Solar Panel Implementation

UVic Student Union Building Draft Report for Review

Electrical Engineering Services

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DESIGNING A BETTER TOMORROW

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1. Introduction

This report contains a detailed analysis of the feasibility of implementing solar generation on the roof of the Student Union Building (SUB) at the University of Victoria. The analysis considers the system's generation, cost, payback period, and ease of implementation. Additionally, this report considers the types and locations of solar panels, inverters, and power optimizers, as well as how these would tie into UVic's existing electrical distribution.

1.1 LAYOUT

The PV system was modelled using a software called Helioscope, which was used to lay out the system and simulate its generation over the course of the year. Several different layouts were considered and compared in terms of generation, shading, and ease of access to the electrical room. The following layout was chosen because of its efficiency of generation, location with respect to the electrical room, and its minimal exposure to shading. It is worth mentioning that this can easily be reduced to just one or two roof sections, or expanded using other parts of the roof if the client would like to pursue this.

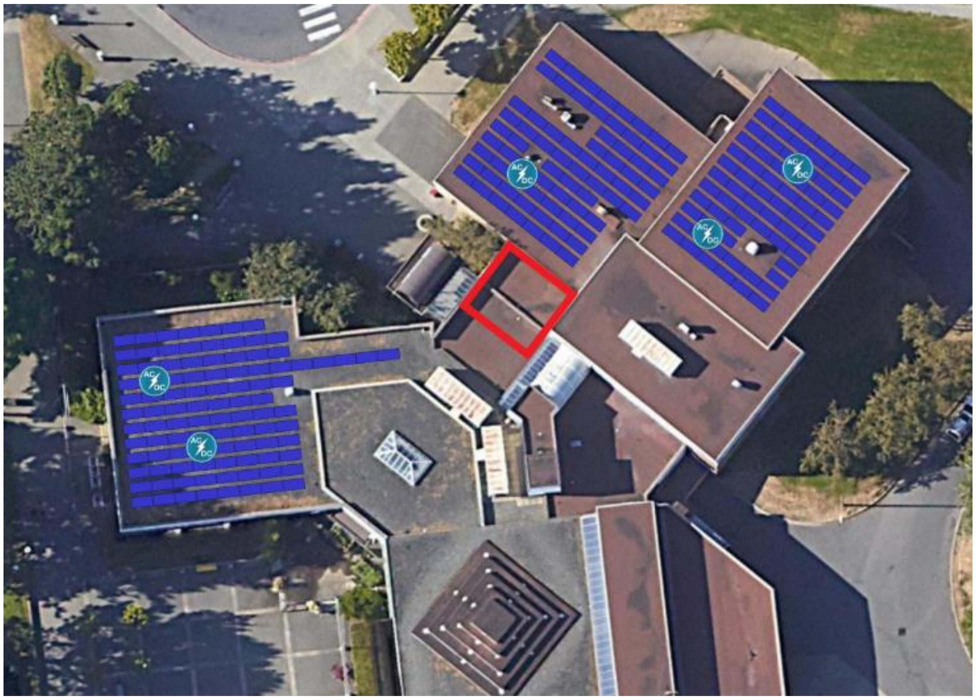


Figure 1: Overhead View of PV Layout

The model takes into account the effects of shading of surrounding rooftops or mechanical equipment. The red square shows the approximate location of the main electrical room, which is located in the basement of the Student Union Building. The panels are angled at 15 degrees with a row spacing of about 1.34ft. With this arrangement they experience minimal inter-row shading while still providing adequate walking space and setback from the roof edge for servicing.

2. Solar Panel System

The solar panel system consists of the solar modules, which interface with sunlight and produce DC current, the inverters which converts this DC current into usable AC current to power the building, the optional battery storage, which is not necessary but can be useful in the event of a power failure, and finally the roof mounting system, which will depend on the configuration and application of the solar panels. The following components have been proposed, however, alternate manufacturers and components can be considered by AES if the client so chooses.

