City of Vergas

Solar Photovoltaic System Proposal

Prepared For:
City Council
City of Vergas, Minnesota
140 W Linden St, Vergas, MN 56587

Prepared By:
Holsen Solar
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jess@holsenhome.com | (701) 219-5036

Date: July 14, 2025

Contents

Statement of Work

City of Vergas Solar PV Installation Project
Prepared by: Holsen Solar
Date: July 14, 2025
Project Location: 140 W Linden St, Vergas, MN 56587

1. Project Summary and Objectives

The City of Vergas, in partnership with the Lakes Country Service Cooperative (LCSC), is pursuing a renewable energy project to reduce operating costs and improve energy resilience. This initiative includes the installation of a 25.0 kW AC / 26.16 kW DC rooftop solar PV system at the Vergas Community Events Center located at 140 W Linden St, Vergas, MN.

2. Scope of Work

A. Design and Engineering
   a. 26.16 kWDC solar PV system using 48 Longi LR5-72HBD-545M bifacial modules
   b. Yaskawa Solectria PVI 25TL 3-phase inverter (25.0 kWAC)
   c. 10° flush-mounted IronRidge pitched roof racking
   d. System performance modeling (HelioScope), and PE-stamped design
   e. Year 1 energy production estimate: 27.16 MWh

B. Procurement and Equipment
   a. UL-listed and NEC-compliant modules, inverters, and racking
   b. Built to withstand Minnesota wind, snow, and hail exposure

C. Installation
   a. Turnkey installation performed by licensed electricians
   b. Includes structural review, permitting, utility interconnection, wiring, and AC disconnect
   c. Includes one 200A service panel and one fused outdoor-rated 200A disconnect

D. Utility Interconnection
   a. Holsen Solar will handle utility coordination and submission of interconnection applications
   b. Net metering will be implemented under Otter Tail Power guidelines

E. Commissioning and Monitoring
   a. Commissioning upon utility approval
   b. Online performance monitoring enabled

3. Project Schedule
Upon signing of installation contract, the project schedule shall progress through the following milestones:

Weeks 1-4
- Stamped Engineering Drawings
- Building and Electrical Permits Pulled
- Interconnection Application Submitted
- Materials Ordered

Weeks 5-6
- Installation

Weeks 7-8
- Remote Monitoring Configuration
- Electrical and Building Inspection
- Utility Testing
- Project Commissioning
- Maintenance Manual Provided

Milestone	Estimated Date
Permitting Initiated	July 15, 2025
Final Design Approved	July 31, 2025
Equipment Ordered	August 1, 2025
Construction Begins	September 1, 2025
Electrical Generation Commences	October 24, 2025

4. Estimated Cost
Total Project Cost: $59,707.00
Includes all equipment, labor, permitting, interconnection, engineering, and commissioning services.

5. Warranties and Operations
A. Workmanship Warranty
Holsen Solar provides a 10-year workmanship warranty covering defects in installation and labor, including:
- Electrical connections

- Structural mounting
- Roof penetrations and sealing
- Installation of inverters, conduit, and wiring
- This warranty is transferable and includes no-cost repairs for covered issues.

B. Manufacturer Warranties
    a. Longi LR5-72HBD-545M: 12-Year Product, 30-Year Performance
    b. Yaskawa Inverter: 10-Year Warranty

C. Operations & Maintenance Services (Optional)

Holsen Solar offers an annual Operations and Maintenance (O&M) service agreement that includes:

- Annual on-site visual inspections
- Preventative maintenance: bolt tightening, inverter cleaning, wiring checks
- Remote system monitoring and troubleshooting
- Annual panel cleaning
- Recycling of any components requiring replacement

D. O&M Cost: $17.00 per installed kW DC annually (e.g., $445.00 for a 26.16 kW system)
- Increases 3% annually after the first year
- Automatically renews unless canceled with 30 days' notice

6. Compliance

- Licensed in MN with PE-stamped drawings
- Compliant with NEC, fire, and structural codes
- Designed not to exceed 40 kW AC or 120% of site’s annual usage
- Prevailing wage rates followed as required

7. Environmental and Safety Standards

- All components meet or exceed UL, fire, and environmental safety standards
- Installation site kept clean and safe throughout construction
- No proprietary lock-in. The system design allows for open repair/replacement.

8. Contact Information

Jessica Grondahl
Chief Operating Officer
Holsen Solar
jess@holsenhome.com
(701) 219-5036
www.holsensolar.com

HOLSEN SOLAR
ELECTRIC · EV · AUTOMATION

208v System - Under 120% Cooperative Purchasing Connection - Vergas, 140 W Linden St, Vergas, MN 56587

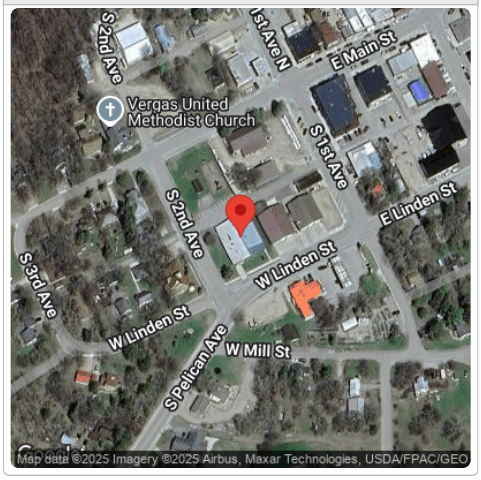
Report

Project Name	Cooperative Purchasing Connection - Vergas
Project Address	140 W Linden St, Vergas, MN 56587
Prepared By	Benjamin Holsen holsenb@gmail.com

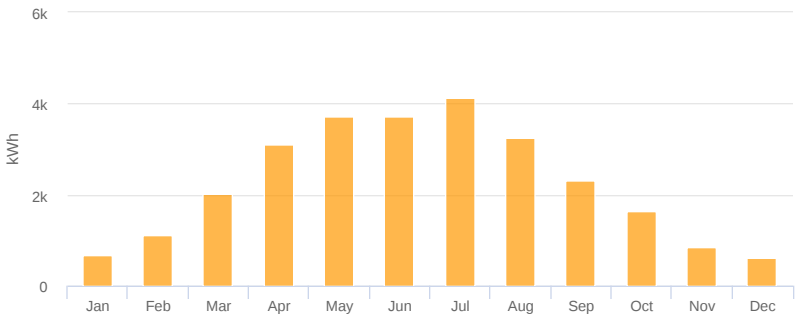
System Metrics

Design	208v System - Under 120%
Module DC Nameplate	26.16 kW
Inverter AC Nameplate	25.00 kW Load Ratio: 1.05
Annual Production	27.16 MWh
Performance Ratio	81.0%
kWh/kWp	1,038.1
Weather Dataset	TMY, 10km Grid (46.65,-95.85), NREL (prospector)
Simulator Version	3742ceedfb-6837545441-de630f359c-5421eb7cba

