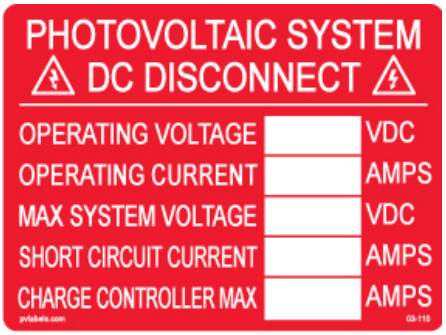
NEC 690.50 Equipment Bonding Jumpers. COMPLIANCE: If any equipment bonding jumpers need to be used, they will be 6AWG jumpers in compliance with section 250.120(C).

VI. MARKING

NEC 690.51 Modules. COMPLIANCE: All Solarworld SW 280 MONO BLACK modules used in this system have nameplate labels specifying all of the required information for this section.

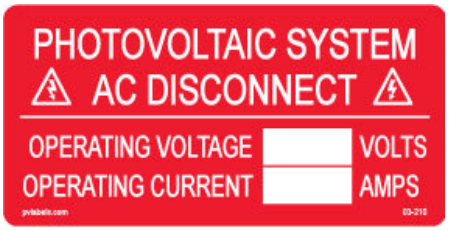
NEC 690.52 Alternating Current Photovoltaic Modules : COMPLIANCE: N/A, AC modules not used.

NEC 690.53 Direct-Current Photovoltaic Power Source: COMPLIANCE: The DC Disconnects will bear a label listing the Rated Max Imp, Vmp, Max system voltage, Max Circuit current using a label of the following format:



4" x 3"

NEC 690.54 Interactive System Point of Interconnection : COMPLIANCE: The AC Disconnect breakers where the inverters tie back into the grid through the service panel will be labeled as such using the following label and the operating voltage of 277V and 16AMPS.



4" x 2"

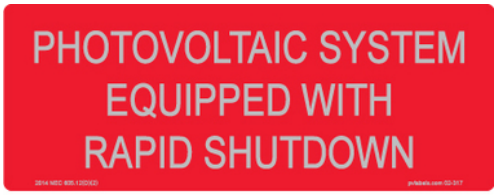
NEC 690.55 Photovoltaic Power System Employing Energy Storage: COMPLIANCE: N/A, No Energy storage used.

NEC 690.56 Identification of Power Sources. COMPLIANCE: N/A, No Energy storage used.

NEC 690.56 (A) Facilities with Stand Alone System. COMPLIANCE: N/A Not stand alone system

NEC 690.56 (B) Facilities with Utility Services and PV Systems. COMPLIANCE: Will provide a plaque providing the location of the PV System disconnecting means.

NEC 690.56 (C) Facilities with Rapid Shutdown. COMPLIANCE: Will provide a label at the utility service location indicating that the system has Rapid Shutdown capability as shown below:



5 ¾" x 2 ¼"

VII: Connection to Other Sources

NEC 690.57 Load Disconnect. COMPLIANCE: N/A No Loads specified in this system

NEC 690.60 Identified Interactive Equipment. COMPLIANCE: The ABB PVI-3.6 Inverters are UL 1741 compliant and specifically designed for utility interactive connections.

NEC 690.61 Loss of Interactive System Power. COMPLIANCE: The ABB PVI-3.6 Inverters are UL 1741 compliant and specifically designed for utility interactive connections. This inverter will shutdown upon loss of grid power.

NEC 690.63 Unbalanced Interconnections. COMPLIANCE: N/A

NEC 690.64 Point of Interconnection. COMPLIANCE: The 3 3600W Inverters will be interconnected through the 480Y 600A service panel in the lab through 3 20A reverse feed rated breakers placed in the farthest location on the busbar from the main feed. This is based on the 120% rule that allows us to backfeed up to 120% of the busbar rating if placed on the opposite end of the busbar from the main feed according to NEC 705.12. (D)(3)(b) The breaker panel will be labeled with the following label:

4" X 2"

VIII. Storage Batteries

NEC 690.71-690.75 Unbalanced Interconnections. COMPLIANCE: N/A, No Batteries

IX Systems Over 1000V

NEC 690.80-690.85 Unbalanced Interconnections. COMPLIANCE: N/A, Not over 1000V.

NEC 705.12 Point of Connection **COMPLIANCE: See NEC690.64 Point of Interconnection**

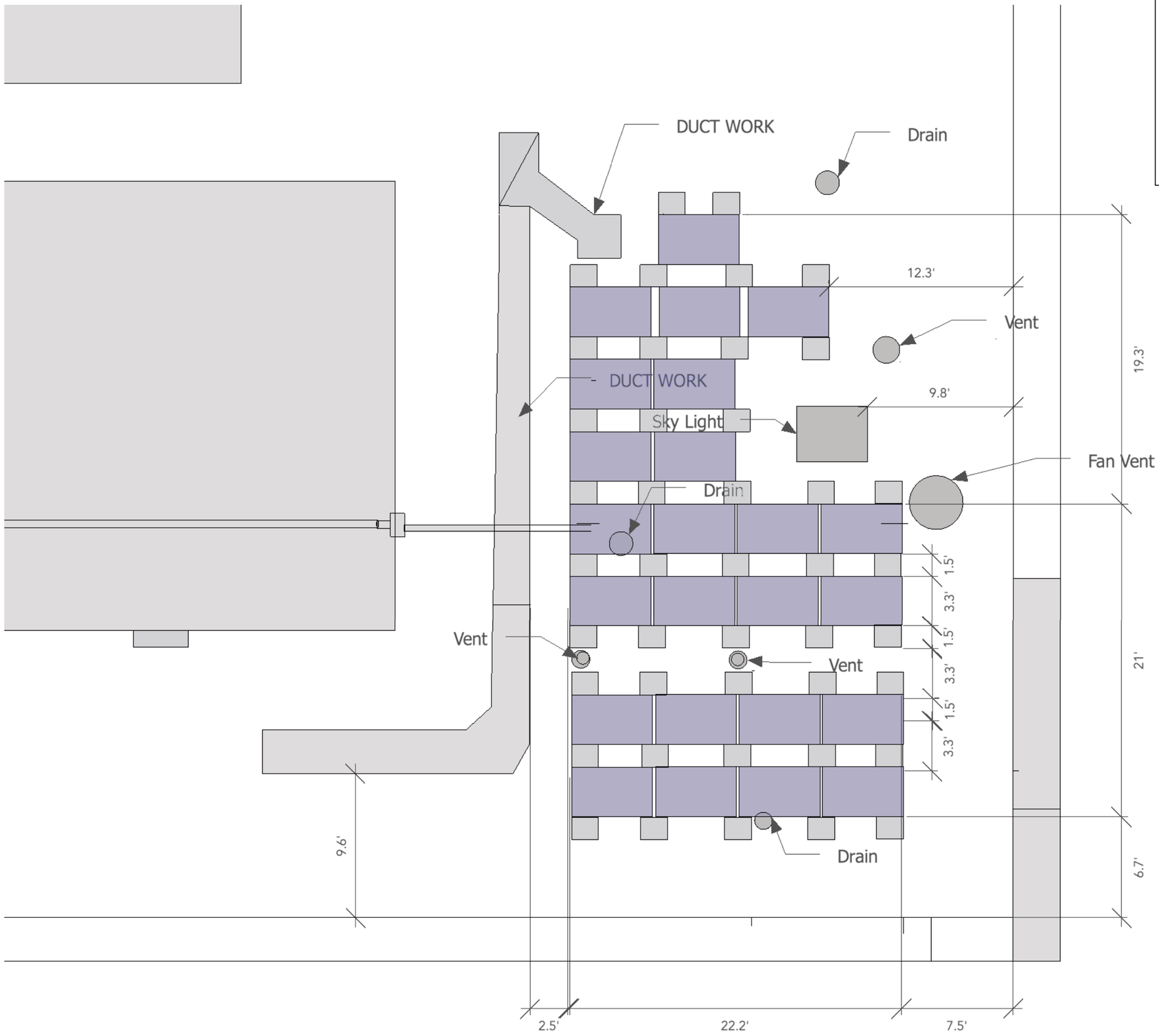
APPLICABLE IECC 2009 CODES

IECC Chapter 4 RESIDENTIAL **COMPLIANCE N/A Non residential installation**

IECC Chapter 5 COMMERCIAL

IECC 502.4.3 Sealing of the building envelope. Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

COMPLIANCE: EACH PENETRATION OF A FIRE RESISTANT RATED ASSEMBLY BY A PIPE, TUBE WIRE OR CONDUIT SHALL BE PROTECTED BY A THROUGH PENETRATION FIRE STOP SYSTEM THAT HAS BEEN TESTED ACCORDING TO ASTM E814 OR E199.



NOTE: THIS ARRAY LAYOUT IS A ROUGH GUIDELINE FOR THE INSTALLATION AND EXACT POSITION AND LOCATION MAY CHANGE SLIGHTLY DURING INSTALLATION IN ORDER TO WORK AROUND OBSTACLES TO AVOID SHADING AND OPTIMIZE THE ARRAY. ANY CHANGES IN ARRAY POSITION WILL BE COMPLIANT WITH ALL APPLICABLE CODES AND ENGINEERING SPECIFICATIONS.

N

TRUE ENERGY USA
3840 Windermere Pkwy
STE 403
Cumming, GA 30041

SHEET NAME:
SITE PLAN

GEORGIA TECH SOLAR ARRAY
BUNGER HENRY BUILDING

778 ATLANTIC DR, NW ATLANTA, GA 30332

DRAWN BY: SHK
CHECKED BY: DRP

ISSUE/REVISIONS

DATE	DESCRIPTION
11/14/16	INITIAL

SHEET ID:
S-1

11/17/2016

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Sunmodule® Plus
SW 275-290 MONO BLACK (33mm frame)

SOLARWORLD
REAL VALUE

TUV Power controlled:
Lowest measuring tolerance in industry

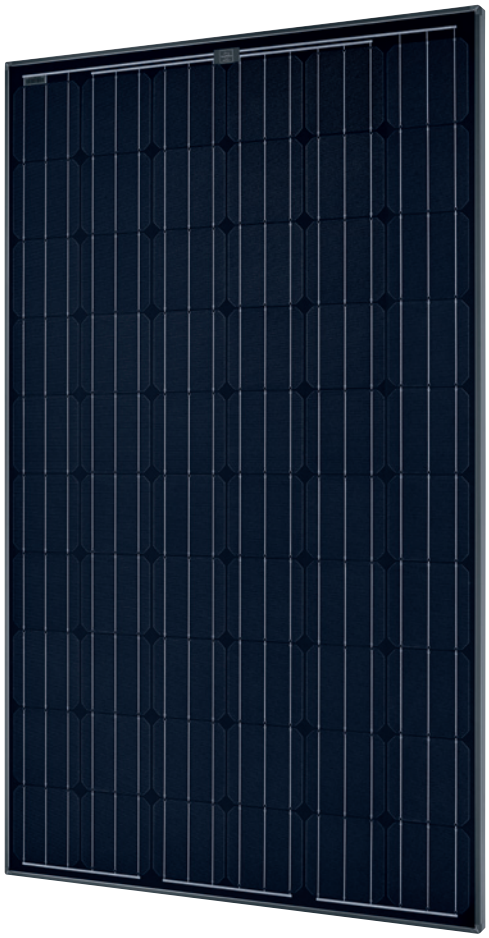
Every component is tested to meet
3 times IEC requirements

Designed to withstand heavy
accumulations of snow and ice

Sunmodule Plus:
Positive performance tolerance

25-year linear performance warranty
and 10-year product warranty

Glass with anti-reflective coating



World-class quality
Fully-automated production lines and seamless monitoring of the process and material ensure the quality that the company sets as its benchmark for its sites worldwide.

SolarWorld Plus-Sorting
Plus-Sorting guarantees highest system efficiency. SolarWorld only delivers modules that have greater than or equal to the nameplate rated power.

25-year linear performance guarantee and extension of product warranty to 10 years
SolarWorld guarantees a maximum performance digression of 0.7% p.a. in the course of 25 years, a significant added value compared to the two-phase warranties common in the industry, along with our industry-first 10-year product warranty.*

*in accordance with the applicable SolarWorld Limited Warranty at purchase.
www.solarworld.com/warranty

- Qualified, IEC 61215
- Safety tested, IEC 61730
- Blowing sand resistance, IEC 60068-2-68
- Ammonia resistance, IEC 62716
- Salt mist corrosion, IEC 61701
- Periodic inspection

UL 1703

- Periodic inspection
- Power controlled

ISO 9001
ISO 14001
Certified

Home Innovation
NGBS GREEN CERTIFIED

MADE IN USA OF US
AND IMPORTED PARTS

solarworld.com

Sunmodule® Plus
SW 275-290 MONO BLACK (33mm frame)

SOLARWORLD
REAL VALUE

PERFORMANCE UNDER STANDARD TEST CONDITIONS (STC)*

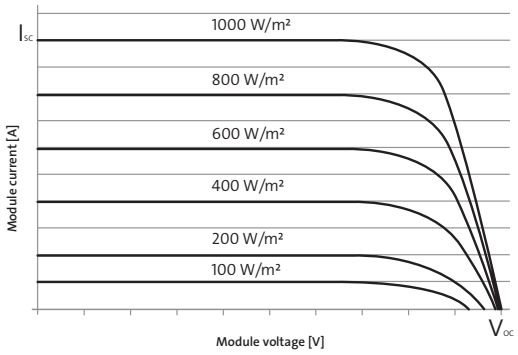
		SW 275	SW 280	SW 285	SW 290
Maximum power	P_{max}	275 Wp	280 Wp	285 Wp	290 Wp
Open circuit voltage	V_{oc}	39.4 V	39.5 V	39.7 V	39.9 V
Maximum power point voltage	V_{mpp}	31.0 V	31.2 V	31.3 V	31.4 V
Short circuit current	I_{sc}	9.58 A	9.71 A	9.84 A	9.97 A
Maximum power point current	I_{mpp}	8.94 A	9.07 A	9.20 A	9.33 A
Module efficiency	η_m	16.40 %	16.70 %	17.00 %	17.30 %

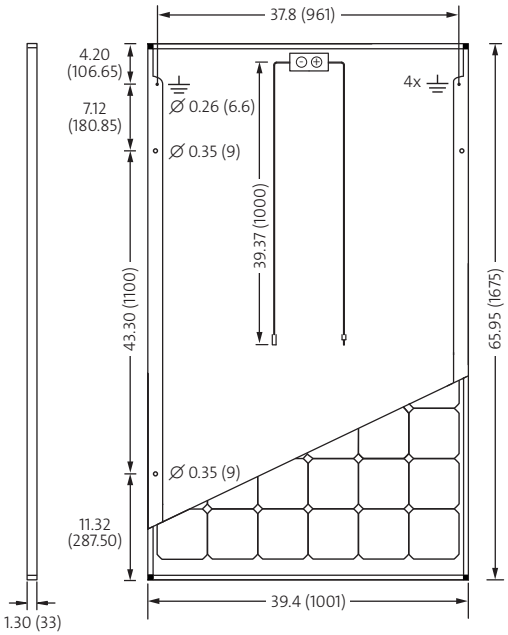
*STC: 1000W/m², 25°C, AM 1.5

PERFORMANCE AT 800 W/M², NOCT, AM 1.5

		SW 275	SW 280	SW 285	SW 290
Maximum power	P_{max}	203.1 Wp	207.2 Wp	211.1 Wp	215 Wp
Open circuit voltage	V_{oc}	35.7 V	35.8 V	36.0 V	36.2 V
Maximum power point voltage	V_{mpp}	28.1 V	28.3 V	28.4 V	28.5 V
Short circuit current	I_{sc}	7.75 A	7.85 A	7.96 A	8.06 A
Maximum power point current	I_{mpp}	7.22 A	7.33 A	7.43 A	7.54 A

Minor reduction in efficiency under partial load conditions at 25° C: at 200 W/m², 100% of the STC efficiency (1000 W/m²) is achieved.