2.1 PHOTOVOLTAIC MODULES

Figure 2: Hanwha Q. Peak Duo L-G7.2 400W Solar Panel

The standard solar panel solution uses the Hanwha Q. Peak Duo L-G7.2 400W module. It is a monocrystalline panel with innovative all-weather technology allowing it to perform well in low-light and low temperature conditions. It includes a 12-year product warranty and a 25-year linear performance warranty, which is essentially a 25-year guaranteed lifetime with a linear performance declination that is better than the industry standard. Its dimensions are 2015mm x 1000mm x 35mm including the frame, which allowed for a setup of 240 modules with a 15-degree tilt and 41cm row spacing. Refer to Appendix A to find the module datasheet for more information.

2.2 INVERTER AND POWER OPTIMIZER

Figure 3: SolarEdge SE14.4KUS 14.4kW Inverter

The inverter used in this design is the Three Phase SolarEdge SE14.4KUS 14.4kW inverter, paired with the SolarEdge P500 Power Optimizer, which is meant to mitigate the effects of shading and optimize power generation. This combination was chosen due to its superior performance when compared to other inverters as well as its convenience of code compliance. SolarEdge complies with the Canadian Electrical Code for Rapid Shutdown, and Arc Fault Protection without requiring the addition of extra devices. The features of the SolarEdge SE14.4KUS inverter are as follows:

- Specifically designed to work with power optimizers
- Quick and easy inverter commissioning directly from a smartphone using the SolarEdge SetApp
- Internet connection through Ethernet or Wireless
- Fixed voltage inverter for longer strings
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Built-in module-level monitoring
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- Integrated Safety Switch
- Supplied with RS485 Surge Protection, to better withstand lightning events
- Small, lightweight, and easy to install outdoors or indoors on provided bracket

This inverter can be installed outdoors or indoors and provides module level monitoring using the SolarEdge Monitoring Platform. The P500 power optimizers can be seen below.

Figure 4: Solar Edge P500 Power Optimizer

The optimizer is a DC-to-DC converter that provides Maximum Power Point Tracking (MPPT) at each module. They ensure that the output voltage of each panel is at its highest point, regardless of debris or shade covering a section of a panel. Through MPPT they minimize the loss in power generation due to obstructions and shading and maximize overall production.

2.3 SOLAR PANEL RACKING

There is a variety of mounting structures available for various arrangements in a PV system. The mounting structure used will depend on whether the modules are ground mounted, flat roof mounted, or flush mounted to a sloped roof. In this case, the panels were installed on a flat roof with a fixed tilt of 15 degrees and a row spacing of 1.34ft. The racking system used was KB Racking's 'Anchor Rack', whose datasheet can be found in Appendix A. This is a ballast-free racking system that screws directly onto the roof, providing a secure mount while keeping the weight of the system to a minimum. This system is favorable for an existing building as it will have minimal impact on the structural integrity of the roof. There are ballasted racking systems available that are weighed down rather than screwed directly into the roof. However, these are generally not approved by structural engineers as they weigh significantly more and could harm the structural integrity of the roof. Furthermore, the ballasted racking systems are not secured to the roof so in the event of an earthquake the modules could move around and potentially fall off the roof. Therefore, it is generally preferred to use the non-ballasted system. The Anchor Rack is displayed below in Figure 5.

Figure 5: KB Racking Anchor Rack Mounting System

The rack mounting will be coordinated with the structural characteristics of the roof to ensure there is adequate load support for the PV system. It is possible that additionally infrastructure may be required to allow for proper roof drainage as well as to provide adequately spaced rails for the racking system to mount to. Additionally, it is worth mentioning that there are several Work Safe BC requirements in place for anyone servicing the PV system. These requirements could be having a three-meter setback from the panels to any edge of a roof above 10ft high, having module separation to allow for a person to walk down the rows of panels for servicing, or having some sort of fall restraint in place if the panels are mounted extremely close together and placed all the way to the edge of the roof. The fall restraints may include a railing around the edge of the roof, or a way to anchor into the roof with a harness. The exact requirements will be determined once a design decision has been finalized. In the case of this report, the panels were mounted with a fixed tilt and even row spacing. In a real application, it may be necessary to include a fall restraint or remove certain panels to achieve an adequate setback from the roof edges that above 10ft high. Further review of the proposed mounting system would be required by a structural engineer to ensure it is adequate for the roof structure in terms of support and mounting locations. Additionally, the roof penetrations will have to be coordinated with an architect.