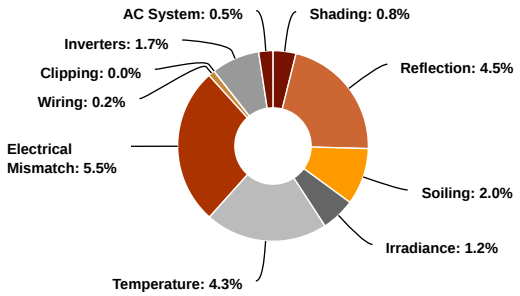
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m^2)	Annual Global Horizontal Irradiance	1,343.4	
	POA Irradiance	1,281.9	-4.6%
	Shaded Irradiance	1,271.5	-0.8%
	Irradiance after Reflection	1,214.6	-4.5%
	Irradiance after Soiling	1,190.3	-2.0%
	Total Collector Irradiance	**1,190.8**	**0.0%**
Energy (kWh)	Nameplate	31,161.0	
	Output at Irradiance Levels	30,788.0	-1.2%
	Output at Cell Temperature Derate	29,459.0	-4.3%
	Output after Electrical Mismatch	27,828.3	-5.5%
	Optimal DC Output	27,764.3	-0.2%
	Constrained DC Output	27,764.1	0.0%
	Inverter Output	27,292.1	-1.7%
	Energy to Grid	**27,155.6**	**-0.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp	9.1 °C	
	Avg. Operating Cell Temp	21.0 °C	
Simulation Metrics			
	Operating Hours	4669	
	Solved Hours	4669	

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, 10km Grid (46.65,-95.85), NREL (prospector)											
Solar Angle Location	Meteo Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Sandia Model											
Temperature Model Parameters	Rack Type	a	b	Temperature Delta								
	Fixed Tilt	-3.56	-0.075	3°C								
	Flush Mount	-2.81	-0.0455	0°C								
	East-West	-3.56	-0.075	3°C								
	Carport	-3.56	-0.075	3°C								
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	2	2	2	2	2	2	2	2	2	2	2	2
Irradiation Variance	5%											
Cell Temperature Spread	4° C											
Module Binning Range	-2.5% to 2.5%											
AC System Derate	0.50%											
Module & Component Characterizations	Type	Component	Characterization									
	Module	LR5-72HPH-545M (2022) (Longi)	Spec Sheet Characterization, PAN									
	Inverter	PVI 25TL (Yaskawa)	Spec Sheet									

Components

Component	Name	Count
Inverters	PVI 25TL (Yaskawa)	1 (25.00 kW)
Strings	10 AWG (Copper)	3 (98.9 ft)
Module	Longi, LR5-72HPH-545M (2022) (545W)	48 (26.16 kW)

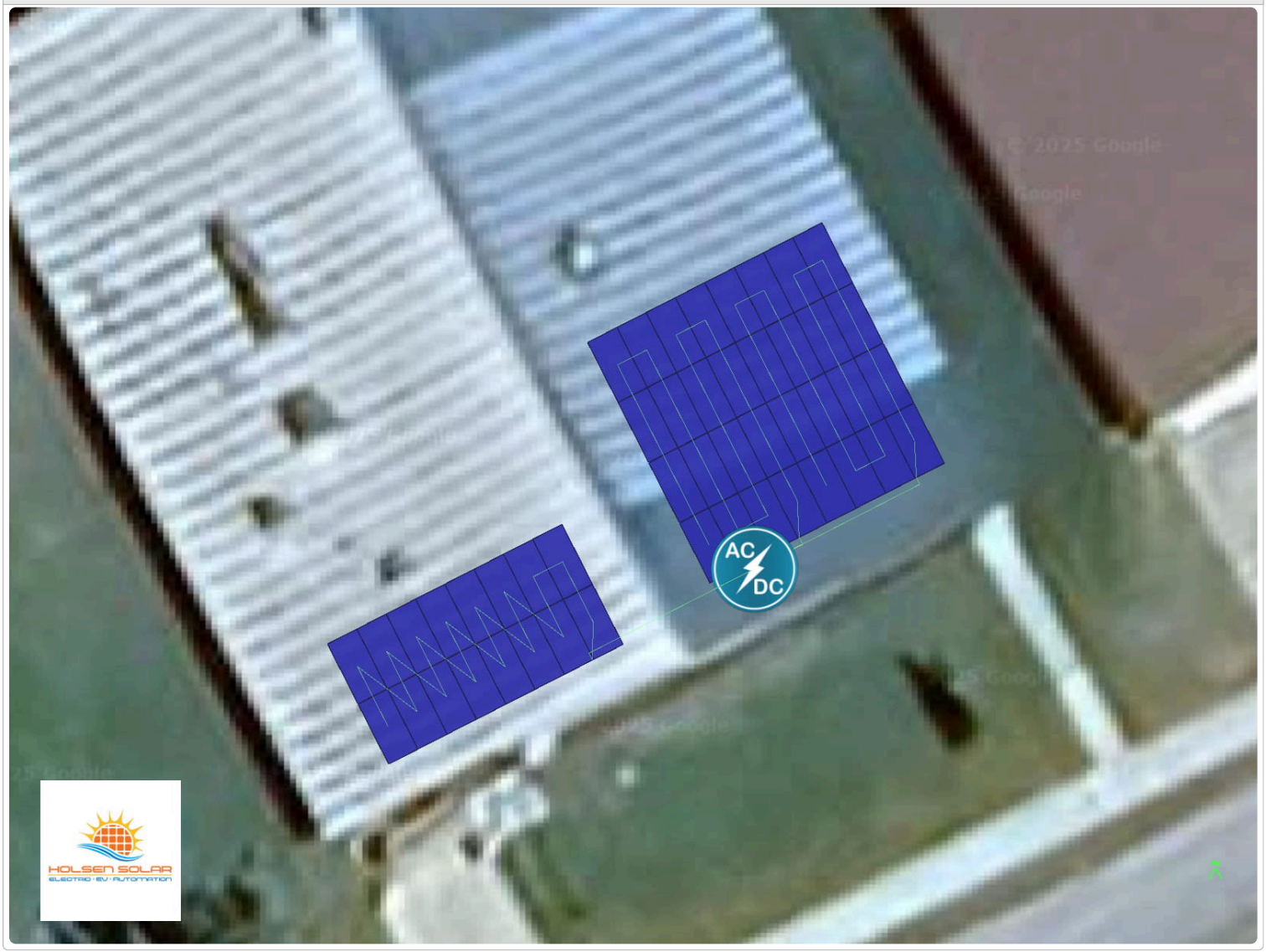
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	5-17	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Landscape (Horizontal)	10°	63°	0.0 ft	1x1	32	32	17.44 kW
Field Segment 2	Flush Mount	Landscape (Horizontal)	10°	63°	0.0 ft	1x1	16	16	8.72 kW