COMPONENT MATERIALS

Cells per module	60	*Front*	Low-iron empered glass with ARC (EN 12150)
Cell type	Mono crystalline	*Frame*	Black anodized aluminum
Cell dimensions	6.17 in x 6.17 in (156.75 x 156.75 mm)	*Weight*	39.7 lbs (18.0 kg)

THERMAL CHARACTERISTICS

NOCT	48°C
TCI_{sc}	0.044 %/K
TCV_{oc}	-0.31 %/K
TCP_{mpp}	-0.41 %/K
Operating temp	-40° C to +85° C

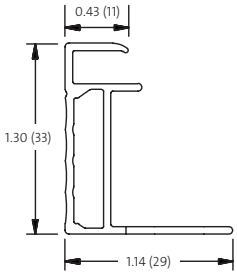
ADDITIONAL DATA

Power sorting	-0 Wp/+5 Wp
J-Box	IP65
Connector	PV wire per UL4703 with H4 connectors
Module fire performance	(UL 1703) Type 1

PARAMETERS FOR OPTIMAL SYSTEM INTEGRATION

Maximum system voltage SC II / NEC		1000 V
Maximum reverse current		25 A
Number of bypass diodes		3
*Design loads**	*Two rail system*	113 psf downward, 64 psf upward
*Design loads**	*Three rail system*	178 psf downward, 64 psf upward
*Design loads**	*Edge mounting*	178 psf downward, 41 psf upward

* Please refer to the Sunmodule installation instructions for the details associated with these load cases.



- Compatible with both "Top-Down" and "Bottom" mounting methods
- ⏚ Grounding Locations:
  – 4 locations along the length of the module in the extended flange.

All units provided are imperial. SI units provided in parentheses.
SolarWorld AG reserves the right to make specification changes without notice.

SW-01-7520US 07-2015

Certificate of Compliance

Certificate: 2593411 **Master Contract:** 257442 (257442)

Project: 70099796 **Date Issued:** 2016-10-21

Issued to: **SolarWorld AG**
24 Martin Luther King Strasse
Bonn, Nordrhein-Westfalen 53175
GERMANY
Attention: Stefan Haupt

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: Qiang (Sean) Jiang
Qiang (Sean) Jiang

PRODUCTS
CLASS - C531110 - POWER SUPPLIES-Photovoltaic Modules and Panels
CLASS - C531190 - POWER SUPPLIES-Photovoltaic Modules and Panels - Certified to US Standards

PART A:

Photovoltaic Modules with maximum system voltage of 600 V dc, 1000 V dc or 1500 V and with Fire Performance of Type 1, Model Series:

Sunmodule Plus SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290, 295 or 300 followed by "mono", may be followed by "black", may be followed by "Laminate".

Sunmodule Plus SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275 or 280 followed by "poly", may be followed by "black" may be followed by "Laminate".

XL modules - "Sunmodule SW", followed by 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355 or 360 followed by "XL mono", may be followed by "black".

XL modules - "Sunmodule SW", followed by 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330 or 335 followed by "XL poly", may be followed by "black".

Certificate: 2593411 **Master Contract:** 257442

Project: 70099796 **Date Issued:** 2016-10-21

XL modules - "Sunmodule Bisun SW", followed by 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355 or 360 followed by "XL duo"

Off-Grid modules - Sunmodule SW, followed by, 80 mono RHA, 100 poly RGP, 120 poly R6A, 130 poly R6A, 135 poly R6A, 140 poly R6A, 145 poly R6A, 150 poly R6A, 155 poly R6A, 160 poly R6A, or mono R6A.

Electrical Ratings -

Mono-crystalline Versions - (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 300	40.1	31.6	9.57	10.23	300
SW 295	40.0	31.5	9.45	10.1	295
SW 290	39.9	31.4	9.33	9.97	290
SW 285	39.7	31.3	9.20	9.84	285
SW 280	39.5	31.2	9.07	9.71	280
SW 275	39.4	31.0	8.94	9.58	275
SW 270	39.2	30.9	8.81	9.44	270
SW 265	39.0	30.8	8.69	9.31	265
SW 260	38.9	30.7	8.56	9.18	260
SW 255	38.7	30.6	8.43	9.05	255
SW 250	37.8	31.1	8.05	8.28	250
SW 245	37.7	30.8	7.96	8.25	245
SW 240	37.6	30.6	7.87	8.22	240
SW 235	37.5	30.3	7.77	8.19	235
SW230	37.4	30.0	7.68	8.16	230
SW 225	37.3	29.7	7.59	8.13	225
SW 220	37.2	29.4	7.50	8.10	220
SW 215	37.1	29.1	7.41	8.07	215
SW 210	37.0	28.8	7.32	8.04	210
SW 205	37.0	28.5	7.22	8.01	205
SW 200	36.9	28.2	7.13	7.98	200

Certificate: 2593411 **Master Contract:** 257442

Project: 70099796 **Date Issued:** 2016-10-21

Poly-crystalline Versions - (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 280	39.8	33.0	8.58	9.19	280
SW 275	39.4	32.6	8.53	9.13	275
SW 270	39.1	32.2	8.48	9.07	270
SW 265	38.7	31.8	8.43	9.00	265
SW 260	38.4	31.4	8.37	8.94	260
SW 255	38.0	30.9	8.32	8.88	255
SW 250	37.6	30.5	8.27	8.81	250
SW 245	37.3	30.1	8.22	8.75	245
SW 240	36.9	29.7	8.17	8.69	240
SW 235	37.0	30.0	7.85	8.35	235
SW 230	36.9	29.8	7.72	8.25	230
SW 225	36.8	29.5	7.63	8.17	225
SW 220	36.6	29.2	7.54	8.08	220
SW 215	36.5	28.9	7.44	8.00	215
SW 210	36.4	28.7	7.32	7.90	210
SW 205	36.2	28.5	7.20	7.80	205
SW 200	36.1	28.3	7.07	7.70	200

Off-grid modules:

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 80 mono RHA	22.5	18.5	4.35	4.66	80
SW 100 poly RGP	44.2	37.6	2.75	3.02	100
SW 120 poly R6A	21.7	16.9	7.14	7.71	120
SW 130 poly R6A	21.8	17.4	7.49	7.99	130
SW 135 poly R6A	21.9	17.7	7.69	8.16	135
SW 140 poly R6A	22.1	17.8	7.85	8.35	140
SW 145 poly R6A	22.2	18.0	8.17	8.69	145
SW 150 poly R6A	22.5	18.3	8.27	8.81	150
SW 155 poly R6A	22.8	18.6	8.37	8.93	155
SW 160 poly R6A	23.1	18.9	8.47	9.05	160
SW 150 mono R6A	22.8	18.4	8.37	8.85	150

Certificate: 2593411 **Master Contract:** 257442

Project: 70099796 **Date Issued:** 2016-10-21

XL Modules - Mono-crystalline Versions - (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 360	48.4	38.9	9.95	9.32	360
SW 355	48.2	38.7	9.89	9.25	355
SW 350	48.0	38.4	9.82	9.17	350
SW 345	47.8	38.2	9.75	9.10	345
SW 340	47.6	38.0	9.69	9.01	340
SW 335	47.4	37.8	9.62	8.93	335
SW 330	47.2	37.5	9.55	8.87	330
SW 325	46.1	37.0	9.48	8.84	325
SW 320	45.9	36.7	9.41	8.78	320
SW 315	45.6	36.5	9.35	8.71	315
SW 310	45.4	36.2	9.28	8.64	310
SW 305	45.6	36.3	9.02	8.49	305
SW 300	47.0	38.3	7.87	8.22	300
SW 295	46.9	38.0	7.79	8.20	295
SW 290	46.8	37.7	7.72	8.17	290
SW 285	46.7	37.4	7.64	8.15	285
SW 280	46.6	37.1	7.57	8.12	280
SW 275	46.5	36.8	7.50	8.10	275
SW 270	46.4	36.5	7.43	8.08	270
SW 265	46.3	36.2	7.36	8.05	265
SW 260	46.3	35.9	7.28	8.03	260

XL Modules - Poly-crystalline Versions - (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 335	46.8	39.0	9.20	8.61	335
SW 330	46.6	38.7	9.13	8.54	330
SW 325	46.2	38.4	9.05	8.48	325
SW 320	46.1	38.2	8.40	8.96	320
SW 315	45.9	37.9	8.33	8.88	315
SW 310	45.6	37.6	8.26	8.80	310
SW 305	45.4	37.4	8.19	8.72	305
SW 300	45.2	37.1	8.12	8.63	300
SW 295	45.0	36.8	8.04	8.55	295
SW 290	44.8	36.5	7.97	8.47	290

SW 285	44.6	36.2	7.90	8.39	285
SW 280	44.3	36.0	7.83	8.31	280
SW 275	43.3	35.5	7.75	8.25	275
SW 270	42.9	35.2	7.68	8.17	270
SW 265	42.6	34.9	7.60	8.09	265
SW 260	42.2	34.6	7.52	8.00	260

XL modules - "Sunmodule Bisun SW", Mono-crystalline Versions

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
Bisun SW295 XL duo	46.9	38.0	7.79	8.20	295
Bisun SW300 XL duo	47.0	38.3	7.87	8.22	300
Bisun SW305 XL duo	45.4	36.2	9.28	8.64	310
Bisun SW310 XL duo	45.6	36.5	9.35	8.71	315
Bisun SW315 XL duo	45.6	36.3	9.02	8.49	305
Bisun SW320 XL duo	45.9	36.7	9.41	8.78	320
Bisun SW325 XL duo	46.1	37	9.48	8.84	325
Bisun SW330 XL duo	47.2	37.5	9.55	8.87	330
Bisun SW335 XL duo	47.4	37.8	9.62	8.93	335
Bisun SW340 XL duo	47.6	38	9.69	9.01	340
Bisun SW345 XL duo	47.8	38.2	9.75	9.1	345
Bisun SW350 XL duo	48	38.4	9.82	9.17	350
Bisun SW355 XL duo	48.2	38.7	9.89	9.25	355
Bisun SW360 XL duo	48.4	38.9	9.95	9.32	360

PART B

Photovoltaic Modules with maximum system voltage of 600 V dc or 1000 V dc and with Fire Performance of Type 3, Model Series:

Sunmodule Protect SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275. 280. 285. 290. 295 or 300. followed by "mono". may be followed by "black" or "clear". may be followed by Laminate.

Sunmodule Protect SW, followed by 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265 or 270, 275 or 280. followed by "poly". may be followed by "black" or "clear". may be followed by Laminate.

Electrical Ratings:

Sunmodule Protect SW Mono-Crystalline Versions: (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)

Certificate: 2593411 **Master Contract:** 257442

Project: 70099796 **Date Issued:** 2016-10-21

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 300	40.1	31.6	9.57	10.23	300
SW 295	40.0	31.5	9.45	10.1	295
SW 290	39.9	31.4	9.33	9.97	290
SW 285	39.7	31.3	9.20	9.84	285
SW 280	39.5	31.2	9.07	9.71	280
SW 275	39.4	31.0	8.94	9.58	275
SW 270	39.2	30.9	8.81	9.44	270
SW 265	39.0	30.8	8.69	9.31	265
SW 260	38.9	30.7	8.56	9.18	260
SW 255	38.7	30.6	8.43	9.05	255
SW 250	37.8	31.1	8.05	8.28	250
SW 245	37.7	30.8	7.96	8.25	245
SW 240	37.6	30.6	7.87	8.22	240
SW 235	37.5	30.3	7.77	8.19	235
SW230	37.4	30.0	7.68	8.16	230
SW 225	37.3	29.7	7.59	8.13	225
SW 220	37.2	29.4	7.50	8.10	220
SW 215	37.1	29.1	7.41	8.07	215
SW 210	37.0	28.8	7.32	8.04	210
SW 205	37.0	28.5	7.22	8.01	205
SW 200	36.9	28.2	7.13	7.98	200

Sunmodule Protect SW Poly-Crystalline Versions: (Type designations may be followed by "black"):

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
SW 280	39.8	33.0	8.58	9.19	280
SW 275	39.4	32.6	8.53	9.13	275
SW270	39.1	32.2	8.48	9.07	270
SW265	38.7	31.8	8.43	9.00	265
SW260	38.4	31.4	8.37	8.94	260
SW255	38.0	30.9	8.32	8.88	255
SW250	37.6	30.5	8.27	8.81	250
SW245	37.3	30.1	8.22	8.75	245
SW240	36.9	29.7	8.17	8.69	240
SW235	37.0	30.0	7.85	8.35	235
SW230	36.9	29.8	7.72	8.25	230
SW225	36.8	29.5	7.63	8.17	225
SW220	36.6	29.2	7.54	8.08	220
SW215	36.5	28.9	7.44	8.00	215

SW210	36.4	28.7	7.32	7.90	210
SW205	36.2	28.5	7.20	7.80	205
SW200	36.1	28.3	7.07	7.70	200

Sunmodule Bisun SWxxx duo, where 'xxx' is the output power in W, from 250 to 300 with a maximum system voltage of 1000 V dc and with Fire Performance of Type 1.

Electrical Data:

Model	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, (A dc)	Rated Maximum Power at STC, (Watts)
Bisun SW250 duo	37.8	31.1	8.05	8.28	250
Bisun SW255 duo	38.7	30.6	8.43	9.05	255
Bisun SW260 duo	38.9	30.7	8.56	9.18	260
Bisun SW265 duo	39.0	30.8	8.69	9.31	265
Bisun SW270 duo	39.2	30.9	8.81	9.44	270
Bisun SW275 duo	39.4	31.0	8.94	9.58	275
Bisun SW280 duo	39.5	31.2	9.07	9.71	280
Bisun SW285 duo	39.7	31.3	9.20	9.84	285
Bisun SW290 duo	39.9	31.4	9.33	9.97	290
Bisun SW295 duo	40.0	31.5	9.45	10.1	295
Bisun SW300 duo	40.1	31.6	9.57	10.23	300

Notes:

1. Nomenclature - for Off-Grid modules:

Type of cell cut	Dimension of cells (mm) = cut
R6A	156 x 156 = 1 = no cut
RGP	52 x 156 = 1/3 = 1 or 2
RHA	156 x 78 = 1/2 = 1 cut

Where:
R = rural = Module Type "Off Grid";
A or B = 36 = total number of cells in serial connection.
P = 72 = total number of cells in serial connection.

2. Modules followed by 'Laminate' are approved only as components which are sold to manufacturers of complete modules where the final product is subject to approval by CSA Group.

3. Rated electrical characteristics are within +/-10% of measured values at Standard Test Conditions of 100 mW/cm^2 irradiance, AM 1.5 spectrum, and cell temperature of 25ºC.

4. SolarWorld Type 1 and Type 3 modules with Sunfix Plus ® Mount mounting system in combination with roof coverings were evaluated to System Fire Class A Rating, Steep Slope 5/12 & Low Slope ½ /12. Type 1 or Type 3 modules mounted as per Sunfix Plus Mounting Manual, and Sunfix Plus ® Mount mounting system construction as per Sunfix Plus Mounting Manual.