3. Performance Metrics

The performance metrics tested in this report are the power generation, the method of implementation, the cost, and the payback period using an estimated system cost and BC hydro's energy rates. Their results are tabulated and displayed to give a representation of their feasibility. The energy generation will be compared to the Victoria, BC kWh/kWp average to quantify its performance.

3.1 ENERGY GENERATION

This solution was modelled using Helioscope to determine its annual production and overall efficiency under the conditions outlined in Section 1. It was kept to a minimum, using only the roof spaces with the best efficiency, and closest proximity to the main electrical room. Additionally, the power generation was kept well under the BC Hydro maximum of 100kWh. Anything above this limit requires additional testing and investigation from BC Hydro which could cost tens of thousands of dollars. The total connected DC load in this design, with 240 – 400W modules, is 96kWp, where the 'p' in kWp refers to the 'peak value' of the wattage. This can be viewed as the highest potential DC power input to the inverters under perfect operating conditions, which is very rarely the case. In reality, this value will be significantly lower and to make up for it, the DC (input) side is upsized at about 1.33 times the AC (output) side. The total connected AC (inverter) load with 5 – 14.4kW inverters is 72kWh, which is the highest power that the PV system will produce under ideal operation conditions. The total annual production after simulation was found to be 104MWh, giving a kWh/kWp ratio of 1,084kWh/kWp. According to Natural Resources Canada, the average kWh/kWp ratio for Victoria ranges anywhere from 1000kWh/kWp to 1100kWh/kWp, which puts this system near the top in terms of generation. The annual generation broken down by month can be seen below in Figure 6.

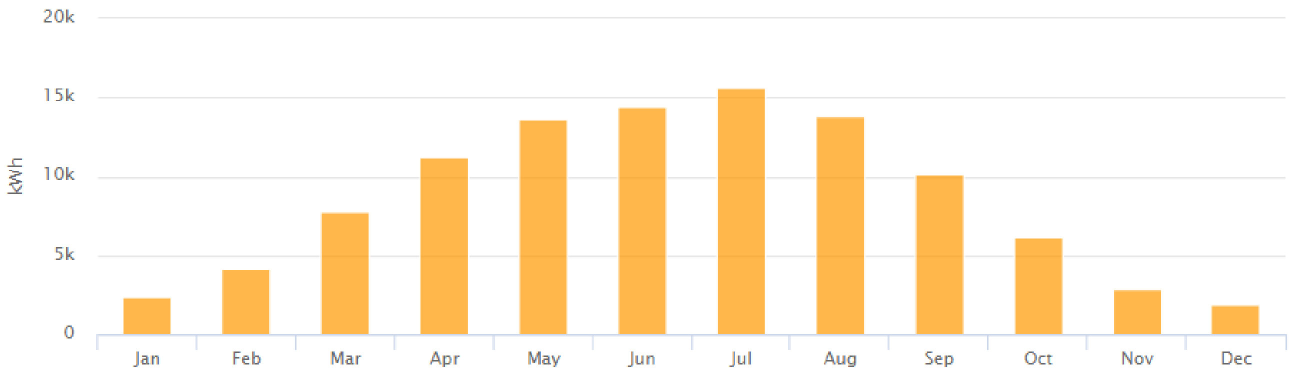


Figure 6: Monthly Energy Production

The largest energy production is seen in July with the monthly output being 15,669kWh and the smallest production is seen in December with a monthly output of 1,864kWh. This is in line with what is expected considering the weather conditions of Victoria.

3.2 IMPLEMENTATION

The existing distribution in the Student Union Building is a 4000A – 120/208V, 3-phase, 4 wire system with plenty of physical space to add new fused switches onto the switchgear. The design outlined in section 1 requires five 14.4kW inverters each taking on four strings of 12 PV modules, which will be connected to a panel specifically for the PV. As the output of this inverter cannot exceed 14.4kW at 208V, 3-phase, the required overcurrent protection for each inverter was a 3 pole 50A breaker. The panel will be electrically oversized and rated for 400A to allow for the addition of about 43kW of future PV loads. Since the energy demand of the Student Union Building is substantially lower than what the main distribution can support there is no concern that adding solar generation to the main bus would overload the system in any way. There is some available wall space in a closet in the main electrical room as shown in figure 7 below. This wall space is intended to be used for the new PV electrical panel and the five new inverters.