Detailed Layout2



Vergas Community Center - Solar System Summary

Site Information

- **Building Address:** 140 W Linden St, Vergas, MN 56587
- **Utility:** Otter Tail Power
- **Annual Energy Consumption:** 23,200 kWh
- **Current Electric Rate (Avg.):** $0.07619/kWh
- **Estimated Annual Utility Cost (pre-solar):** ~$1,767/year

System Design & Production

- **Photovoltaic Module:** Longi LR5-72HBD-545M
- **Module Wattage:** 545W
- **Number of Modules:** 48
- **Total DC System Size:** 26.16 kWDC
- **Inverter Type/Model:** Yaskawa Solectria PVI 25TL (25.00 kWAC)
- **Total AC System Size:** 25.0 kWAC
- **Mounting System:** Flush-mounted IronRidge Racking System (domestic content)
- **Tilt / Azimuth:** 10° tilt / 63° azimuth
- **Degradation:** 0.45% per year
- **Year 1 Production:** 27,160 kWh
- **Performance Ratio:** 81.0%
- **Offset vs. Consumption:** 117%
- **Excess Generation Sent to Grid:** ~3,960 kWh

Impact on Utility Costs

- **Annual Energy Offset:** 117%
- **Expected Annual Savings:** 23,200 kWh × $0.07619 = $1,767 (offset consumption)
- **Net Metering Credit Rate:** $0.0833/kWh (Otter Tail Power)
- **Estimated Excess Credit Value:** 3,960 kWh × $0.0833 = $330
- **Demand Charges:** Not applicable

Holsen Solar Workmanship Warranty Agreement

Effective Date:

Warranty Holder:

Installation Address:

System Description:

1. Scope of Warranty

Holsen Solar warrants that the solar energy system and/or electric vehicle (EV) charger installation performed at the above location will be free from defects in workmanship for a period of ten (10) years from the effective date of installation.

This warranty applies exclusively to the installation work performed by Holsen Solar and covers issues resulting from faulty or improper workmanship, including:

- Electrical wiring and connections
- Mounting of solar panels and related structural components
- Roof penetrations and associated sealing to prevent leaks
- Installation and mounting of inverters, charge controllers, and other system components
- EV charger mounting, wiring, and electrical connections
- Conduit runs and mechanical fastenings

2. Warranty Coverage

During the 10-year warranty period, Holsen Solar will, at its discretion, repair or replace any defective workmanship, at no cost to the warranty holder. If the defect is determined to be covered under this warranty, Holsen Solar will perform the necessary corrective action, which may include:

- Adjusting, repairing, or replacing the defective components associated with the workmanship
- Restoring affected areas to the original condition following repairs
- Sealing or repairing roof penetrations to prevent or correct leaks

3. Exclusions and Limitations

This warranty does not cover:

- Damage caused by misuse, abuse, or negligence by the customer or a third party
- Defects resulting from unauthorized modifications or repairs not performed by Holsen Solar
- Normal wear and tear, including aging of components
- Damage caused by natural disasters (e.g., floods, lightning, hail, earthquakes, storms, etc.)
- Damage caused by pests, rodents, or wildlife
- Equipment failures due to manufacturer defects (covered under manufacturer warranties)
- Utility grid-related issues or external power surges

4. Customer Responsibilities

To maintain this warranty, the warranty holder agrees to:

- Operate the system as instructed by Holsen Solar and follow any maintenance recommendations
- Notify Holsen Solar within 30 days of discovering a potential issue covered under this warranty
- Allow Holsen Solar reasonable access to inspect and perform any required warranty repairs

5. Transferability

This warranty is transferable to subsequent property owners within the 10-year warranty period, provided that Holsen Solar is notified of the property ownership change within 30 days of the transfer.

6. Claim Process

To file a warranty claim, the warranty holder must:

1. Contact Holsen Solar at 218-787-6527 or sales@holsenhome.com
2. Provide details of the issue, including photos if possible
3. Schedule an inspection for evaluation of the claim

Holsen Solar will review the claim, inspect the system, and determine the necessary course of action within a reasonable time frame.

7. Limitations of Liability

Holsen Solar's liability under this warranty is limited to the repair or replacement of defective workmanship. Under no circumstances shall Holsen Solar be liable for any incidental, consequential, or indirect damages arising from the use or inability to use the solar energy system or EV charger.

8. Governing Law

This warranty is governed by the laws of the state of Minnesota.

9. Severability

If any provision of this warranty is deemed invalid or unenforceable, the remaining provisions will remain in full force and effect.

By signing below, the warranty holder acknowledges and accepts the terms and conditions of this warranty.

Warranty Holder Signature: _____

Date: _____

Authorized Representative of Holsen Solar: _____

Date: _____

HOLSEN SOLAR OPERATIONS AND MAINTENANCE AGREEMENT

Effective Date:

System Owner/O&M Contract Holder:

Installation Address:

System Description:

This Agreement is made and entered into on _____, by and between _____("Client") and BWRH LTD, DBA Holsen Solar, a North Dakota limited liability company ("Provider") with offices at 1709 1st Ave N, Suite M, Fargo, ND 58102.

1. Scope of Services

Provider shall furnish the following Operations and Maintenance (O&M) services for the Client's solar energy system, located at _____:

A) Annual visual inspection of the solar array and associated components

B) Preventative maintenance, including bolt tightening, inverter cleaning/checks, and wiring inspections

C) Remote system monitoring and troubleshooting of performance issues

D) Solar panel cleaning to remove dirt, dust, and debris that may impact performance

E) Component recycling and disposal for any items requiring replacement

2. Compensation

The Client agrees to pay the Provider an annual O&M fee of $17.00 per kilowatt (DC) of the installed system size. This pricing is fixed for the first twelve (12) months from the effective date

of this agreement.
Beginning in year two, the annual fee shall increase by three percent (3%) per calendar year.

Example:

- Year 1: $17.00/kW (DC)
- Year 2: $17.51/kW (DC)
- Year 3: $18.03/kW (DC), and so on.

Payment shall be due within 30 days of the invoice date, which will be issued annually on the anniversary of the agreement's effective date.

3. Term and Renewal

This Agreement shall remain in effect for an initial term of 1 year and shall automatically renew annually unless either party provides written notice of non-renewal at least 30 days prior to the renewal date.

4. Access and Monitoring

Client shall provide Provider with reasonable access to the solar installation for inspection and maintenance purposes. Provider shall also maintain access to system performance monitoring data.

5. Limitations

This agreement covers only routine O&M services as described. It does not include the cost of major component replacements, structural modifications, or repairs due to external damage not caused by Provider.

6. Termination

Either party may terminate this Agreement with 30 days' written notice. In the event of termination, Client shall pay Provider for services performed through the effective termination date.

7. Miscellaneous

This Agreement is governed by the laws of the State of Minnesota. Any amendments must be in writing and signed by both parties.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date first written above.