Certificate: 2593411 **Master Contract:** 257442

Project: 70099796 **Date Issued:** 2016-10-21

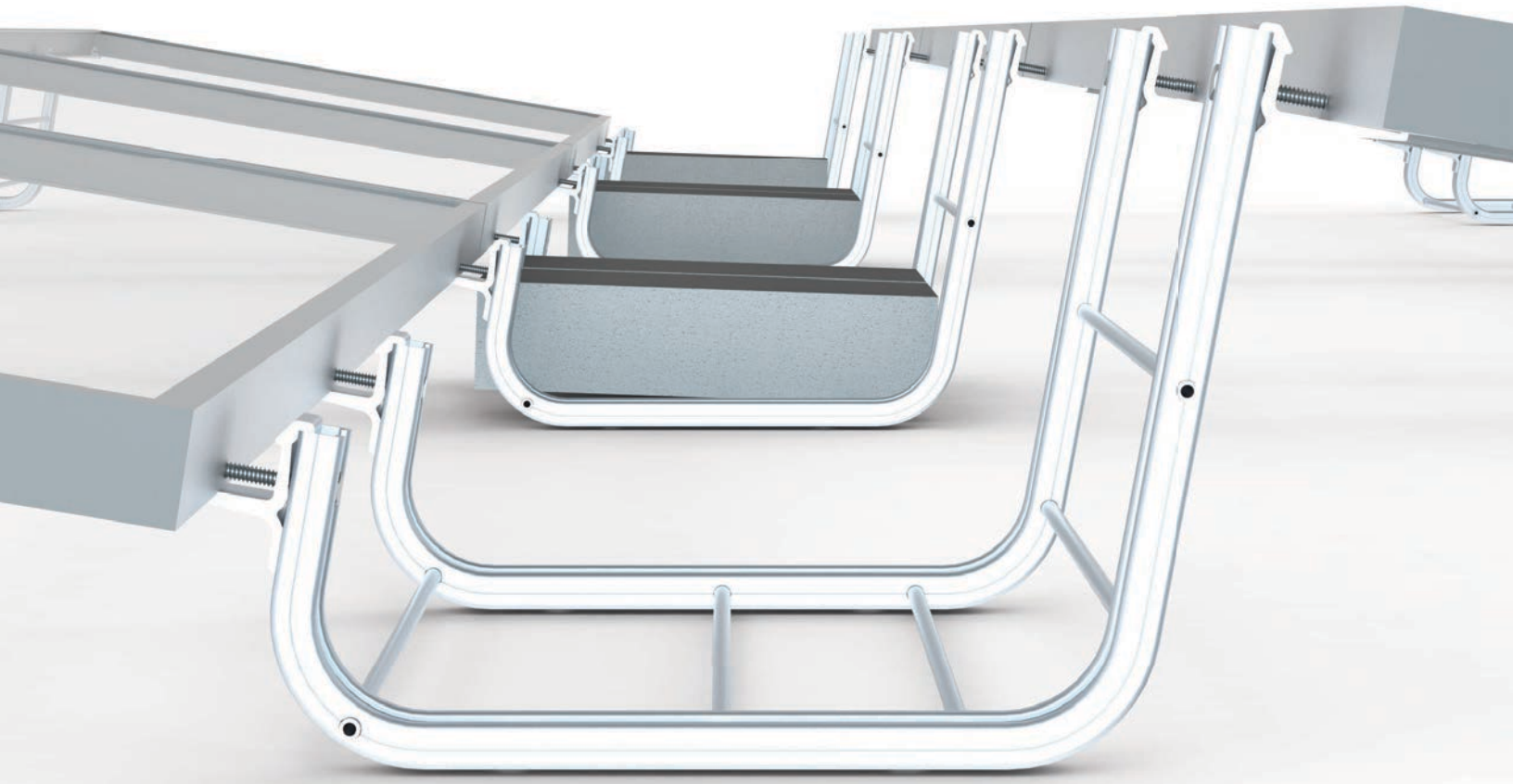
APPLICABLE REQUIREMENTS

ULC/ORD- C1703-01 - Flat-Plate Photovoltaic Modules and Panels
UL 1703-3rd Edition - Flat-Plate Photovoltaic Modules and Panels

ROOFMOUNT

UNIRAC

ROOFMOUNT introduces the Power of Simplicity to the ballasted flat roof solar industry. The system consists of only two major components, minimizing preparation work and installation time. Seamlessly design around roof obstacles, support most framed modules and bond the system with just the turn of a wrench.



SIMPLE DESIGN • FAST INSTALLATION

SIMPLE DESIGN • AVAILABILITY • DESIGN TOOLS • QUALITY PROVIDER

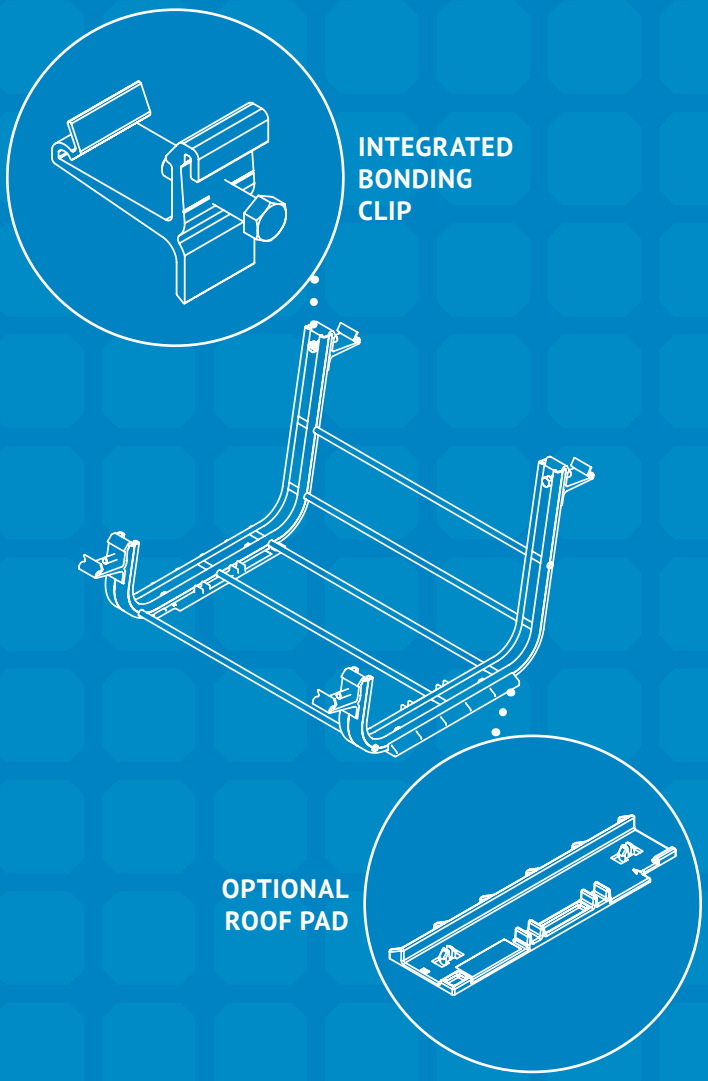
ROOFMOUNT

UNIRAC

SIMPLE DESIGN

TWO MAJOR COMPONENTS. ONE TOOL

RM supports most framed PV modules at 10 degree tilt. The component list consists of only two major components - a fully assembled ballast bay and a universal module clip. Our engineers specified a chemical locking hex bolt, providing a UL2703 certified grounding path from module to ballast bay, with just the turn of a wrench. RM is accessory-rich to support your specific installation needs, because it was designed to conveniently work with off the shelf wire management products. A snap into place, membrane-friendly, rubber roof pad is also available as a low-cost option for roof protection.



AVAILABILITY

NATIONWIDE NETWORK

Unirac maintains the largest network of stocking distributors for our racking solutions. Our partners have distinguished their level of customer support, availability, and overall value, thereby providing the highest level of service to users of Unirac products. Count on our partners for fast and accurate delivery to meet your project needs. Visit Unirac.com for a list of distributors.

INTEGRATED DESIGN TOOLS

DESIGN, SAVE, AND SHARE YOUR ARRAY VISUALLY

U-Builder is the most powerful streamlined design tool for your solar mounting project. Integrated with HelioScope's technology, U-Builder becomes a powerful online tool that streamlines the process of designing a code compliant solar mounting system. Key benefits allow you to quickly plan project sites, analyze design decisions, and simplify your workflow. You will enjoy the ability to share projects with customers: there's no need to print results and send to a distributor, just click and share.

LISTED **UL2703**

BONDING & GROUNDING
MECHANICAL LOADING
SYSTEM FIRE CLASSIFICATION

UNIRAC CUSTOMER SERVICE MEANS THE HIGHEST LEVEL OF PRODUCT SUPPORT

UNMATCHED EXPERIENCE | CERTIFIED QUALITY | ENGINEERING EXCELLENCE | BANKABLE WARRANTY | DESIGN TOOLS | PERMIT DOCUMENTATION

TECHNICAL SUPPORT

Unirac's technical support team is dedicated to answering questions & addressing issues in real time. An online library of documents including engineering reports, stamped letters and technical data sheets greatly simplifies your permitting and project planning process.

CERTIFIED QUALITY PROVIDER

Unirac is the only PV mounting vendor with ISO certifications for 9001:2008, 14001:2004 and OHSAS 18001:2007, which means we deliver the highest standards for fit, form, and function. These certifications demonstrate our excellence and commitment to first class business practices.

BANKABLE WARRANTY

Don't leave your project to chance, Unirac has the financial strength to back our products and reduce your risk. Have peace of mind knowing you are receiving products of exceptional quality. ROOFMOUNT is covered by a 20-year manufacturing warranty on all parts.

PROTECT YOUR REPUTATION WITH QUALITY RACKING SOLUTIONS BACKED BY ENGINEERING EXCELLENCE AND A SUPERIOR SUPPLY CHAIN

TÜV Rheinland PTL

Attn: John Nagyvary
Unirac Inc.
1411 Broadway Blvd
Albuquerque, NM 87102
Phone: +505 242 6411
Email: john.nagyvary@unirac.com

Email:
MWitt@us.tuv.com

December 19, 2014

UL SU 2703 Fire Testing Completed

Type of Equipment: PV Mounting System
Model Designation: Unirac Roof Mount
Test Requirement: UL Subject 2703, Issue 2

TÜV Rheinland File Number:
L1-URC140731-RM
TÜV Rheinland Project Number:
URC140731

Dear Mr. Nagyvary,

This letter is confirmation that the **Unirac Roof Mount (RM) PV Mounting System** has successfully completed fire testing according to the UL Subject 2703 with references from UL1703 rev. May 2014 standard.

Congratulations on this achievement.

The Unirac Roof Mount (RM) PV Mounting System has demonstrated compliance with a Class A Fire Rating when installed with the following Fire Types:

- Type 1
- Type 2
- Type 3

Complete test results, including any necessary mitigation measures for the fire rating, can be found in report R1-URC140731-RM.

This correspondence may be used as a Letter of Compliance (LOC) indicating the **Unirac Roof Mount (RM) PV Mounting System** has met the relevant system fire requirements.

Sincerely,

Mark Witt
Engineering Manager
TÜV Rheinland PTL, LLC

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Solar inverters

ABB string inverters
PVI-3.0/3.6/3.8/4.2-TL-OUTD
3.0kW to 4.2kW

This family of single-phase string inverters complements the typical number of rooftop solar panels enabling homeowners to get the most efficient energy harvesting for the size of the property.

This inverter offers a dual input section that processes two strings with independent Multiple Power Point Tracking (MPPT).
This is especially useful for rooftop installations with two different orientations from two sub-arrays oriented in different directions, or unbalanced strings (for example: East and West).
The dual-input sections with independent MPPT enable a more optimal energy harvesting condition.

The high-speed MPPT offers real-time power tracking and improved energy harvesting.
The flat efficiency curve ensures high-efficiency at all output levels allowing a consistent and stable performance across the entire input voltage and output power range.
The transformerless operation gives the highest efficiency of up to 97.0 percent.
The wide input voltage range makes the inverter suitable to low-power installations with reduced string size.
This rugged, outdoor inverter has been designed to be a completely sealed unit, to withstand the harshest environmental conditions.

Highlights
- Single-phase and three-phase output grid connection
- Wide input-voltage range for increased stringing flexibility and energy harvesting
- The high-speed and precise MPPT algorithm offers real-time power tracking and improved energy harvesting
- Outdoor NEMA 4X rated enclosure for unrestricted use under any environmental conditions
- Integrated DC disconnect switch in compliance with international Standards (-S Version)

Power and productivity for a better world™

Additional highlights

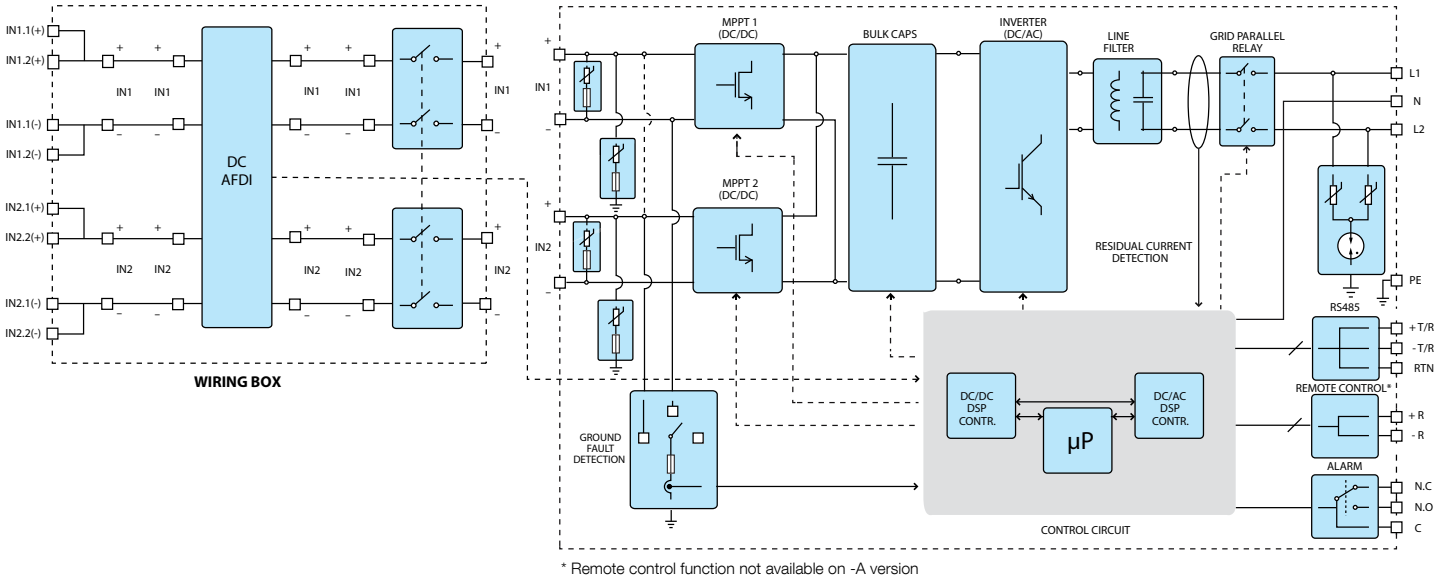
- RS-485 communication interface (for connection to laptop or data logger)
- Available with the optional VSN300 Wifi Logger Card for easy and affordable wireless monitoring
- Compliant with NEC 690.12 when used with ABB's Rapid Shutdown device
- Comes standard with DC Arc Fault Circuit Interruptor (AFCI) to comply with NEC 690.11