Figure 7: Available Wall Space in Main Electrical Room

As shown above, there is currently a cabinet with a few shelves for tools or any other equipment used for servicing electrical equipment. This cabinet will likely need to be moved to a new location or removed altogether to make room for mounting the five new inverters. According to the SolarEdge Inverter Installation Guide, the inverters can be mounted one above the other as long as there is at least 20cm between the top of an inverter and the bottom of the StorEdge Connection Unit. Additionally, they can be installed side by side with the same 20cm separation from one edge to another. As the H x W x D dimensions of each inverter with the safety switch are 775mm x 315mm x 260mm it is reasonable to assume that this wall, along with the walls on the right and left-hand sides, will have sufficient space for mounting all five new inverters. A single line diagram showing the breaker sizes for each inverter, as well as the size of the fused switch for the new panel can be seen below. Since there are 14 spots available in the existing main distribution panel, the new panel 'PV' can be connected directly into the existing electrical distribution using a 400A fused switch, while still leaving plenty of open spots for the addition of future loads.

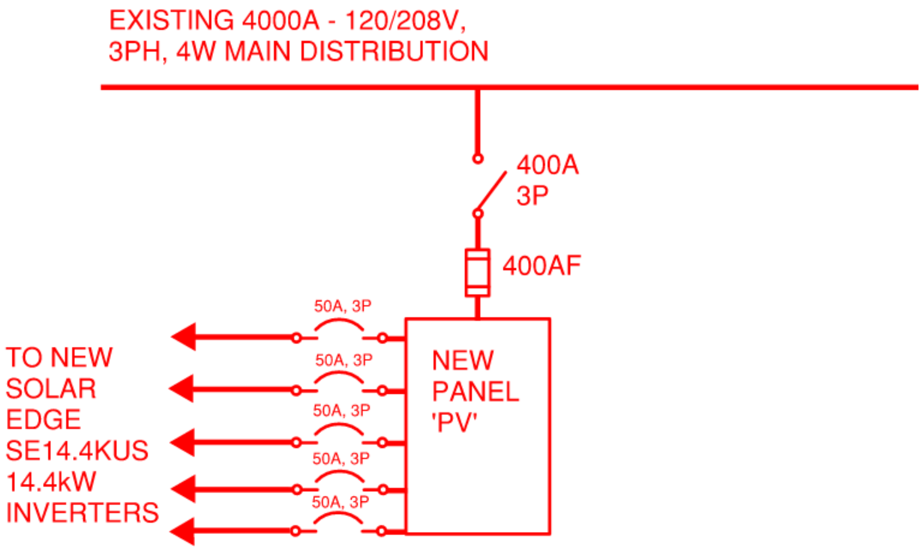


Figure 8: Single Line Diagram for Addition of Panel 'PV'

Figure 8 gives a rough idea of how the electrical panel 'PV' and the solar panel inverters are tied into the existing electrical distribution. The panel will be rated for 400A to allow for the addition of future PV as mentioned above. There is still plenty of unused space on the roof for potential solar generation. A quick model in helioscope suggests that there is about 200kWp (roughly 160kWh) of additional roof space available.

3.3 SYSTEM COST

According to energyhub.org, the average cost per installed watt for a solar panel system in Canada is $3.01/Watt. This would put the average cost of the system described in sections 1 and 2 of this report to be:

$$Average\ Cost = \frac{\$3.01}{W} * 96000W = \$288{,}960$$

A more accurate cost of the system is estimated in Table 1 below. Note that this figure was simply generated to provide an estimated payback period as outlined in Section 3.3. The actual estimated cost of this system should be confirmed by a cost consultant prior to commencing work. Furthermore, the values in Table 1 below were found from various distributors online and may vary in a real application. It is worth noting that the following equipment is tax exempt from British Columbia's PST: solar photovoltaic collector panels, wiring, controllers, and devices that convert direct current into alternating current (inverters), when they are sold as part of a solar photovoltaic system.