Holsen Solar
By: _____
Name: Jessica Grondahl
Title: COO

Client
By: _____
Name:
Title:

Hi-MO 5

LR5-72HBD

530~550M

- Based on M10 wafer, best choice for ultra-large power plants
- Advanced module technology delivers superior module efficiency
  - M10 Gallium-doped Wafer
  - Smart Soldering
  - 9-busbar Half-cut Cell
- Globally validated bifacial energy yield
- High module quality ensures long-term reliability

12 12-year Warranty for Materials and Processing

30 30-year Warranty for Extra Linear Power Output

Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730

ISO9001:2015: ISO Quality Management System

ISO14001: 2015: ISO Environment Management System

ISO45001: 2018: Occupational Health and Safety

IEC62941: Guideline for module design qualification and type approval

LONGi

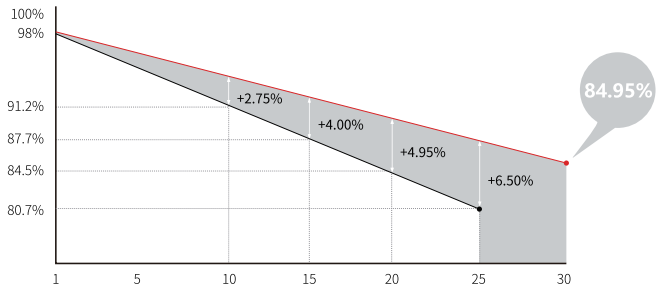
Hi-MO 5

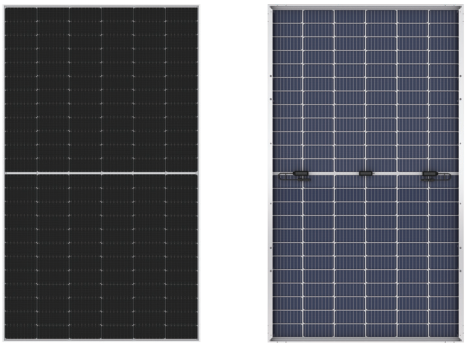
LR5-72HBD 530~550M

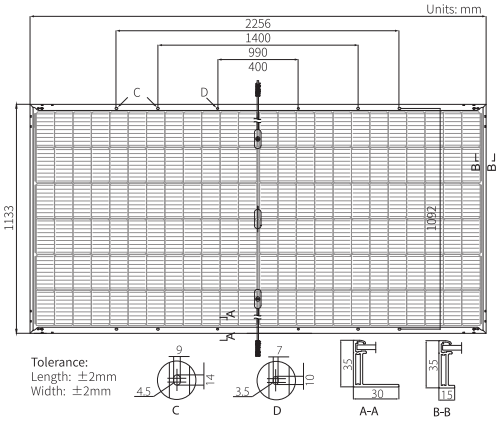
21.5%	0~3%	<2%	0.45%	HALF-CELL
MAX MODULE EFFICIENCY	POWER TOLERANCE	FIRST YEAR POWER DEGRADATION	YEAR 2-30 POWER DEGRADATION	Lower operating temperature

Additional Value

30-Year Power Warranty







Mechanical Parameters

Cell Orientation	144 (6×24)
Junction Box	IP68, three diodes
Output Cable	4mm², +400, -200mm/±1400mm length can be customized
Glass	Dual glass, 2.0+2.0mm heat strengthened glass
Frame	Anodized aluminum alloy frame
Weight	32.3kg
Dimension	2256×1133×35mm
Packaging	31pcs per pallet / 155pcs per 20' GP / 558pcs per 40' HC

Electrical Characteristics

STC : AM1.5 1000W/m² 25°C NOCT : AM1.5 800W/m² 20°C 1m/s Test uncertainty for Pmax: ±3%

Module Type	LR5-72HBD-530M		LR5-72HBD-535M		LR5-72HBD-540M		LR5-72HBD-545M		LR5-72HBD-550M	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	530	396.2	535	399.9	540	403.6	545	407.4	550	411.1
Open Circuit Voltage (Voc/V)	49.20	46.26	49.35	46.40	49.50	46.54	49.65	46.68	49.80	46.82
Short Circuit Current (Isc/A)	13.71	11.07	13.78	11.12	13.85	11.17	13.92	11.23	13.99	11.29
Voltage at Maximum Power (Vmp/V)	41.35	38.58	41.50	38.72	41.65	38.86	41.80	39.00	41.95	39.14
Current at Maximum Power (Imp/A)	12.82	10.27	12.90	10.33	12.97	10.39	13.04	10.45	13.12	10.51
Module Efficiency(%)	20.7		20.9		21.1		21.3		21.5	

Electrical characteristics with different rear side power gain (reference to 540W front)

Pmax /W	Voc/V	Isc /A	Vmp/V	Imp /A	Pmax gain
567	49.50	14.54	41.65	13.61	5%
594	49.50	15.23	41.65	14.26	10%
621	49.60	15.92	41.75	14.91	15%
648	49.60	16.62	41.75	15.56	20%
675	49.60	17.31	41.75	16.21	25%

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ 3%
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1500V (IEC/UL)
Maximum Series Fuse Rating	30A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Bifaciality	70±5%
Fire Rating	UL type 29 IEC Class C

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

Temperature Coefficient of Isc	+0.050%/°C
Temperature Coefficient of Voc	-0.265%/°C
Temperature Coefficient of Pmax	-0.340%/°C

LONGi

No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China.
Web: www.longi.com

SOLECTRIA® PVI 25TL-208

25 KW, 208 VAC, 1000 VDC STRING INVERTERS

Features

- UL Listed as PV Rapid Shutdown Systems with APsmart, NEP and Tigo Energy
- NEC 2017 compliant & UL listed Arc-Fault circuit protection
- 15-90° Mounting orientation for low profile roof installs
- Optional Ethernet Network Card enables remote FW upgrades
- Integrated AC & DC disconnect switches
- 3 MPPT's with 2 inputs each for maximum flexibility
- Copper and Aluminum compatible AC connections
- NEMA Type 4X outdoor rated enclosure
- Certified to IEEE 1547-2018 and UL 1741SB
- Separable wirebox design for fast service
- Standard 10 year warranty
- Generous 1.8 DC/AC Inverter Load Ratio
- Compatible with Bifacial PV Modules

Rapid Shutdown Ready Wirebox

New

Yaskawa Solectria Solar's PVI 25TL-208 25kW (25kVA) three phase string inverters are designed for rooftop and carport applications

PVI 25TL-208 DESIGN

These high performance, advanced and reliable inverters are designed specifically for the North American environment and grid.

High efficiency at 97.0% peak and 96.5% CEC, wide operating voltages, broad temperature ranges and a NEMA Type 4X enclosure enable this inverter platform to operate at high performance across many applications.

The product ships with the Rapid Shutdown Ready wirebox, fully integrated and separable with touch-safe fusing, monitoring, and AC and DC disconnect switches.