Technical data and types

Type code	PVI-3.0-OUTD-US			PVI-3.6-OUTD-US			PVI-3.8-OUTD-US			PVI-4.2-OUTD-US		
General specifications												
Nominal output power	3000W			3600W			3300 W	3800W		4200W		
Maximum output power wattage	3000 W	3300[1] W	3300[1] W	3600 W	4000[1] W	4000[1] W	3300 W	4200[1] W	4200[1] W	4200 W	4600[1] W	4600[1] W
Rated grid AC voltage	208V	240V	277V	208V	240V	277V	208V	240V	277V	208V	240V	277V
Input side (DC)												
Number of independent MPPT channels	2			2			2			2		
Maximum usable power for each channel	2000W			3000W			3000W			3000W		
Absolute maximum voltage (Vmax)	600V											
Start-up voltage (Vstart)	200V (adj. 120-350V)											
Full power MPPT voltage range	160-530V			120-530V			140-530V			140-530V		
Operating MPPT voltage range	0.7 x Vstart - 580V (≥90V)											
Maximum current (Idcmax) for both MPPT in parallel	20A			32A			32A			32A		
Maximum usable current per channel	10A			16A			16A			16A		
Maximum short circuit current limit per channel	12.5A			20.0A			20.0A			20.0A		
Number of wire landing terminals per channel	2 pairs											
Array wiring termination	Terminal block, pressure clamp, AWG20-AWG6											
Output side (AC)												
Grid connection type	1Ø/ 2W	Split-Ø/3W	1Ø/ 2W	1Ø/ 2W	Split-Ø/3W	1Ø/ 2W	1Ø/ 2W	Split-Ø/3W	1Ø/ 2W	1Ø/ 2W	Split-Ø/3W	1Ø/ 2W
Adjustable voltage range (Vmin-Vmax) (V)	183-228V	211-264V	244-304V	183-228V	211-264V	244-304V	183-228V	211-264V	244-304V	183-228V	211-264V	244-304V
Grid frequency	60Hz											
Adjustable grid frequency range	57-60.5Hz											
Maximum current ($I_{ac,max}$)	14.5A	14.5A	12.0A	17.2A	16.0A	16.0A	16.0A	16.0A	16.0A	20.0A	20.0A	20.0A
Power factor	> 0.995 (adjustable to ±0.8)											
Total harmonic distortion at rated power	< 2%											
Grid wiring termination type	Terminal block, Pressure clamp, AWG20-AWG6											
Input protection devices												
Reverse polarity protection	Yes											
Over-voltage protection type	Varistor, 2 for each channel											
PV array ground fault detection	Pre start-up R_{ISO} and dynamic GFDI (requires floating arrays)											
Output protection devices												
Anti-islanding protection	Meets UL1741 / IEEE1547 requirements											
Over-voltage protection type	Varistor, 2 (L_1 - L_2 / L_1 - G)											
Maximum AC OCPD rating	20A	20A	15A	25A	20A	20A	20A	20A	20A	25A	25A	25A
Efficiency												
Maximum efficiency	96.9%			97%			97%			97%		
CEC efficiency	96%											
Operating performance												
Nighttime consumption	< $0.6W_{RMS}$											
Stand-by consumption	< $8W_{RMS}$											
Communication												
User-interface	16 characters x 2 lines LCD display											
Remote monitoring (1xRS485 incl.)	VSN700 Data Logger (opt.), VSN300 Wifi Logger Card (opt.)											
Environmental												
Ambient air operating temperature range	-13°F to +140°F (-25°C to 60°C) with derating above 122°F (50°C)											
Ambient air storage temperature range	-40°F to +176°F (-40°C to +80°C)											
Relative humidity	0-100% RH condensing											
Acoustic noise emission level	< 50 db (A) @1m											
Maximum operating altitude without derating	6560ft (2000m)											

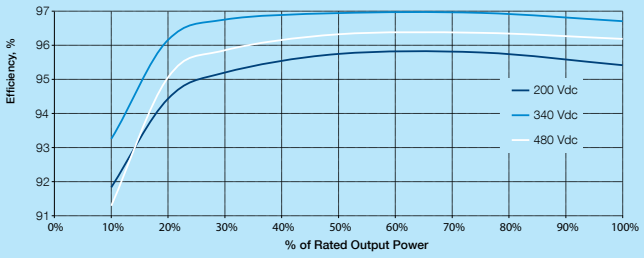
1. Capability enabled at nominal AC voltage and with sufficient DC power available.

Block diagram of PVI-3.0/3.6/3.8/4.2-TL-OUTD

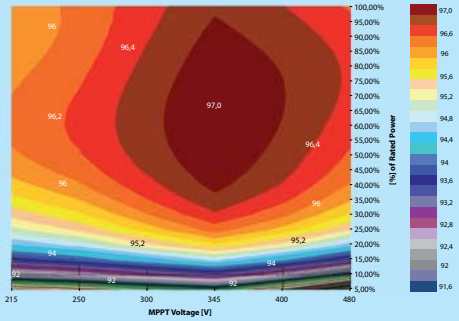


* Remote control function not available on -A version

PVI-4.2-OUTD-US



PVI-4.2-OUTD-US



Technical data and types

Type code	PVI-3.0-OUTD-US	PVI-3.6-OUTD-US	PVI-3.8-OUTD-US	PVI-4.2-OUTD-US
Mechanical specifications				
Enclosure rating	NEMA 4X			
Cooling	Natural convection			
Dimensions H x W x D	33.8 x 12.8 x 8.7in (859 x 325 x 222mm)[2]			
Weight	<47.3lb (21.3kg)[2]			
Shipping weight	< 60lb (27.0kg)[2]			
Mounting system	Wall bracket			
Conduit connections[2]	Bottom: (2) pre-drilled opening for ¾ inch conduits and concentric markings for 1 inch (both sides) and 1½ inch conduit (DC side only) Sides: (2) pre-drilled opening for ¾ inch conduits with concentric markings for 1 inch (both sides) and 1½ inch conduit (DC side only) Back: (2) concentric markings for ¾ inch and 1 inch conduits			
DC switch rating (per contact) (A/V)	25/600			
Safety and Compliance				
Isolation level	Transformerless (floating array)			
Safety and EMC standard	UL1741, UL1741SA (draft), IEEE1547, IEEE1547.1, CSA-C22.2 N. 107.1-01, UL1998 UL 1699B, FCC Part 15 Class B			
Safety approval	$_{C}$CSA$_{us}$ or $_{C}$TUV$_{us}$			
Regional Compliance	Rule 21, HECO, NEC 2014 690.11, NEC 2014 690.12 with ABB Rapid Shutdown device			
Available models				
With DC switch, wiring box, arc fault detector and interrupter	PVI-3.0-OUTD-S-US-A	PVI-3.6-OUTD-S-US-A	PVI-3.8-OUTD-S-US-A	PVI-4.2-OUTD-S-US-A

2. When equipped with optional DC switch and wiring box.
All data is subject to change without notice

Support and service

ABB supports its customers with a dedicated, global service organization in more than 60 countries, with strong regional and national technical partner networks providing a complete range of life cycle services.

For more information please contact your local ABB representative or visit:

www.abb.com/solarinverters

www.abb.com

This inverter is marked with one of the two certification marks shown here (TuV or CSA).

9AKK106103A4852 REV F EN 09.11.2015 #16634

Power and productivity for a better world™

Certificate of Compliance

Certificate: 2708406 **Master Contract:** 259813

Project: 2722409 **Date Issued:** April 24, 2014

Issued to: ABB, Inc.
16250 W. Glendale Drive
New Berlin, WI 53151
USA

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: Jocelyn Jens
Product Group Coordinator

Authorized by: Lindsay Clark
Operations Manager

PRODUCTS

CLASS 5311 09 - POWER SUPPLIES - Distributed Generation Power Systems Equipment
CLASS 5311 89 - POWER SUPPLIES - Distributed Generation - Power Systems Equipment
- Certified to U.S. Standards

Utility Interactive Inverter, Models PVI-4.2-OUTD-US, PVI-3.8-OUTD-US, PVI-3.6-OUTD-US, PVI-3.0-OUTD-US, PVI-4.2-OUTD-S-US, PVI-3.8-OUTD-S-US, PVI-3.6-OUTD-S-US, PVI-3.0-OUTD-S-US, PVI-4.2-OUTD-S-US-A, PVI-3.8-OUTD-S-US-A, PVI-3.6-OUTD-S-US-A, PVI-3.0-OUTD-S-US-A, PVI-4.2-OUTD-US-W, PVI-3.8-OUTD-US-W, PVI-3.6-OUTD-US-W and PVI-3.0-OUTD-US-W; provided with two DC input channels, permanently connected, system ratings as follows:

Notes:
1. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including "–Z" suffix.
2. For details related to rating, size, configuration, etc. reference should be made to the CSA Certification Record or the Certificate of Compliance Annex A.

Certificate: 2708406 **Master Contract:** 259813

Project: 2722409 **Date Issued:** April 24, 2014

APPLICABLE REQUIREMENTS

CSA-C22.2 No.107.1-01	-	General Use Power Supplies
*UL Std No. 1741-Second Edition	-	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (January 28, 2010)
UL 1699B	-	Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection (Issue Number 2, January 14, 2013)
CSA TIL M-07		Interim Certification Requirements for Photovoltaic (PV) DC Arc Fault Protection (Issue Number 1, March 11, 2013)

*Note: Conformity to UL 1741-Second Edition (January 28, 2010) includes compliance with applicable requirements of IEEE 1547 and IEEE 1547.1

Supplement to Certificate of Compliance

Certificate: 2708406 (Project 2722409) **Master Contract:** 259813

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
2708406	March 12, 2014	Multiple Listing for Power-One / ABB, Models PVI-4.2-OUTD-US, PVI-3.8-OUTD-US, PVI-3.6-OUTD-US, PVI-3.0-OUTD-US, PVI-4.2-OUTD-S-US, PVI-3.8-OUTD-S-US, PVI-3.6-OUTD-S-US, PVI-3.0-OUTD-S-US, PVI-4.2-OUTD-S-US-A, PVI-3.8-OUTD-S-US-A, PVI-3.6-OUTD-S-US-A, PVI-3.0-OUTD-S-US-A, PVI-4.2-OUTD-US-W, PVI-3.8-OUTD-US-W, PVI-3.6-OUTD-US-W, PVI-3.0-OUTD-US-W (Alt. File No. 259813, Form A)
2722409	April 24, 2014	Update ML Certificate to include firmware changes.

Multiple Listing Project No	Listee Models	Submittor Models	Submittor Project No
2708406	PVI-4.2-OUTD-US	PVI-4.2-OUTD-US	2096477 (2682842)
2708406	PVI-3.8-OUTD-US	PVI-3.8-OUTD-US	2096477 (2682842)
2708406	PVI-3.6-OUTD-US	PVI-3.6-OUTD-US	2096477 (2682842)
2708406	PVI-3.0-OUTD-US	PVI-3.0-OUTD-US	2096477 (2682842)
2708406	PVI-4.2-OUTD-S-US	PVI-4.2-OUTD-S-US	2096477 (2682842)
2708406	PVI-3.8-OUTD-S-US	PVI-3.8-OUTD-S-US	2096477 (2682842)
2708406	PVI-3.6-OUTD-S-US	PVI-3.6-OUTD-S-US	2096477 (2682842)
2708406	PVI-3.0-OUTD-S-US	PVI-3.0-OUTD-S-US	2096477 (2682842)
2708406	PVI-4.2-OUTD-S-US-A	PVI-4.2-OUTD-S-US-A	2096477 (2682842)
2708406	PVI-3.8-OUTD-S-US-A	PVI-3.8-OUTD-S-US-A	2096477 (2682842)
2708406	PVI-3.6-OUTD-S-US-A	PVI-3.6-OUTD-S-US-A	2096477 (2682842)
2708406	PVI-3.0-OUTD-S-US-A	PVI-3.0-OUTD-S-US-A	2096477 (2682842)
2708406	PVI-4.2-OUTD-US-W	PVI-4.2-OUTD-US-W	2096477 (2682842)
2708406	PVI-3.8-OUTD-US-W	PVI-3.8-OUTD-US-W	2096477 (2682842)
2708406	PVI-3.6-OUTD-US-W	PVI-3.6-OUTD-US-W	2096477 (2682842)
2708406	PVI-3.0-OUTD-US-W	PVI-3.0-OUTD-US-W	2096477 (2682842)

Certificate of Compliance Annex A

Utility Interactive Inverter, Models PVI-4.2-OUTD-US, PVI-3.8-OUTD-US, PVI-3.6-OUTD-US, PVI-3.0-OUTD-US, PVI-4.2-OUTD-S-US, PVI-3.8-OUTD-S-US, PVI-3.6-OUTD-S-US, PVI-3.0-OUTD-S-US, PVI-4.2-OUTD-S-US-A, PVI-3.8-OUTD-S-US-A, PVI-3.6-OUTD-S-US-A, PVI-3.0-OUTD-S-US-A, PVI-4.2-OUTD-US-W, PVI-3.8-OUTD-US-W, PVI-3.6-OUTD-US-W and PVI-3.0-OUTD-US-W; provided with two DC input channels, permanently connected, system ratings as follows:

PART A: Utility Interactive Inverter, Models PVI-4.2-OUTD-US, PVI-4.2-OUTD-S-US, PVI-4.2-OUTD-S-US-A, and PVI-4.2-OUTD-US-W:

Model	PVI-4.2-OUTD-US	PVI-4.2-OUTD-S-US & PVI-4.2-OUTD-S-US-A	PVI-4.2-OUTD-US-W
Maximum Input Voltage (DC)	600 V dc	600 V dc	600 V dc
Range of Input Operating Voltage (DC)	90-580 V dc, 360 V dc nominal	90-580 V dc, 360 V dc nominal	50-580 V dc, 360 V dc nominal
Maximum Input Current (DC)	16 A (Each Input - 2 provided)	16 A (Each Input - 2 provided)	32 A
Maximum Input Short Circuit Current (DC)	20 A (Each Input - 2 provided)	20 A (Each Input - 2 provided)	40 A
Maximum Utility Backfeed Current (AC)	0 A	0 A	0 A
Output Power Factor Rating	>0.995	>0.995	>0.995
Operating Voltage Range (AC) (See Note 2)	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration
Operating Frequency Range (HZ)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)
Field Adjustable Operating Frequency Range (HZ)	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz
Number of Phases	1	1	1
Nominal Output Voltage (AC) (See Note 2)	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac
Normal Output Frequency	60 Hz	60 Hz	60 Hz
Continuous Output Current (AC)	20 A / 20 A / 20 A	20 A / 20 A / 20 A	20 A / 20 A / 20 A
Maximum Output Power (AC) (See Note 4)	4600 W/ 4600 W / 4200 W	4600 W/ 4600 W / 4200 W	4600 W/ 4600 W / 4200 W
Maximum Continuous Output Power (AC) @ +45°C ambient (See Note 4)	4200 W	4200 W	4200 W
Maximum Output Fault Current and Duration	(See Note 6)	(See Note 6)	(See Note 6)
Maximum Output Overcurrent Protection	25 A / 25 A/ 25 A	25 A / 25 A/ 25 A	25 A / 25 A/ 25 A
Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times	See Note 7	See Note 7	See Note 7

Certificate of Compliance Annex A

Model	PVI-4.2-OUTD-US	PVI-4.2-OUTD-S-US & PVI-4.2-OUTD-S-US-A	PVI-4.2-OUTD-US-W
Trip Limit and Trip Time Accuracy	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)
Normal Operation Temperature Range	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)
Output Power Temperature Derating and Maximum Full Power Operating Ambient	(See Note 4)	(See Note 4)	(See Note 4)
Enclosure Rating Type	4X	4X	4X

Device	Device Version	Device Checksum
Rev. Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.2.2	2283

Alternate Device Version (referred to Alternate Microcontroller, Atmel, Type ATMEGA 256-16-AU):

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.1.4.0	4D9A

Alternate Device Version (referred to Firmware revision for very high voltage field adjustable time setting)

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.1.4.1**	**7368**

For –A Model Series Only

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.4.0	0B01

Alternate Device Version for –A Model Series Only

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.0.4.1**	**9A14**

Notes:

1. Inverter models PVI-4.2-OUTD-US, PVI-4.2-OUTD-S-US, PVI-4.2-OUTD-S-US-A and PVI-4.2-OUTD-US-W have been evaluated for use in utility-interactive applications.

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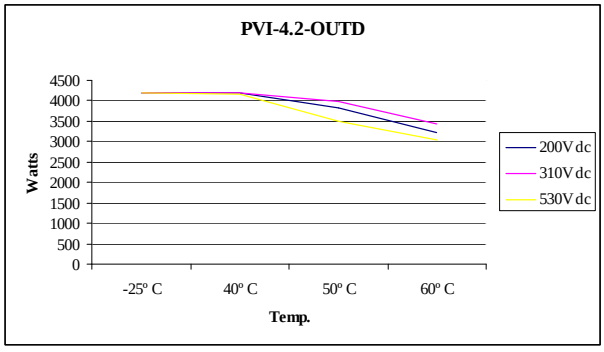
2. The output of Inverter, models PVI-4.2-OUTD-US, PVI-4.2-OUTD-S-US, PVI-4.2-OUTD-S-US-A, and PVI-4.2-OUTD-US-W may be 277 V ac, 240 V ac or 208 V ac which is user settable based on the utility system.