The integrated Sunspec compliant PLC transmitter in the wirebox enables PVRSS certified module-level rapid shutdown when used with APsmart, NEP, and Tigo products.

The Ethernet Network Card enables monitoring, controls and remote product upgrades.

Tigo® Enhanced

APsmart ALTENERGY POWER

NEP NORTHERN ELECTRIC

YASKAWA SOLECTRIA SOLAR

Yaskawa Solectria Solar 1-978-683-9700 | Email: sales@solectria.com | solectria.com
Document No. FL.PVI25TL-208.01 | 02/15/2023 |

SOLECTRIA® PVI 25TL-208 TECHNICAL DATA

SPECIFICATIONS

PVI 25TL-208 Commercial Transformerless String Inverter		
DC Input	Maximum PV Power	45 kW (17 kW per MPPT)
	Maximum Input Voltage	1000 VDC
	DC Voltage Ranges: Operating / Maximum Power (MPPT)	200 - 950 VDC / 480 - 850 VDC
	Start-up DC Input Voltage / Power	330 V / 80 W
	Number of MPPT Trackers/Inputs	3 Trackers / 2 Fused-Inputs each
	Maximum Available PV Current (Isc x 1.25)	135 A (45 A per MPPT)
	DC Surge Protection	Type II MOV, 2800 V_C, 20 kAI_{TM} (8/20 µs)
AC Output	Rated AC Real Power / Apparent Power / Output Current	25 kW / 25 kVA / 69.5 A
	Nominal Output Voltage / Range	208 VAC / -12% to +10%
	Nominal Output Frequency / Range	60 Hz / 57-63 Hz
	Power Factor	Unity, > 0.99 (Adjustable 0.8 leading to 0.8 lagging)
	Fault Current Contribution (1 Cycle RMS)	64.1 A
	Total Harmonic Distortion (THD) @Rated Load	< 3%
	Grid Connection Type	3-Ph/PE/N (neutral conductor optional)
	Maximum OCPD Device	125 A
	AC Surge Protection	Type II MOV, 1240 VC, 15 kA ITM (8/20 µs)
Efficiency	Maximum Efficiency / CEC Efficiency	97.0% / 96.5%
	Stand-by / Night Consumption	< 3 W
Environment	Enclosure Protection Degree	NEMA Type 4X
	Cooling Method	Variable speed cooling fans
	Operating Temperature Range [1]	-22°F to +140°F / - 30°C to +60°C
	Non-Operating Temperature Range	No low temp minimum to +158°F / +70°C maximum
	Operating Humidity	0 to 100%
	Operating Altitude	13,123.4 ft / 4000 m (derating from 9842.5 ft / 3000 m)
Display and Communication	Modbus Protocol	Proprietary / SunSpec
	SolrenView Web-based Monitoring Service	Optional
	Revenue Grade Metering	Optional, external
	Communication Interface	RS-485
	Remote Firmware Upgrades	Ethernet network card required
	Remote Diagnostics	Ethernet network card required
Safety	Certifications and Standards	IEEE 1547-2018, UL 1741-SB, UL1741-SA, UL1699B, UL1998, CSA-C22.2 NO.107.1-01, FCC Part 15 (Subpart B, Class A)
	Selectable Grid Standard	IEEE 1547, CA Rule 21, ISO-NE, HECO
	Smart-Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt. Watt-VAr
Warranty	Standard Terms	10 years
Mechanical	Acoustic Noise Rating	< 60 dBA @ 1m and 25°C
	Dimensions (H x W x D)	39.4 x 23.6 x 10.24 in. (1000 x 600 x 260 mm)
	Weight	Inverter: 123.5 lbs / 56 kg; Wire-box: 33lbs / 15kg
	Mounting / Installation Angle [2]	15 to 90 degrees from horizontal (vertical or angled)
	AC Termination	M8 Stud Type Terminal Block (Wire range: #6 - 3/0 AWG Cu / Al, Lugs not supplied)
	DC Termination	Screw Clamp, Neg. Busbar Wire range: #14 - #6 AWG Cu

Wirebox Specifications			
Wirebox Fuse Configuration		6 Fused Positions (2 Positions per MPPT), 20A Fuses Standard (25, 30A accepted) [3]	
Wirebox Versions	**APsmart Transmitter Built-In**	Inverter Model: PVI-25TL-208WB-APS (only positive polarity fused)	MLRSD Compatibility: APsmart RSD-S and RSD-D
	NEP Transmitter Built-In	Inverter Model: PVI 25TL-208WB-NEP (only positive polarity fused)	MLRSD Compatibility: NEP PVG-2
	Tigo Transmitter Built-In	Inverter Model: PVI-25TL-208WB-TGO (only positive polarity fused)	MLRSD Compatibility: Tigo TS4-A-F (ver 6.7+) and TS4-A-2F

1) Active Power Derating begins at 45°C when PF=1 and Vmp ≥ Vmin, and at 50°C when PF=1 and Vmp ≥ 700 Vdc.
2) Shade Cover accessory required for installation angles of 75 degrees or less from horizontal.
3) Fuse values above 20A have additional spacing requirements; see the user's manual for details.
Yaskawa Solectria Solar does not supply optional fuse sizes.

IT'S PERSONAL

YASKAWA SOLECTRIA SOLAR

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Document No. FL.PVI25TL-208.01 | 02/15/2023 |

SOLECTRIA® PVI 25TL-480

3-PHASE TRANSFORMERLESS COMMERCIAL STRING INVERTER

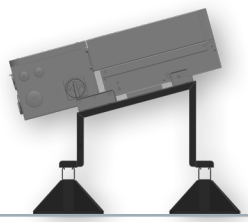
FEATURES

- 1000 VDC
- Certified to IEEE 1547-2018 and UL 1741SB
- 2 MPPTs with 3 inputs each
- Integrated DC and AC disconnects
- AC terminals compatible with copper and aluminum conductors
- SunSpec Modbus compliant
- 15 - 90° installation orientation
- Remote diagnostics
- Built-in SunSpec compliant transmitter for Module-Level Rapid Shutdown
- UL Listed as PV Rapid Shutdown Systems with APsmart, Northern Electric Power (NEP), and Tigo Energy
- LED indicator light
- Yaskawa Connect Pro app for system visibility
- Compatible with Bifacial PV Modules

OPTIONS

- Web-based monitoring
- Shade cover
- 15° rooftop mounting rack

* Rooftop Mounting Kit includes support legs for a 15° tilt angle and shade cover (not depicted)



Yaskawa Solectria Solar's PVI 25TL-480 is a state-of-the-art compact 3-phase string inverter, ideal for rooftops, carports and ground-mount PV systems.

PVI 25TL-480 DESIGN

The PVI 25TL-480 comes standard with AC and DC disconnects, two MPPTs, and a wiring box with six fuse positions for the positive conductors (compliant with the 2017 and 2020 NEC).

For rooftop PV systems, both wirebox models provide PV Rapid Shutdown System (PVRSS) compliance and include a built-in SunSpec compliant powerline communication transmitter. One wirebox model is Tigo Enhanced for rapid shutdown and the other wirebox model is compatible with APsmart rapid shutdown devices.

Yaskawa Solectria Solar also offers its Roof-Mounting Kit, to simplify installation on rooftops. Yaskawa Solectria Solar's family of PVI 25TL-480 inverter models provides flexibility and convenience unmatched in the industry

Tigo® Enhanced

APsmart ALTENERGY POWER

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Document No. FL.PVI25TL-480.01 | 02/15/2023 |

SOLECTRIA® PVI 25TL-480 TECHNICAL DATA

SPECIFICATIONS

PVI 25TL-480 Commercial Transformerless String Inverter		
DC Input	Maximum PV Power	37.5 kW (22 kW per MPPT)
	Maximum Input Voltage	1000 VDC
	DC Voltage Ranges: Operating / Maximum Power (MPPT)	200 – 950 VDC / 560 – 850 VDC
	Start-up DC Input Voltage / Power	330 V / 80 W
	Number of MPPT Trackers / Inputs	2 Trackers / 3 Fused-Inputs each
	Maximum Available PV Current (Isc x 1.25)	90 A (45 A per MPPT)
	DC Surge Protection	Type II MOV, 1240 V_C, 15 kA I_{TM} (8/20 µs)
AC Output	Rated AC Real Power / Apparent Power / Output Current	25 kW / 25 kVA / 30.5 A
	Nominal Output Voltage / Range	480 VAC / -12% to +10%
	Nominal Output Frequency / Range	60 Hz / 57-63 Hz
	Power Factor	Unity, > 0.99 (Adjustable 0.8 leading to 0.8 lagging)
	Fault Current Contribution (1 Cycle RMS)	31 A
	Total Harmonic Distortion (THD) @Rated Load	< 3%
	Grid Connection Type	3-Ph/PE/N (neutral conductor optional)
	Maximum OCPD Device	50 A
	AC Surge Protection	Type II MOV, 1025 V_C, 15 kA I_{TM} (8/20 µs)
Efficiency	Peak Efficiency	98.5%
	CEC Efficiency	98.0%
	Tare Loss	< 1 W
Environment	Ambient Temperature Range	-22°F to +140°F (-30°C to +60°C); Derating occurs over +113°F (+45°C)
	Storage Temperature Range	No low temp minimum; up to +158°F (+70°C)
	Relative Humidity (non-condensing)	0-100%
	Operating Altitude	13,123 ft (4,000 m); Derating occurs from 9,842.5 ft (3,000 m)
Communications	Modbus Protocol	Proprietary / SunSpec
	SolrenView Web-Based Monitoring Service	Optional
	Revenue Grade Metering	Optional, External
	Communication Interface	LED Display, Yaskawa Connect Pro app (Bluetooth®)
	Remote Firmware Upgrades	Ethernet Network Card required
	Remote Diagnostics	Ethernet Network Card required
Safety	Certifications and Standards	IEEE 1547-2018, UL 1741-SB, UL1741-SA, UL1699B, UL1998, CSA-C22.2 NO.107.1-01, FCC Part 15 (Subpart B, Class A)
	Selectable Grid Standards	IEEE 1547, CA Rule 21, ISO-NE
	Smart Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt, Watt-VAr
Warranty	Standard Limited Warranty	10 Years
Mechanical	Acoustic Noise Rating	< 50 dBA @ 1 m at 25°C
	AC/DC Disconnect	Standard, fully-integrated
	Mounting Angle	15-90° from horizontal (angled to vertical)
	Dimensions (H x W x D)	Power Head: 15.95 in. x 15.75 in. x 7.875 in (405 mm x 400 mm x 200 mm) Wirebox: 10.24 in. x 15.75 in. x 7.875 in (260 mm x 400 mm x 200 mm)
	Weight	Power Head: 48.5 lbs (22 kg); Wirebox: 13.2 lbs (6 kg)
	Enclosure Rating and Finish	NEMA Type 4X; Polyester Powder Coated Aluminum

Wirebox Specifications			
Wirebox Fuse Configuration		6 Fused Positions (3 Positions per MPPT), 20A Fuses Standard (25, 30A accepted) **	
Wirebox Versions	APsmart Transmitter Built-In	Inverter Model: PVI-25TL-480-APS20 (only positive polarity fused)	MLRSD Compatibility: APsmart RSD-S and RSD-D
	Tigo Transmitter Built-In	Inverter Model: PVI-25TL-480-TGO20 (only positive polarity fused)	MLRSD Compatibility: Tigo TS4-A-F (ver 6.7+) and TS4-A-2F

* Please inquire at sales@solectria.com for more information
** Yaskawa Solectria Solar does not supply optional fuse sizes

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Intertek

IT'S PERSONAL

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Document No. FL.PVI25TL-480.01 | 02/15/2023 |

SOLECTRIA®
PVI-36TL-480-V2

3-PHASE TRANSFORMERLESS COMMERCIAL STRING INVERTERS

FEATURES

- Wirebox models with built-in SunSpec compliant transmitters for Module-Level Rapid Shutdown for simple, safe NEC compliance
- UL Listed as PV Rapid Shutdown Systems with APsmart, Northern Electric Power (NEP), and Tigo Energy
- Integrated UL-listed Arc-Fault protection
- 15 - 90° mounting angle allows low-profile rooftop installations
- 3 MPPTs with 5 fused inputs each for PV array flexibility
- Industry-leading DC/AC ratio of 1.5
- Integrated AC and DC disconnects
- Remote firmware upgrades and diagnostics
- NEMA 4X outdoor rated enclosure, with proven performance
- Certified to IEEE 1547-2018 and UL 1741SB
- Compatible with Bifacial PV Modules

OPTIONS

- Shade cover
- DC fuse bypass
- Web-based monitoring

Yaskawa Solectria Solar's PVI 36TL-480-V2 are transformerless 3-phase inverters, ideal for rooftops, carports and ground-mount PV systems.

The PVI-36TL-480-V2 is the new generation of 36kW transformerless inverters from Yaskawa Solectria Solar that are IEEE 1547-2018 compliant. It comes standard with AC and DC disconnects, three MPPTs, and a wiring box with 15 fuse positions.

This updated inverter is improved for rooftop PV systems. Module-Level Rapid shutdown (MLRSD) wirebox models provide PV Rapid Shutdown System (PVRSS) compliance and include a built-in SunSpec compliant powerline communication transmitter.

One wirebox model is Tigo Enhanced for rapid shutdown and the other two wirebox models are compatible with APsmart or NEP rapid shutdown devices.

Yaskawa Solectria Solar's PVI-36TL-480-V2 inverters, including standard wireboxes and the rapid-shutdown ready wirebox models, provides flexibility and convenience unmatched in the industry.