3. Inverter Model PVI-4.2-OUTD-US-W is intended for operation with an AC Generated supply (i.e. wind or hydro); this inverter is intended to receive an input supply from a certified interface module (rectifier-controller which converts AC voltage from an AC generator into a regulated DC voltage).

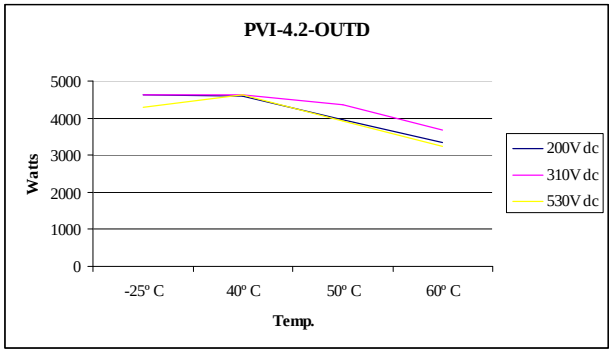
4. Maximum output power can be delivered only with an input voltage range of:

220-530 V dc for 208 V ac configuration
200-530 V dc for 240 V ac configuration
200-530 V dc for 277 V ac configuration

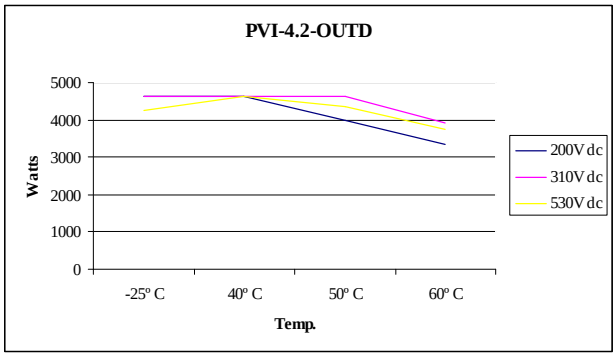
Power Derating Curves over Temperature range -25° to 60°C at 208V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 240V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 277V ac output:



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5. Inverter Models PVI-4.2-OUTD-US, PVI-4.2-OUTD-S-US, PVI-4.2-OUTD-S-US-A, and PVI-4.2-OUTD-US-W are intended to be used in an ungrounded power system in conjunction with the requirements specified in the National Electrical Code, ANSI/NFPA 70, 2005 Ed, section 690.35.

6. Maximum Output Fault Current and Duration:

Models	Output Voltage	Fault Current RMS (A)	Duration (mSec) 3 cycles	Fault Current PK (A)	Total Duration (mSec)
PVI-4.2-OUTD Series	208	13.5	49.92	122.4	119.0
PVI-4.2-OUTD Series	240	14.7	49.92	164.4	120.9
PVI-4.2-OUTD Series	277	12.3	49.92	165.9	123.2

7. Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times:

Table 68.1
Voltage and frequency limits for utility Interaction

Condition	Simulated utility source		Maximum time (sec) at 60 Hz[a] before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	$< 0.50\ V_{nor}$[b]	Rated (60 Hz)	0.16 (Fixed)
B	$0.50\ V_{nor}$[b] $\leq V < 0.88\ V_{nor}$ (Adjustable)	Rated (60 Hz)	2 (Fixed)
C	$1.10\ V_{nor}$[b] $< V < 1.20 V_{nor}$ (*) (Adjustable)	Rated (60 Hz)	1 (Fixed)
D	$1.20 V_{nor} \leq V$ (*)	Rated (60 Hz)	**0.16 (Default) (Adj. 0.001 to 0.16s)**
E	Rated	f > 60.5 Hz (Default) (Adj. 60.2 to 63.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
F	Rated	f < 59.3 Hz (Default) (Adj. 59.8 to 57.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
G	Rated	f < 57.0 Hz	0.16 (Fixed)
H	Rated	f > 63.0 Hz	0.16 (Fixed)

[a] When a utility frequency other than 60 Hz is used for the test, the maximum number of cycles it takes to cease to export power to the simulated utility shall not exceed the number of cycles a utility frequency of 60 Hz takes regardless of the time the inverter takes to cease to export power to the simulated utility.

[b] V is the nominal output voltage rating.

(*) Note: For model at 277V High Voltage is fixed at 110% V_{nor} and Very High Voltage is fixed at 111% V_{nor}.

8. All models meet the surge requirements of IEEE C62.41.2-2002, Location Category B (6kV). Tests were performed using ring wave and combination waveforms, both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the units were operational with control functionally verified by frequency and voltage disconnect tests.

9. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including "–Z" suffix.

10. Model PVI-4.2-OUTD-S-US-A is provided with PV DC ARC-Fault Circuit Protection for series arcing faults.

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PART B: Utility Interactive Inverter, Models PVI-3.8-OUTD-US, PVI-3.8-OUTD-S-US, PVI-3.8-OUTD-S-US-A, and PVI-3.8-OUTD-US-W:

Model	PVI-3.8-OUTD-US	PVI-3.8-OUTD-S-US PVI-3.8-OUTD-S-US-A	PVI-3.8-OUTD-US-W
Maximum Input Voltage (DC)	600 V dc	600 V dc	600 V dc
Range of Input Operating Voltage (DC)	90-580 V dc, 360 V dc nominal	90-580 V dc, 360 V dc nominal	90-580 V dc, 360 V dc nominal
Range of Input Operating Voltage (DC) @ Maximum Output Power	200-530 V dc	200-530 V dc	200-530 V dc
Maximum Input Current (DC)	16 A (Each Input – 2 provided)	16 A (Each Input – 2 provided)	32 A
Maximum Input Short Circuit Current (DC)	20 A (Each Input – 2 provided)	20 A (Each Input – 2 provided)	40 A
Maximum Utility Backfeed Current (AC)	0 A	0 A	0 A
Output Power Factor Rating	>0.995	>0.995	>0.995
Operating Voltage Range (AC) (See Note 2)	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration
Operating Frequency Range (HZ)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)
Field Adjustable Operating Frequency Range (HZ)	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz
Number of Phases	1	1	1
Nominal Output Voltage (AC) (See Note 2)	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac
Normal Output Frequency	60 Hz	60 Hz	60 Hz
Continuous Output Current (AC)	16 A / 16 A / 16 A	16 A / 16 A / 16 A	16 A / 16 A / 16 A
Maximum Output Power (AC) (See Note 4)	4200 W/3800 W/3300 W	4200 W/3800 W/3300 W	4200 W/3800 W/3300 W
Maximum Continuous Output Power (AC) @ +50°C ambient (See Note 4)	3800 W/3800 W/3300 W	3800 W/3800 W/3300 W	3800 W/3800 W/3300 W
Maximum Output Overcurrent Protection	20 A / 20 A/ 20 A	20 A / 20 A/ 20 A	20 A / 20 A/ 20 A
Normal Operation Temperature Range	-25°C to +60°C	-25°C to +60°C	-25°C to +60°C
Enclosure Rating Type	4X	4X	4X

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Device	Device Version	Device Checksum
Rev. Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.2.2	2283

Alternate Device Version (referred to Alternate Microcontroller, Atmel, Type ATMEGA 256-16-AU):

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.1.4.0	4D9A

Alternate Device Version (referred to Firmware revision for very high voltage field adjustable time setting)

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.1.4.1**	**7368**

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Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.4.0	0B01

Alternate Device Version for –A Model Series Only

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.0.4.1**	**9A14**

Notes:

1. Inverter models PVI-3.8-OUTD-US, PVI-3.8-OUTD-S-US, PVI-3.8-OUTD-S-US-A, and PVI-3.8-OUTD-US-W have been evaluated for use in utility-interactive applications.

2. The output of Inverter, models PVI-3.8-OUTD-US, PVI-3.8-OUTD-S-US, PVI-3.8-OUTD-S-US-A, and PVI-3.8-OUTD-US-W may be 277 V ac, 240 V ac or 208 V ac which is user settable based on the utility system.

3. Inverter Model PVI-3.8-OUTD-US-W is intended for operation with an AC Generated supply (i.e. wind or hydro); this inverter is intended to receive an input supply from a certified interface module (rectifier-controller which converts AC voltage from an AC generator into a regulated DC voltage).

4. Maximum output power can be delivered only with an input voltage range of:

   200-530 V dc for 208 V ac configuration
   200-530 V dc for 240 V ac configuration
   200-530 V dc for 277 V ac configuration

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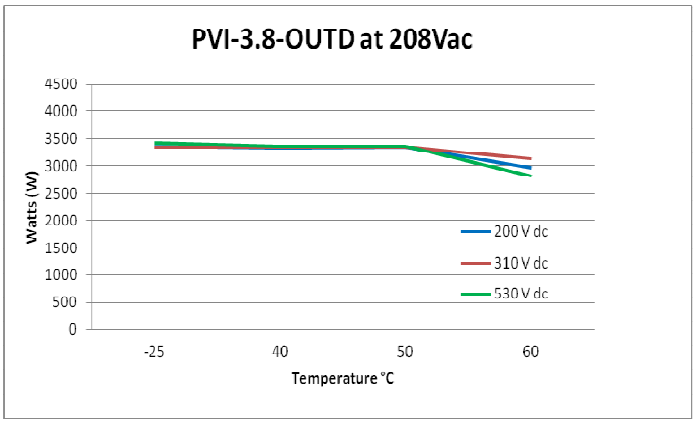
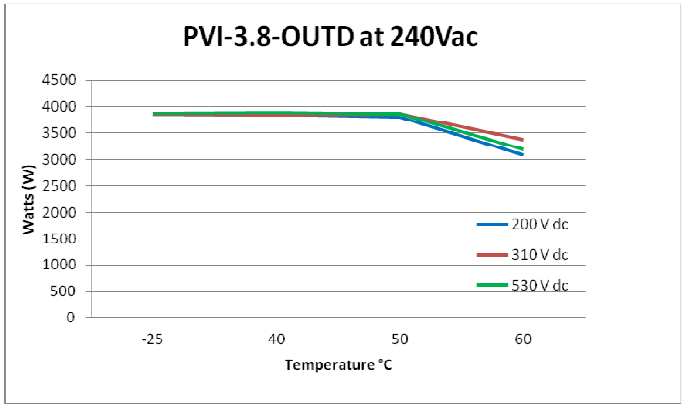
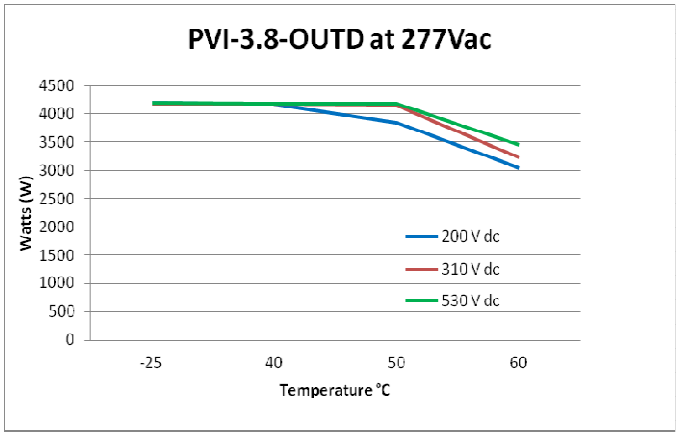
Power Derating Curves over Temperature range -25° to 60°C at 208V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 240V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 277V ac output:



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5. Inverter Models PVI-3.8-OUTD-US, PVI-3.8-OUTD-S-US, PVI-3.8-OUTD-S-US-A, and PVI-3,8-OUTD-US-W are intended to be used in an ungrounded power system in conjunction with the requirements specified in the National Electrical Code, ANSI/NFPA 70, 2005 Ed, section 690.35.

6. Maximum Output Fault Current and Duration:

Models	Output Voltage	Fault Current RMS (A)	Duration (mSec) 3 cycles	Fault Current PK (A)	Total Duration (mSec)
PVI-3.8-OUTD Series	208	11.6	50.0	224.0	89.0
PVI-3.8-OUTD Series	240	12.8	50.0	336.0	100.8
PVI-3.8-OUTD Series	277	13.0	50.0	276.0	96.4

7. Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times:

Voltage and frequency limits for utility Interaction

Condition	Simulated utility source		Maximum time (sec) at 60 Hz[a] before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 0.50 V_{nor}[b]	Rated (60 Hz)	0.16 (Fixed)
B	0.50 V_{nor}[b] ≤ V < 0.88 V_{nor} (Adjustable)	Rated (60 Hz)	2 (Fixed)
C	1.10 V_{nor}[b] < V < 1.20V_{nor} (*) (Adjustable)	Rated (60 Hz)	1 (Fixed)
D	1.20V_{nor} ≤ V (*)	Rated (60 Hz)	**0.16 (Default) (Adj. 0.001 to 0.16s)**
E	Rated	f > 60.5 Hz (Default) (Adj. 60.2 to 63.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
F	Rated	f < 59.3 Hz (Default) (Adj. 59.8 to 57.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
G	Rated	f < 57.0 Hz	0.16 (Fixed)
H	Rated	f > 63.0 Hz	0.16 (Fixed)

[a] When a utility frequency other than 60 Hz is used for the test, the maximum number of cycles it takes to cease to export power to the simulated utility shall not exceed the number of cycles a utility frequency of 60 Hz takes regardless of the time the inverter takes to cease to export power to the simulated utility.

[b] V is the nominal output voltage rating.

(*) Note: For model at 277V High Voltage is fixed at 110% V_{nor} and Very High Voltage is fixed at 111% V_{nor}.

8. All models meet the surge requirements of IEEE C62.41.2-2002, Location Category B (6kV). Tests were performed using ring wave and combination waveforms, both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the units were operational with control functionally verified by frequency and voltage disconnect tests.

9. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including "–Z" suffix.

10. Model PVI-3.8-OUTD-S-US-A is provided with PV DC ARC-Fault Circuit Protection for series arcing faults.

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PART C: Utility Interactive Inverter, Models PVI-3.6-OUTD-US, PVI-3.6-OUTD-S-US, PVI-3.6-OUTD-S-US-A, and PVI-3.6-OUTD-US-W:

Model	PVI-3.6-OUTD-US	PVI-3.6-OUTD-S-US & PVI-3.6-OUTD-S-US-A	PVI-3.6-OUTD-US-W
Maximum Input Voltage (DC)	600 V dc	600 V dc	600 V dc
Range of Input Operating Voltage (DC)	90-580 V dc, 360 V dc nominal	90-580 V dc, 360 V dc nominal	50-580 V dc, 360 V dc nominal
Maximum Input Current (DC)	16 A (Each Input - 2 provided)	16 A (Each Input - 2 provided)	32 A
Maximum Input Short Circuit Current (DC)	20 A (Each Input - 2 provided)	20 A (Each Input - 2 provided)	40 A
Maximum Utility Backfeed Current (AC)	0 A	0 A	0 A
Output Power Factor Rating	>0.995	>0.995	>0.995
Operating Voltage Range (AC) (See Note 2)	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration
Operating Frequency Range (HZ)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)
Field Adjustable Operating Frequency Range (HZ)	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz
Number of Phases	1	1	1
Nominal Output Voltage (AC) (See Note 2)	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac
Normal Output Frequency	60 Hz	60 Hz	60 Hz
Continuous Output Current (AC)	16 A / 16 A / 17.2 A	16 A / 16 A / 17.2 A	16 A / 16 A / 17.2 A
Maximum Output Power (AC) (See Note 4)	4000 W/4000W/3600 W	4000 W/4000W/3600 W	4000 W/4000W/3600 W
Maximum Continuous Output Power (AC) @ +55°C ambient (See Note 4)	3600 W	3600 W	3600 W
Maximum Output Fault Current and Duration	(See Note 6)	(See Note 6)	(See Note 6)
Maximum Output Overcurrent Protection	20 A / 20 A/ 25 A	20 A / 20 A/ 25 A	20 A / 20 A/ 25 A
Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times	See Note 7	See Note 7	See Note 7

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Model	PVI-3.6-OUTD-US	PVI-3.6-OUTD-S-US & PVI-3.6-OUTD-S-US-A	PVI-3.6-OUTD-US-W
Trip Limit and Trip Time Accuracy	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)
Normal Operation Temperature Range	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)
Output Power Temperature Derating and Maximum Full Power Operating Ambient	(See Note 4)	(See Note 4)	(See Note 4)
Enclosure Rating Type	4X	4X	4X

Device	Device Version	Device Checksum
Rev. Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.2.2	2283

Alternate Device Version (referred to Alternate Microcontroller, Atmel, Type ATMEGA 256-16-AU):

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.1.4.0	4D9A

Alternate Device Version (referred to Firmware revision for very high voltage field adjustable time setting)

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.1.4.1**	**7368**

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Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.4.0	0B01

Alternate Device Version for –A Model Series Only

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.0.4.1**	**9A14**

Notes:

1. Inverter models PVI-3.6-OUTD-US, PVI-3.6-OUTD-S-US, PVI-3.6-OUTD-S-US-A, and PVI-3.6-OUTD-US-W have been evaluated for use in utility-interactive applications.

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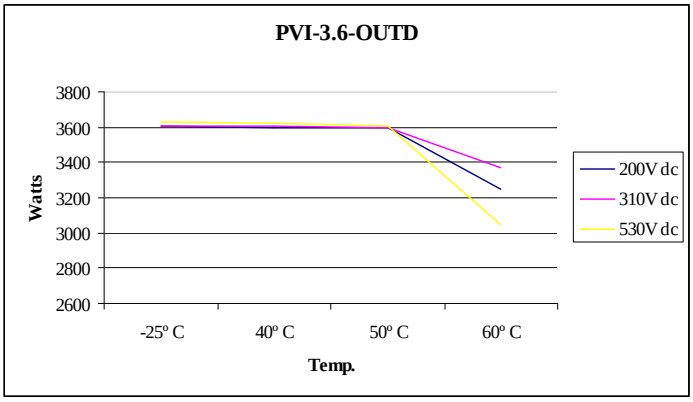
2. The output of Inverter, models PVI-3.6-OUTD-US, PVI-3.6-OUTD-S-US, PVI-3.6-OUTD-S-US-A, and PVI-3.6-OUTD-US-W may be 277 V ac, 240 V ac or 208 V ac which is user settable based on the utility system.

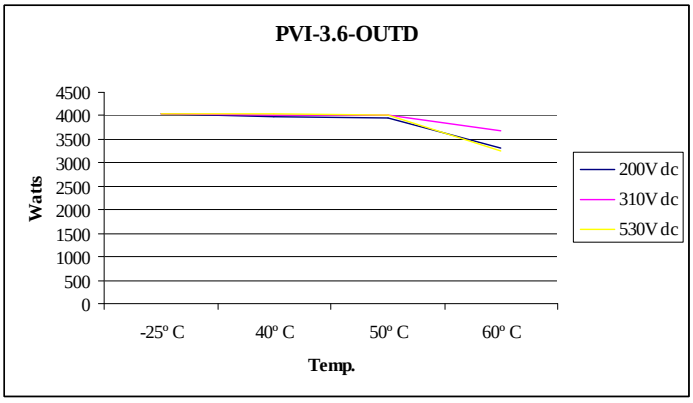
3. Inverter Model PVI-3.6-OUTD-US-W is intended for operation with an AC Generated supply (i.e. wind or hydro); this inverter is intended to receive an input supply from a certified interface module (rectifier-controller which converts AC voltage from an AC generator into a regulated DC voltage).

4. Maximum output power can be delivered only with an input voltage range of:
220-530 V dc for 208 V ac configuration
200-530 V dc for 240 V ac configuration
200-530 V dc for 277 V ac configuration

Power Derating Curves over Temperature range -25° to 60°C at 208V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 240V ac output:



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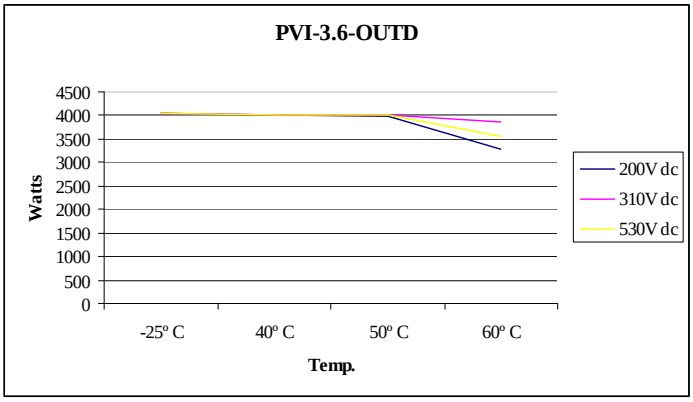
Power Derating Curves over Temperature range -25° to 60°C at 277V ac output:



5. Inverter Models PVI-3.6-OUTD-US, PVI-3.6-OUTD-S-US, PVI-3.6-OUTD-S-US-A, and PVI-3.6-OUTD-US-W are intended to be used in an ungrounded power system in conjunction with the requirements specified in the National Electrical Code, ANSI/NFPA 70, 2005 Ed, section 690.35.

6. Maximum Output Fault Current and Duration:

Models	Output Voltage	Fault Current RMS (A)	Duration (mSec) 3 cycles	Fault Current PK (A)	Total Duration (mSec)
PVI-3.6-OUTD Series	208	12.2	49.92	93.9	124.4
PVI-3.6-OUTD Series	240	12.5	49.92	136.5	120.2
PVI-3.6-OUTD Series	277	11.3	49.92	164.6	116.3

7. Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times:

Table 68.1
Voltage and frequency limits for utility Interaction

Condition	Simulated utility source		Maximum time (sec) at 60 Hz[a] before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 0.50 V_{nor}[b]	Rated (60 Hz)	0.16 (Fixed)
B	0.50 V_{nor}[b] ≤ V < 0.88 V_{nor} (Adjustable)	Rated (60 Hz)	2 (Fixed)
C	1.10 V_{nor}[b] < V < 1.20V_{nor} (*) (Adjustable)	Rated (60 Hz)	1 (Fixed)
D	1.20V_{nor} ≤ V (*)	Rated (60 Hz)	**0.16 (Default) (Adj. 0.001 to 0.16s)**
E	Rated	f > 60.5 Hz (Default) (Adj. 60.2 to 63.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
F	Rated	f < 59.3 Hz (Default) (Adj. 59.8 to 57.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
G	Rated	f < 57.0 Hz	0.16 (Fixed)
H	Rated	f > 63.0 Hz	0.16 (Fixed)

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[a] When a utility frequency other than 60 Hz is used for the test, the maximum number of cycles it takes to cease to export power to the simulated utility shall not exceed the number of cycles a utility frequency of 60 Hz takes regardless of the time the inverter takes to cease to export power to the simulated utility.
[b] V is the nominal output voltage rating.
(*) Note: For model at 277V High Voltage is fixed at 110% V_{nor} and Very High Voltage is fixed at 111% $V_{nor.}$

8. All models meet the surge requirements of IEEE C62.41.2-2002, Location Category B (6kV). Tests were performed using ring wave and combination waveforms, both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the units were operational with control functionally verified by frequency and voltage disconnect tests.

9. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including "–Z" suffix.

10. Model PVI-3.6-OUTD-S-US-A is provided with PV DC ARC-Fault Circuit Protection for series arcing faults.

PART D

Utility Interactive Inverter, Models PVI-3.0-OUTD-US, PVI-3.0-OUTD-S-US, PVI-3.0-OUTD-S-US-A, and PVI-3.0-OUTD-US-W:

Model	PVI-3.0-OUTD-US	PVI-3.0-OUTD-S-US & PVI-3.0-OUTD-S-US-A	PVI-3.0-OUTD-US-W
Maximum Input Voltage (DC)	600 V dc	600 V dc	600 V dc
Range of Input Operating Voltage (DC)	90-580 V dc, 360 V dc nominal	90-580 V dc, 360 V dc nominal	50-580 V dc, 360 V dc nominal
Maximum Input Current (DC)	10 A (Each Input - 2 provided)	10 A (Each Input - 2 provided)	20 A
Maximum Input Short Circuit Current (DC)	12.5 A (Each Input - 2 provided)	12.5 A (Each Input - 2 provided)	25 A
Maximum Utility Backfeed Current (AC)	0 A	0 A	0 A
Output Power Factor Rating	>0.995	>0.995	>0.995
Operating Voltage Range (AC) (See Note 2)	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration	244-304 V ac for 277 V ac configuration 211-264 V ac for 240 V ac configuration 183-228 V ac for 208 V ac configuration
Operating Frequency Range (HZ)	59.3-60.5 Hz (Default)	59.3-60.5 Hz (Default)	59.3-60.5 Hz
Field Adjustable Operating Frequency Range (HZ)	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz	57.0-59.8 Hz, 60.2-63.0 Hz
Number of Phases	1	1	1
Nominal Output Voltage (AC) (See Note 2)	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac	277 V ac / 240 V ac / 208 V ac
Normal Output Frequency	60 Hz	60 Hz	60 Hz

Certificate of Compliance Annex A

Model	PVI-3.0-OUTD-US	PVI-3.0-OUTD-S-US & PVI-3.0-OUTD-S-US-A	PVI-3.0-OUTD-US-W
Continuous Output Current (AC)	12 A / 14.5 A/ 14.5 A	12 A / 14.5 A/ 14.5 A	12 A / 14.5 A/ 14.5 A
Maximum Output Power (AC) (See Note 4)	3300 W/3300W/3000 W	3300 W/3300W/3000 W	3300 W/3300W/3000 W
Maximum Continuous Output Power (AC) @ +55C (See Note 4)	3000 W	3000 W	3000 W
Maximum Output Fault Current and Duration	(See Note 6)	(See Note 6)	(See Note 6)
Maximum Output Overcurrent Protection	15 A / 20 A/ 20 A	15 A / 20 A/ 20 A	15 A / 20 A/ 20 A
Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times	See Note 7	See Note 7	See Note 7
Trip Limit and Trip Time Accuracy	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)	Voltage: +/- 2% Frequency: +/- 0.10 Hz Time: 2 grid cycles (33 ms @ 60 Hz)
Normal Operation Temperature Range	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)	-25°C to +60°C (See Note 4)
Output Power Temperature Derating and Maximum Full Power Operating Ambient	(See Note 4)	(See Note 4)	(See Note 4)
Enclosure Rating Type	4X	4X	4X

Device	Device Version	Device Checksum
Rev. Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.2.2	2283

Alternate Device Version (referred to Alternate Microcontroller, Atmel, Type ATMEGA 256-16-AU):

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.1.4.0	4D9A

Alternate Device Version (referred to Firmware revision for very high voltage field adjustable time setting)

Device	**Device Version**	**Device Checksum**
Rev Number DC-DC Converter	**A.2.0.5**	**7B01**
Rev. Number Inverter	**B.2.0.C**	**5DEB**
Rev. Number Microprocessor	**C.1.4.1**	**7368**

For –A Model Series Only

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.5	9CD8
Rev. Number Microprocessor	C.0.4.0	0B01

Certificate of Compliance Annex A

Alternate Device Version for –A Model Series Only

Device	Device Version	Device Checksum
Rev Number DC-DC Converter	A.2.0.5	7B01
Rev. Number Inverter	B.2.0.C	5DEB
Rev. Number Microprocessor	C.0.4.1	9A14

Notes:

1. Inverter, Models PVI-3.0-OUTD-US, PVI-3.0-OUTD-S-US, PVI-3.0-OUTD-S-US-A, and PVI-3.0-OUTD-US-W have been evaluated for use in utility-interactive applications.

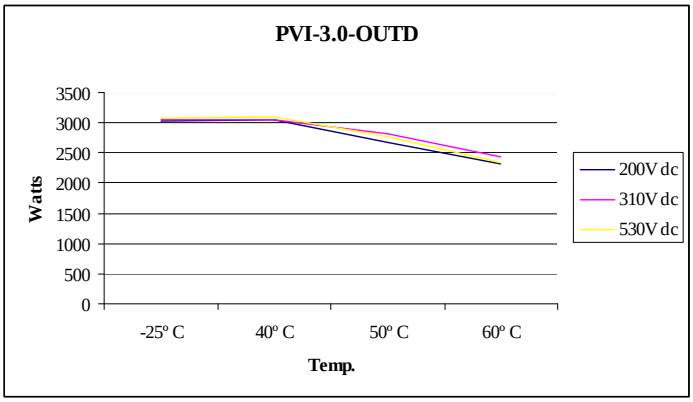
2. The output of Inverter, models PVI-3.0-OUTD-US, PVI-3.0-OUTD-S-US, PVI-3.0-OUTD-S-US-A, and PVI-3.0-OUTD-US-W may be 277 V ac, 240 V ac or 208 V ac which is user settable based on the utility system.

3. Inverter Model PVI-3.0-OUTD-US-W is intended for operation with an AC Generated supply (i.e. wind or hydro); this inverter is intended to receive an input supply from a certified interface module (rectifier-controller which converts AC voltage from an AC generator into a regulated DC voltage).

4. Maximum output power can be delivered only with an input voltage range of:

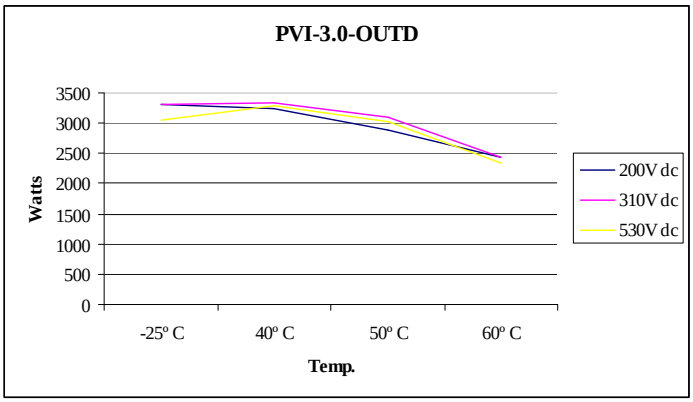
   200-530 V dc for 208 V ac configuration
   200-530 V dc for 240 V ac configuration
   200-530 V dc for 277 V ac configuration

Power Derating Curves over Temperature range -25° to 60°C at 208V ac output:

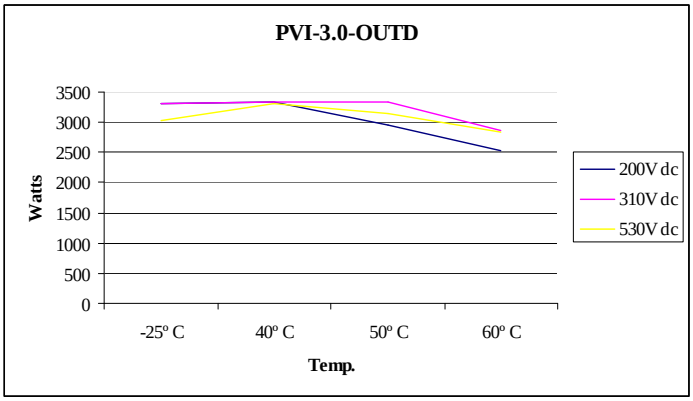


Certificate of Compliance Annex A

Power Derating Curves over Temperature range -25° to 60°C at 240V ac output:



Power Derating Curves over Temperature range -25° to 60°C at 277V ac output:



5. Inverter Models PVI-3.0-OUTD-US, PVI-3.0-OUTD-S-US, PVI-3.0-OUTD-S-US-A, and PVI-3.0-OUTD-US-W are intended to be used in an ungrounded power system in conjunction with the requirements specified in the National Electrical Code, ANSI/NFPA 70, 2005 Ed, section 690.35.