Standard Wirebox

- 20A fuses, both polarities
- No built-in PVRSS transmitter

Module-Level Rapid Shutdown Wireboxes

- 20A fuses; positive polarity only
- Built-in PVRSS transmitter
- 3 models for compatibility with APsmart, NEP and Tigo module-level rapid shutdown devices

Tigo® Enhanced

APsmart ALTENERGY POWER

NEP NORTHERN ELECTRIC

YASKAWA SOLECTRIA SOLAR

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Document No. FL.PVI36TL480V2.01 | 02/15/2023 |

PVI-36TL-480-V2 TECHNICAL DATA

SPECIFICATIONS

Inverter Model		PVI-36TL-480-V2
DC Input	Maximum PV Power	54 kW (18 kW per MPPT)
	Maximum Input Voltage	1000 VDC
	DC Voltage Ranges: Operating/Max. Power (MPPT)	200-950 VDC / 400-840 VDC
	Start-up DC Input Voltage/Power	330 V / 80 W
	Number of MPPT Trackers/Inputs	3 Trackers / 5 Fused-inputs each
	Maximum Available PV Current (Isc x 1.25)	122.4 A (40.8 A per MPPT)
	DC Surge Protection	Type II MOV, 2800 V_C , 20 kA I_{TM} (8/20 µs)
AC Output	Rated AC Real Power/Apparent Power/Output Current	36 kW / 36 kVA / 43.5 A
	Nominal Output Voltage/Range	480 VAC / -12% to +10%
	Nominal Output Frequency/Range	60 Hz / 57-63 Hz
	Power Factor	Unity, > 0.99 (Adjustable 0.8 leading to 0.8 lagging)
	Fault Current Contribution (1 Cycle RMS)	73.2 A (1.68 PU)
	Total Harmonic Distortion (THD) @ Rated Load	< 3%
	Grid Connection Type	3-Ph/PE/N (neutral conductor optional)
	AC Surge Protection	Type II MOV, 1500 V_C , 15 kA I_{TM} (8/20 µs)
Efficiency	Peak Efficiency	98.8%
	CEC Efficiency	98.5%
	Tare Loss	< 1 W
Environment	Ambient Temperature Range	-22°F to +140°F (-30°C to +60°C)
	Storage Temperature Range	No low temp minimum to +158°F (+70°C)
	Relative Humidity (non-condensing)	0-100%
	Operating Altitude	13,123.4 ft (4,000 m) Derating occurs from 9,842.5 ft (3,000 m)
Communications	Modbus Protocol	Proprietary / SunSpec
	SolrenView Web-Based Monitoring Service	Optional
	Revenue Grade Metering	Optional, External
	Communication Interface	RS-485 Modbus RTU
	Remote Firmware Upgrades	Ethernet Network Card required
	Remote Diagnostics	Ethernet Network Card required
Safety	Certifications and Standards	UL1741-SA Ed. 2, UL1741-SB, UL1699B, CSA-C22.2 NO.107.1-01, IEEE1547a-2018; FCC PART15
	Selectable Grid Standards	IEEE 1547a-2018, CA Rule 21, ISO-NE
	Smart Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt
Warranty	Standard Limited Warranty	10 Years
Mechanical	Acoustic Noise Rating	< 60 dBA @ 1 m and 25°C
	AC/DC Disconnect	Standard, fully-integrated, load break rated
	Mounting Angle*	15° - 90° from horizontal
	Weight	Inverter: 123.5 lbs (56 kg); Wiring Box: 33 lbs (15 kg)
	Enclosure Rating and Finish	NEMA Type 4X; Polyester Powder Coated Aluminum
	Dimensions (H x W x D)	Power Head: 22.7" x 23.6" x 10.24" (576 mm x 600 mm x 260 mm)
		Wirebox: 16.7" x 23.6" x 10.24" (424 mm x 600 mm x 260 mm)
		Overall: 39.4" x 23.6" x 10.24" (1000 mm x 600 mm x 260 mm)

* Shade cover accessory required for installation of 75° or less

IT'S PERSONAL

YASKAWA SOLECTRIA SOLAR

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Document No. FL.PVI36TL480V2.01 | 02/15/2023 |

SOLECTRIA®
PVI-50TL-480 / PVI-60TL-480

3-PHASE TRANSFORMERLESS COMMERCIAL STRING INVERTERS

FEATURES

- Wirebox models with built-in SunSpec compliant transmitters for Module-Level Rapid Shutdown for simple, safe NEC compliance
- UL Listed as PV Rapid Shutdown Systems with APsmart, Northern Electric Power (NEP), and Tigo Energy
- Dual rated listing allows selection of either 50/60 kVA (factory default) or 55/66 kVA (allowing full rated power down to ±0.91 PF)
- Integrated UL-listed Arc-Fault protection
- 15 - 90° mounting angle allows low-profile rooftop installations
- 3 MPPTs with 5 fused inputs each for PV array flexibility
- Industry-leading DC/AC ratios of 1.8 (50TL) and 1.5 (60TL)
- Integrated AC and DC disconnects
- Remote firmware upgrades and diagnostics
- NEMA 4X outdoor rated enclosure, with proven performance
- Certified to IEEE 1547-2018 and UL 1741SB
- Compatible with Bifacial PV Modules

OPTIONS

- Shade cover
- DC fuse bypass
- Web-based monitoring

Yaskawa Solectria Solar's PVI 50TL-480 and PVI 60TL-480 are transformerless 3-phase inverters, ideal for rooftops, carports and ground-mount PV systems

The PVI-50TL-480 and PVI-60TL-480 come standard with AC and DC disconnects, three MPPTs, and a wiring box with 15 fuse positions.

For rooftop PV systems, both Module-Level Rapid shutdown (MLRSD) wirebox models provide PV Rapid Shutdown System (PVRSS) compliance and include a built-in SunSpec compliant powerline communication transmitter.

One wirebox model is Tigo Enhanced for rapid shutdown and the other two wirebox models are compatible with APsmart or NEP rapid shutdown devices.

Yaskawa Solectria Solar's family of PVI-50/60TL-480 inverters, including standard wireboxes and the rapid-shutdown ready wirebox models, provides flexibility and convenience unmatched in the industry.