6. Maximum Output Fault Current and Duration:

Models	Output Voltage	Fault Current RMS (A)	Duration (mSec) 3 cycles	Fault Current PK (A)	Duration (mSec)
PVI-3.0-OUTD Series	208	11.7	49.92	162.0	121.8
PVI-3.0-OUTD Series	240	10.6	49.92	139.7	118.9
PVI-3.0-OUTD Series	277	8.6	49.98	92.2	116.5

Certificate of Compliance Annex A

7. Utility Interconnection and Voltage and Frequency Trip Limits and Trip Times:

Table 68.1
Voltage and frequency limits for utility Interaction

Condition	Simulated utility source		Maximum time (sec) at 60 Hz[a] before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 0.50 V_{nor}[b]	Rated (60 Hz)	0.16 (Fixed)
B	0.50 V_{nor}[b] ≤ V < 0.88 V_{nor} (Adjustable)	Rated (60 Hz)	2 (Fixed)
C	1.10 V_{nor}[b] < V < 1.20V_{nor} (*) (Adjustable)	Rated (60 Hz)	1 (Fixed)
D	1.20V_{nor} ≤ V (*)	Rated (60 Hz)	**0.16 (Default) (Adj. 0.001 to 0.16s)**
E	Rated	f > 60.5 Hz (Default) (Adj. 60.2 to 63.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
F	Rated	f < 59.3 Hz (Default) (Adj. 59.8 to 57.0 Hz)	0.16 (Default) (Adj. 0.16 to 300 sec)
G	Rated	f < 57.0 Hz	0.16 (Fixed)
H	Rated	f > 63.0 Hz	0.16 (Fixed)

[a] When a utility frequency other than 60 Hz is used for the test, the maximum number of cycles it takes to cease to export power to the simulated utility shall not exceed the number of cycles a utility frequency of 60 Hz takes regardless of the time the inverter takes to cease to export power to the simulated utility.

[b] V is the nominal output voltage rating.

(*) Note: For model at 277V High Voltage is fixed at 110% V_{nor} and Very High Voltage is fixed at 111% V_{nor}.

8. All models meet the surge requirements of IEEE C62.41.2-2002, Location Category B (6kV). Tests were performed using ring wave and combination waveforms, both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the units were operational with control functionally verified by frequency and voltage disconnect tests.

9. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including "–Z" suffix.

10. Model PVI-3.0-OUTD-S-US-A is provided with PV DC ARC-Fault Circuit Protection for series arcing faults.

Se STABILITY ENGINEERING
431 W. Ponce de Leon Ave. Ste 4, Decatur, GA 30030 Ph: 404-377-9316

September 16, 2016

Stefan King
Energy Consultant
True Energy USA, LLC
3840 Windermere Pkwy, STE 403
Cumming, GA 30041

RE: GT Benger-Herny Building solar array – verification of racking system for wind loads.
Se#16372

Dear Stefan,

At your request, I have analyzed the design schematic for the ballasted racking system supporting the proposed solar panels on the roof of the Benger-Herny Building at Georgia Tech. The rack system consists of Bay and moduale, clips, blocks, RM clip and bolt, RM footpad and the solar panels. The system was analyzed for resistance to wind loading, using the following parameters.

The following parameters were used to evaluate the roof:
Code: ASCE 7-10; Wind Speed: 115 mph; Wind exposure : B

My evaluation of the schematic design indicates that the racking system is sufficiently ballasted to resist design wind load requirements as require.

WARRANTY AND LIABILITY

This report/drawing set is based upon a visual observation of conditions as they existed at the time of the inspection only. Stability Engineering's investigation did not include a review of hidden or concealed conditions. Although an earnest effort has been made to discover and identify all visible defects, in the event of an oversight, Stability Engineering's maximum liability shall be limited to the fee paid for its services. Stability Engineering reserves the right to supplement or revise its opinions based upon changed conditions, further investigation by Stability Engineering or others, or new findings.

Stability Engineering warrants that its services are performed, within the limits prescribed by the Client, with that level of care and skill ordinarily exercised by members of the same profession currently practicing in the same locality under similar conditions. No other warranties or representations are expressed or implied. This report and its conclusions are intended for the exclusive use of the Client and Stability Engineering shall have no liability arising out of their unauthorized use by others.

Sincerely,
Stability Engineering, Inc.

Pierre Coiron

Pierre Coiron P.E., pres.

Se STABILITY ENGINEERING
431 W. Ponce de Leon Ave. Ste 4, Decatur, GA 30030 Ph: 404-377-9316

September 16, 2016

Stefan King
Energy Consultant
True Energy USA, LLC
3840 Windermere Pkwy, STE 403
Cumming, GA 30041

RE: GT Benger-Herny Building solar array
Se#16372

Dear Stefan,

At your request, I evaluated the roof of the Benger-Herny Building at Georgia Tech in regard to solar panels to be placed on the roof using a ballasted system. The panels will be located at the south-east corner of the building occupying 712 sf.
The weight of the system including ballast is about 6000 lbs for a roof load of less than 10 psf.

The following parameters were used to evaluate the roof:

Code: ASCE 7-10;	Wind Speed: 115 mph;	Ground Snow Load: 5 psf
Roof Snow Load: 3.78 psf	Seismic Ss : .018	Wind exposure : B

The construction of the roof of the building is a concrete waffle slab has an estimated capacity of 50 psf which is more than enough to support the ballasted array.

WARRANTY AND LIABILITY

This report/drawing set is based upon a visual observation of conditions as they existed at the time of the inspection only. Stability Engineering's investigation did not include a review of hidden or concealed conditions. Although an earnest effort has been made to discover and identify all visible defects, in the event of an oversight, Stability Engineering's maximum liability shall be limited to the fee paid for its services. Stability Engineering reserves the right to supplement or revise its opinions based upon changed conditions, further investigation by Stability Engineering or others, or new findings.

Stability Engineering warrants that its services are performed, within the limits prescribed by the Client, with that level of care and skill ordinarily exercised by members of the same profession currently practicing in the same locality under similar conditions. No other warranties or representations are expressed or implied. This report and its conclusions are intended for the exclusive use of the Client and Stability Engineering shall have no liability arising out of their unauthorized use by others.

Sincerely,
Stability Engineering, Inc.

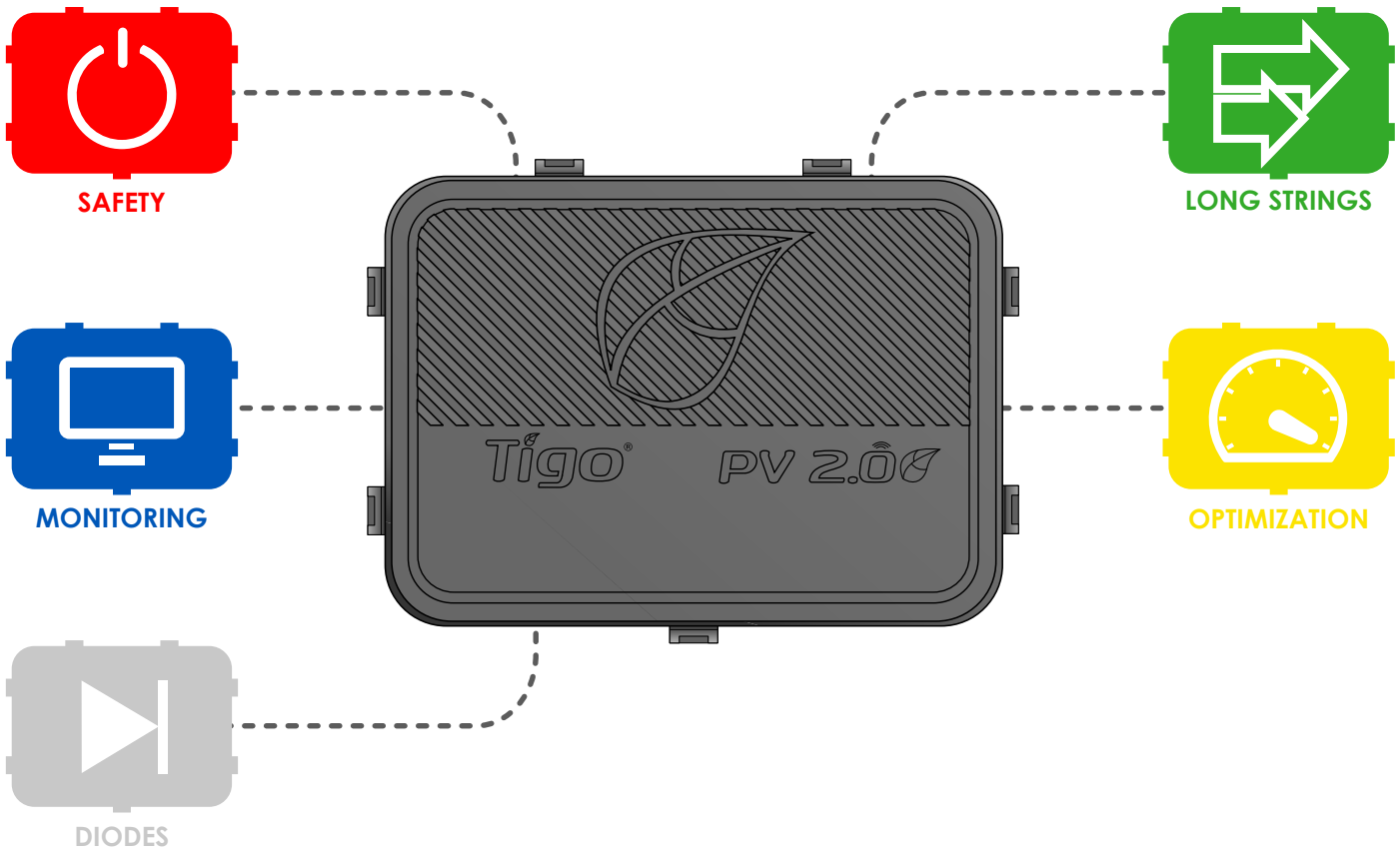
Pierre Coiron

Pierre Coiron P.E., pres.

TS4 PLATFORM

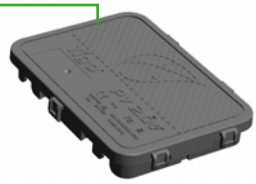
ONE SMART PLATFORM, FOR ANY SMART MODULE CHOICE

The TS4 universal platform enables plug-and-play functionality for any solar module. The base provides a single interface that can be matched with one of several electronic covers to address a range of functions and budgets. Together they form a new generation of module-level power electronics; flexible, replaceable, and upgradeable, accompanied by a powerful PV 2.0 communication backend.

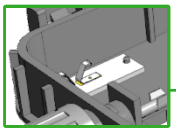


A MODULAR PLATFORM

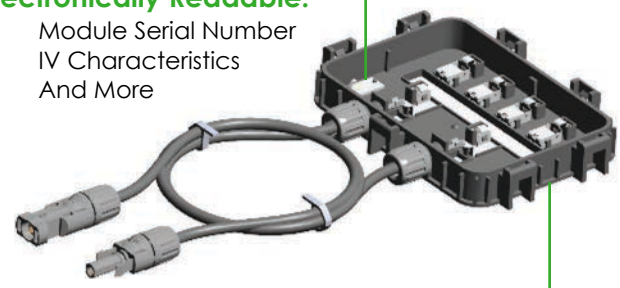
Choice of Electronic Covers
Removable Covers with Different Levels of Functionality



TS4-B
JUNCTION BOX BASE



Electronically Readable:
- Module Serial Number
- IV Characteristics
- And More



PV Module Integrated
Factory-installed for Smart Ready Solar

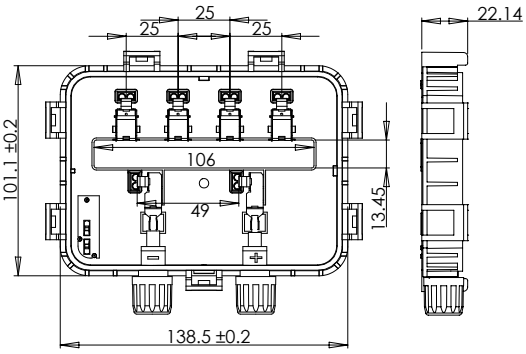
TS4-R
RETROFIT ADD-ON BASE

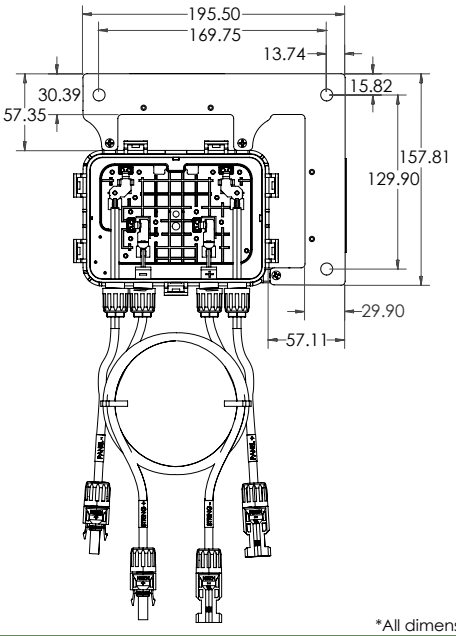
Mounting Bracket
Clips to Standard Module Frame

Connectivity
Add Smart Functionality to a Standard Module

MECHANICAL SPECIFICATIONS

Mechanical	
Operating Temperature Range	-40°C to +75°C (-40°F to +167°F)
Storage Temperature Range	-40°C to +75°C (-40°F to +167°F)
Cooling Method	Natural Convection
Dimensions (with cover)	TS4-B: 152.5mm x 108mm x 25mm, TS4-R: 195.5mm x 158mm x 23mm
Weight (without cover)	TS4-B: 270g, TS4-R: 470g
Environmental Rating	IP65/67, NEMA 3R
Cabling	
Cabling Type	PV1-F
Output Cable Length	1.0m, other lengths on request
Connector	MC4, MC4 compatible
UV Resistance	500hr with UBV light between 300-400nm @ 65°C
Maximum String Voltage	600V UL/1000V IEC or 1000V UL/IEC
Outer Cable Diameter	6.25±0.25mm (600V UL) 7.15±0.25mm (1000V UL)
Wire Cross-Section	4.0mm² (12AWG)





*All dimensions are in mm

MEET ANY PROJECT NEED WITH TS4

Tigo has expanded its smart module platform to provide five levels of customization. With a universal base and a range of covers containing the power electronics, TS4 increases your freedom of choice when selecting features for a particular project and budget. TS4 cover options range from standard diodes all the way to fully optimized performance and safety features.

LONG STRINGS
TS4-L

- String length increased by up to 30%
- Fewer BOS components
- Faster installation
- Inverter optimization
- Lower wire-losses
- Plus all the benefits of Optimization

OPTIMIZATION
TS4-O

- Shade and age tolerance
- Enhanced energy yield
- Greater design flexibility
- Maximized roof usage
- Plus all the benefits of Safety

SAFETY
TS4-S

- NEC 2014 690.12 rapid shutdown compliant
- Module-level deactivation
- Automatic or manual shutdown
- Over-temperature protection
- Plus all the benefits of Monitoring

MONITORING
TS4-M

- Reduced O&M costs
- PV-2.0 data synchronization
- Module bar code tracking
- CRM integration
- Warranty tracking
- Fleet management

DIODES
TS4-D

- Similar to a standard junction box
- Standardization on basic TS4 baseplate
- Applicable to conventional and smart modules
- Field replaceable and upgradeable
- Heat dissipation away from the module

TS4 COVERS

ELECTRICAL RATINGS	DIODES TS4-D	MONITORING TS4-M	SAFETY TS4-S	OPTIMIZATION TS4-O	LONG STRINGS TS4-L
INPUT @ STC					
Rated DC Input Power	375W	375W	375W	375W	375W
Maximum DC Input Voltage (V_{OC})	90V	52V	52V	52V	52V
Maximum Short Circuit Current (I_{SC})	12A	12A	12A	10A	10A
Operating Voltage	0-80V	16-48V	16-48V	16-48V	16-48V
OUTPUT					
Output Power Range	0-375W	0-375W	0-375W	0-375W	0-375W
Output Voltage Range	0-V_{OC}	0-V_{OC}	0-V_{OC}	0-V_{OC}	0-V_{OC}
Communication Type	n/a	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz
Rapid Shutdown Verified (NEC 2014 690.12)	Need additional RS device	Need additional RS device	Yes	Yes	Yes
Impedance Matching Capability	No	No	No	Yes	Yes
Output Voltage Limit	No	No	No	No	Yes
Maximum System Voltage	1000V	1000V	1000V	1000V	1000V
Maximum Series Fuse Rating	15A	15A	15A	15A	15A

ORDERING INFORMATION

	Base	Covers	Pre-Assembled
PV INTEGRATED	TS4-B		
Diodes		TS4-D	
Monitoring		TS4-M	
Safety		TS4-S	
Optimization		TS4-O	
Long Strings		TS4-L	
PV ADD-ON/RETROFIT	TS4-R		
Monitoring			TS4-R-M
Safety			TS4-R-S
Optimization			TS4-R-O

For PV integrated (TS4-B), ask for TS4-based modules.
Retrofit (TS4-R) is available pre-assembled with TS4-M, TS4-S, or TS4-O covers.
Covers are available separately. Specify TS4-D, TS4-M, TS4-S, TS4-O, or TS4-L.

For sales info:
sales@tigoenergy.com or 1.408.402.0802

For product info:
Visit www.tigoenergy.com/products

For TS4-R retrofit units:
Contact your local distributor or sales@tigoenergy.com

For technical info:
http://support.tigoenergy.com

For additional info and product selection assistance, use Tigo's online design tool at www.tigoenergy.com/design

Tigo®

PV 2.0

ABB monitoring and communications
VSN800 Weather Station

The VSN800 Weather Station automatically monitors site meteorological conditions and photovoltaic panel temperature in real-time, transmitting sensor measurements to the Aurora Vision® Plant Management Platform.

The VSN800 contains the essential environmental sensor set needed for solar monitoring.

The expanded sensor set enables plant management across a broad range of plant sizes.
VSN800 is a companion to the VSN700 Data Logger, the VSN730 System Monitor, or the VSN750 Plant Manager where it is fully compatible and integrates seamlessly with the Aurora Vision® Plant Management Platform.

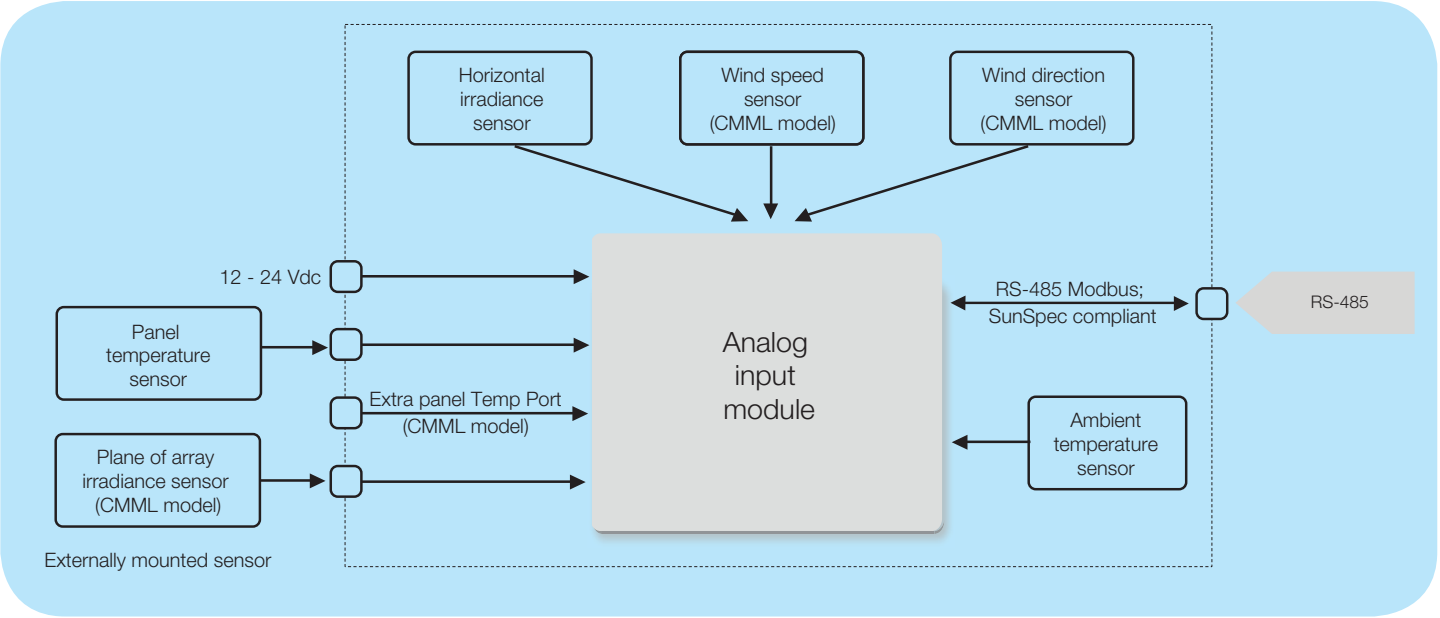
Shipped preconfigured and ready for installation, requiring no special tools.

The VSN800 Weather Station is delivered ready for installation and requires the installer to mechanically mount the modules on a user-supplied mast, connect power and communication, and initialize the automatic system commissioning process from the VSN700. No special software, or on-site calibration is required.
The all-in-one weather station reduces the installation, support and maintenance cost as well as improves the robustness and manageability of the PV plant monitoring solution.
The basic sensor set provides data needed to calculate a performance ratio allowing a plant operator to track solar array performance against expected energy production
The advanced sensor set improves monitoring of weather conditions that can effect energy production. The extra irradiance sensor for mounting at the plane of the array allows more accurate measurement of irradiance that is incident in the plane of the solar panels. Wind speed and direction sensor gives the operator information about how the wind may be cooling the panels and some indication of how much dust may be accumulating on the panels.

Highlights

- Two models offered for basic and advanced sensor sets
- VSN800-12 includes a basic sensor set: ambient temperature, solar irradiance, and back of module temperature
- VSN800-14 includes an additional advanced sensors: plane of array irradiance and wind direction and speed
- Sensors, data acquisition unit, and RS-485 communication all in a single unit

Block diagram of VSN800 Weather Station



BCD.00392 ABB-VSN800 EN REV E 03.01.2016

Technical data and types

Type code	VSN800-12	VSN800-14
Sensors		
Ambient temperature	Range -40°F to 176°F (-40°C to 80°C) Accuracy +/- 0.54°F (0.3°C)	
PV panel temperature	Range -40°F to 176°F (-40°C to 80°C) Accuracy +/- 0.54°F (0.3°C) Cable length 25ft (7.62m)	
Solar radiation	Range 0 to 1750W/m2 Accuracy +/- 5% Temperature range -13°F to 131°F (-25°C to 55°C)	
Number of radiation sensors	1 horizontal	1 horizontal, 1 plane of array
Wind direction	N/A	Range 360 degrees Accuracy +/- 22.5° Threshold 2 MPH (0.89m/s) Temp range -40°F to 140°F(-40°C to 60°C)
Wind speed	N/A	Range 0 to 150 MPH (0 to 67m/s) Accuracy is Greater of 1 mph (0.45m/s) or 5% Threshold 2 MPH (0.89m/s) Temp range -40°F to 140°F(-40°C to 60°C)
Communication		
Serial port	RS-485 2 wire, Modbus RTU, SunSpec Alliance compliant, 8/N/1, max speed 19200	
Terminal block	#22 - #18 AWG	
Recommended cable	Belden #1120A or equivalent	
Power supply		
DC power supply input	10-30 VDC, 50mA	
Terminal block	Accepts AWG #22 - #18	
Compliance		
EMC	FCC Part 15, Subpart B; ICES-003; EN 61326-1:2006; Emission class B, Immunity is class A	
Enclosure	UL 94 V-2, ROHS compliant, IP65	
Humidity	0 to 100% condensing	
Physical parameters		
Dimensions HxWxD	20.9" x 5.1" x 4.7" (0.53m x 0.13m x 0.12m)	24.8" x 9.8" x 13" (0.63m x 0.25m x 0.33m)
Weight	1.75lb (0.8kg)	7lb (3.2kg)
Ambient temperature range	-13°F to 131°F (-25°C to 55°C)	
Mounting	Pole or tripod	
Warranty		
Standard warranty	Two years	

Support and service

ABB supports its customers with a dedicated, global service organization in more than 60 countries, with strong regional and national technical partner networks providing a complete range of life cycle services.

For more information please contact your local ABB representative or visit:

www.abb.com/solarinverters

www.abb.com

Power and productivity for a better world™

ABB monitoring and communications
VSN700 Data Logger

The high-performance VSN700 Data Logger provides simple and quick commissioning with device discovery and automatic IP addressing as well as remote management features.

This SunSpec Compliant™ data logger records data and events from inverters, energy meters, weather stations, and other photovoltaic plant devices. It acts as an Internet gateway to send the data securely and reliably to the Aurora Vision® Plant Management Platform for performance monitoring, condition monitoring, and data reporting.
The VSN700 Data Logger is also available integrated in turnkey solutions, such as VSN730 System Monitor.

Three performance levels offer maximum flexibility.

The VSN700 Data Logger is available in three performance levels to fit virtually any budget and functionality requirements:
VSN700-01 Data Logger is available to residential customers who only need to monitor five (5) single-phase inverters.
VSN700-03 Data Logger is a cost-optimized logger for small commercial installations up to ten (10) single or three-phase string inverters and one weather station (VSN800).
VSN700-05 Data Logger provides both customer data management and inverter command, and control for commercial and utility PV system operation, as well as SCADA integration.

Highlights:

All VSN700 Data Logger models include:

- Data management system with serial and Ethernet ports for data and event logging
- Quick installation and fast plug-n-play commissioning with device discovery mechanism
- Network provisioning with dynamic IP addressing (DHCP client and server)
- Reliable and secure transmission of operational data to Aurora Vision® Plant Management Platform
- Remote configuration and management capabilities, including firmware upgrades over the Internet using Aurora Vision® Plant Portfolio Manager
- Simple end-user UI using Aurora Vision® Plant Viewer

Power and productivity for a better world™

Additional highlights:

VSN700-05 Data Logger (Max) includes the following additional functionality:

- No software limitation on number of devices logged
- Modbus TCP server using SunSpec Alliance compliant Modbus maps for easy SCADA system integration, data collection, and inverter command execution
- Support for most ABB inverters, meters, smart combiners and weather stations (see VSN700 Data Logger model comparison table)

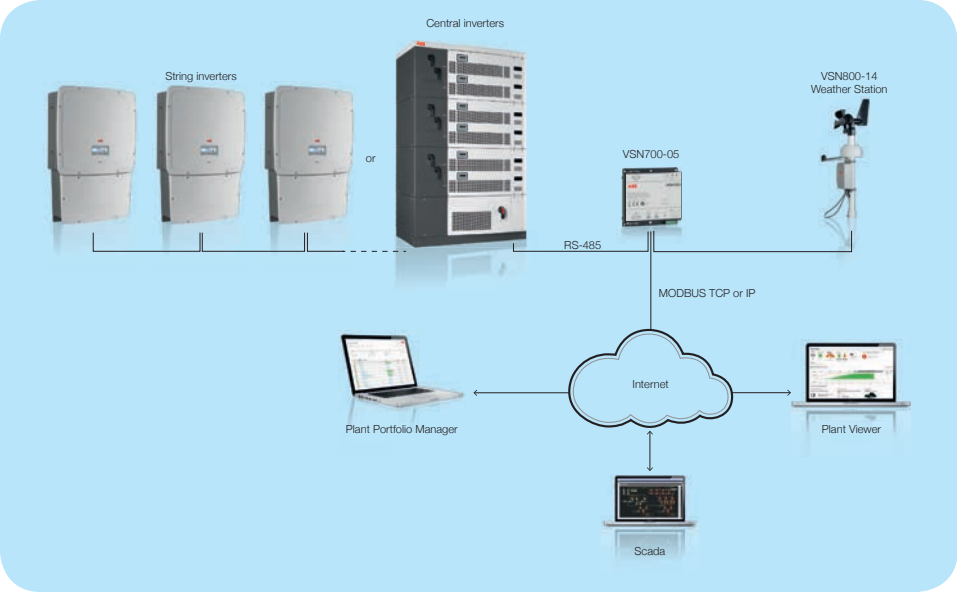
Technical data and types

Type code	VSN700 Data Logger
Communication interfaces	
Serial port interface	(2) RS-485 + (2) RS-232
Maximum devices per serial port	Physical limitation of 32 (reduced by poll rate, inverter data set size, and logger type)
Fieldbus cable	RS-485 Shielded twisted pair. Recommend Belden # 1120A cable or # 3106A for 3 conductors
Ethernet port 0	Firewall protected Ethernet WAN port for Internet connection
Ethernet port 1	Local LAN with static IP address
Ethernet connections	RJ-45 Ethernet 10/100 base-T (LAN/WAN)
Communication protocols	
Plant fieldbus protocols	Aurora protocol, Modbus RTU (SunSpec)
LAN/WAN protocols	HTTP, DHCP, SSL, SSH, XML
Data logging specifications	
Data sampling rate	High-frequency data sampling (less than 1 minute average)
Local storage	Logs data for 30 days based on 15-minute intervals (Days logged may be reduced by intervals shorter than 7 minutes)
Upgradeability	Field upgradable over the Internet or locally via USB memory stick
Power Supply	
AC power supply input	100 - 240 VAC
DC power supply output	12VDC, 1A
Environmental parameters	
Ambient temperature range	Logger only -40°F to 185°F (-40°C to 85°C); power supply 32°F -104°F (0°C-40°C)
Environmental protection	IP 20
Relative humidity	<85% Non-condensing
Mechanical parameters (per unit)	
Dimensions (H x W x D)	1" x 5.5" x 5.25" (.03m x .14m x .13m)
Weight	2lb (0.91kg)
Mounting system	Screws through flanges
Warranty	
Standard warranty	Two years
Accessories	
VSN-MGR-DIN	Din rail mount kit to mount logger on a din rail
VSN800-12	Weather Station with sensors: ambient temperature, panel temperature, global irradiance
VSN800-14	Weather Station with sensors: ambient temperature, panel temperature, global irradiance, plane of array irradiance, wind speed and direction
Compliance	
EMC	FCC Part 15 Class B, CISPR 22, EN 55022 conducted and radiated emission, EN55024

VSN700 Data Logger model comparison

Type Code	VSN700-01	VSN700-03	VSN700-05
Logging real-time power values	15-minute intervals only	1,3,5, 15-minute configurable intervals	1,3,5, 15-minute configurable intervals
Modbus/TCP server	No	No	Yes
Inverter control commands	No	No	Yes
Devices supported	5x ABB inverters	10x ABB inverters	All ABB inverters
	Single-phase (only) string inverters	Three and single-phase string inverters	Other ABB devices and third-party devices (consult latest supported list)
		1 x VSN800-XX Weather Station	

Commercial and utility application with VSN700-05



Residential application with VSN700-01

VSN700 Data Logger accessories

VSN-MGR-DIN	Din rail kit to mount logger on a din rail	
VSN800-12	Weather Station with sensor: ambient, panel, global irradiance	
VSN800-14	Weather Station with sensor: ambient, panel, global irradiance, plane of array irradiance, wind speed and direction	

Support and service

ABB supports its customers with a dedicated, global service organization in more than 60 countries, with strong regional and national technical partner networks providing a complete range of life cycle services.

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