Standard Wirebox

- 20A fuses, both polarities
- No built-in PVRSS transmitter

Module-Level Rapid Shutdown Wireboxes

- 20A fuses; positive polarity only
- Built-in PVRSS transmitter
- 3 models for compatibility with APsmart, NEP and Tigo module-level rapid shutdown devices

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Document No. FL.PVI5060TL.01 | 02/15/2023 |

PVI 50TL-480 / PVI 60TL-480 TECHNICAL DATA

SPECIFICATIONS

Inverter Model		PVI-50TL-480	PVI-60TL-480
DC Input	Maximum PV Power	90 kW (33 kW per MPPT)	90 kW (33 kW per MPPT)
	Maximum Input Voltage	1000 VDC	1000 VDC
	Dc Voltage Ranges: Operating/Max. Power (MPPT)	200-950 VDC / 480-850 VDC	200-950 VDC / 540-850 VDC
	Start-up DC Input Voltage/Power	330 V / 80 W	330 V / 80 W
	Number of MPPT Trackers/Inputs	3 Trackers / 5 Fused-inputs each	3 Trackers / 5 Fused-inputs each
	Maximum Available PV Current (Isc x 1.25)	204 A (68 A per MPPT)	204 A (68 A per MPPT)
	Maximum Operating Input Current (clipping point)	108 A (36 A per MPPT)	114 A (38 A per MPPT)
	DC Surge Protections	Type II MOV, 2800 V_C, 20 kA I_{TM} (8/20 µs)	
AC Output	Rated AC Real Power/Apparent Power/Output Current	50 kW / 50 kVA / 60.2 A	60 kW 60kVA / 72.2 A
	Overhead Mode: Real Power/Apparent Power/Output Current	50 kW / 55 kVA / 66.2 A	60 kW / 66 kVA / 79.4 A
	Nominal Output Voltage/Range	480 VAC / -12% to +10%	480 VAC / -12% to +10%
	Nominal Output Frequency/Range	60 Hz / 57-63 Hz	60 Hz / 57-63 Hz
	Power Factor	Unity, >0.99 (Adjustable 0.8 leading to 0.8 lagging)	Unity, >0.99 (Adjustable 0.8 leading to 0.8 lagging)
	Fault Current Contribution (1 Cycle RMS)	64.1 A	64.1 A
	Total Harmonic Distortion (THD) @ Rated Load	< 3%	< 3%
	Grid Connection Type	3-Ph/PE/N (neutral conductor optional)	3-Ph/PE/N (neutral conductor optional)
	Maximum OCPD Device	110 A	125 A
	AC Surge Protection	Type II MOV, 1240 V_C, 15 kA I_{TM} (8/20 µs)	
Efficiency	Peak Efficiency	98.8%	98.8%
	CEC Efficiency	98.5%	98.5%
	Tare Loss	< 1 W	< 1 W
Environment	Ambient Temperature Range	-22°F to +140°F (-30°C to +60°C); Derating occurs over +113°F (+45°C)	
	Storage Temperature Range	No low temp minimum to +158°F (+70°C)	
	Relative Humidity (non-condensing)	0-100%	
	Operating Altitude	13,123 ft (4,000 m) Derating occurs from 9,842.5 ft (3,000 m)	
Communications	Modbus Protocol	Proprietary / SunSpec	
	SolrenView Web-Based Monitoring Service	Optional	
	Revenue Grade Metering	Optional, External	
	Communication Interface	RS-485 Modbus RTU	
	Remote Firmware Upgrades	Ethernet Network Card required	
	Remote Diagnostics	Ethernet Network Card required	
Safety	Certifications and Standards	IEEE 1547-2018, UL 1741-SB, UL 1741SA-2016, UL1699B, UL1998, CSA-C22.2 No. 107.1-01, FCC Part 15 (Subpart B, Class A)	
	Selectable Grid Standards	IEEE 1547, CA Rule 21, ISO-NE, HECO	
	Smart Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt, Watt-VAr	
Warranty	Standard Limited Warranty	10 Years	
Mechanical	Acoustic Noise Rating	< 60 dBA @ 1 m and 25°C	
	AC/DC Disconnect	Standard, fully-integrated, load break rated	
	Mounting Angle*	15° - 90°◦ from horizontal	
	Weight	Inverter: 123.5 lbs (56 kg); Wiring Box: 33 lbs (15 kg)	
	Enclosure Rating and Finish	NEMA Type 4X; Polyester Powder Coated Aluminum	
	Dimensions (H x W x D)	Power Head: 22.7" x 23.6" x 10.24" (576 mm x 600 mm x 260 mm)	
		Wirebox: 16.7" x 23.6" x 10.24" (424 mm x 600 mm x 260 mm)	
		Overall: 39.4" x 23.6" x 10.24" (1000 mm x 600 mm x 260 mm)	

Wirebox Specifications			
Wirebox	Fused Inputs	15 Fused Positions (5 Positions per MPPT) 20 A Standard (25, 30 A accepted)**	
Wirebox Versions	Standard	PVI-50-60TL-BX-S20 (both polarities fused), No MLRSD transmitter needed	
	APsmart Transmitter Built-in	PVI-50-60TL-WB-APS (only positive polarity fused)	MLRSD compatitility: APsmart RSD-S and RSD-D
	NEP Transmitter Built-In	PVI-50-60TL-WB-NEP (only positive polarity fused)	MLRSD compatibility: NEP PVG-2
	Tigo Transmitter Built-in	PVI-50-60TL-WB-TGO (only positive polarity fused)	MLRSD compatitility: Tigo TS4-A-F (ver 6.7+) and TS4-A-2F

* Shade cover accessory required for installation of 75° or less
** Yaskawa Solectria Solar does not supply optional fuses sizes

IT'S PERSONAL

YASKAWA SOLECTRIA SOLAR

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ESTIMATE

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Bill to
City of Vergas

Ship to
City of Vergas
140 W Linden St
Vergas, MN 56587

Estimate details
Estimate no.: 310-SOLAR
Estimate date: 07/10/2025

#	Product or service	Description	Qty	Rate	Amount
1.	**Solar Energy System**	25kW AC/26.16kW DC Solar System • Interconnection Agreement and Fees • Permits and Fees • All work done by licensed Electrician • Visual Power Disconnect	1	$0.00	$0.00
2.	**Solar Panel**	Longi 545W Bifacial Commercial PV Panel (LR5-72HBD-545M) 12 Year Panel Warranty 30 Year Linear Performance Warranty	48	$240.50	$11,544.00
3.	**Inverter**	Yaskawa PVI 25TL 25kW 208V Inverter (3 Phase) 10-Year Warranty	1	$10,400.00	$10,400.00
4.	**Rapid Shutdown**	Rapid Shutdown Device	48	$45.50	$2,184.00
5.	**Interconnection**	Interconnection Application Submission (Includes fees paid to utility)	1	$400.00	$400.00
6.	**Labor**	Solar System Installation	170	$100.00	$17,000.00
7.	**Services**	Electrical Engineering - Stamped Electrical Drawings of Solar Energy System	20	$250.00	$5,000.00
8.	**Racking System**	Iron Ridge Pitched Roof Aluminum Solar Racking (priced per panel) Qualifies for Domestic Contect Bonus	48	$104.00	$4,992.00
9.	**Services**	Permitting (Includes electrical and building permit application, inspection, fees)	1	$2,000.00	$2,000.00

10.	**Materials**	200A Service Panel with Circuit Breakers	1	$910.00	$910.00
11.	**Materials**	200A Fused Disconnect, Outdoor Rated	1	$850.00	$850.00
12.	**Materials**	Electrical Wiring and Conduit	1	$4,427.00	$4,427.00

Total **$59,707.00**

Accepted date **Accepted by**