Table 1: Estimated Cost of Solar Panel System

Estimated Cost of Solar Panel System			
Component	**Quantity**	**Estimated Cost per Unit**	**Total**
Module	240	$500	$120,000
Inverter	5	$4,200	$21,000
Optimizer	240	$150	$36,000
Racking	-	$0.10/W	$9,600
Labour/Installation	-	-	$120,000
Panel 'PV' and Breakers/Fuses			$7,500
		Grand Total:	**$314,100**

The estimated cost of this system greater than the energyhub.org Canadian average. However, the extra costs likely occur from using high wattage modules and SolarEdge inverters/optimizers which are vital components for achieving an energy production that is above the average for Victoria. Running the simulation with smaller PV modules and different inverters with no optimizers achieves a yearly output of 84MWh, 20MWh/year less than the design in this report.

3.4 PAYBACK PERIOD

The payback period was modelled using Helioscope's Beta Payback Period Generator. As there is no BC Hydro commercial utility rate setting in the Helioscope Beta yet, BC Hydro's Res1101 utility rate was used as an approximation, and the total found in section 3.3 was used as the system cost. It was assumed that the power consumption of the building would be larger than the energy produced from the photovoltaics which would very likely be the case. In the event that the energy demand for the building is lower than the solar panel production, the produced energy will be put back into the grid to be used later as a one-to-one credit with BC Hydro. The payback period was modeled over a 25-year period assuming an annual utility cost escalation of 5% and an annual maintenance fee of $600. This can be seen in the figure below.

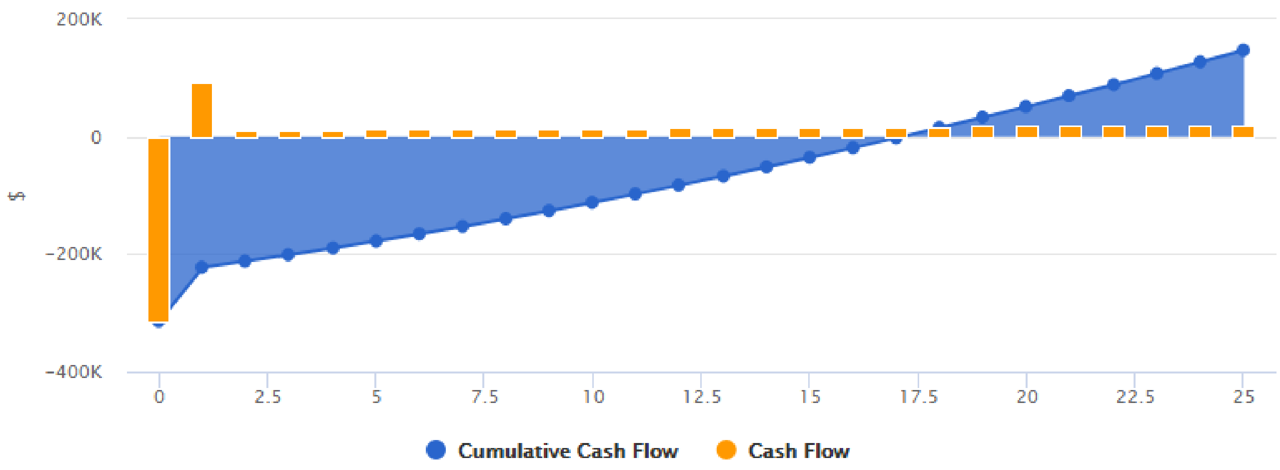


Figure 9: Payback Period

The payback period of this PV system was found to be about 17.1 years. The blue line represents the cumulative cashflow and payback rate from BC Hydro's energy rates. The yellow line represents the Cash Flow, which in this case is assumed as a one-time payment of $314,100 and then an annual maintenance fee of $600 for the next 25 years. The Internal Rate of Return (IRR) and the Return on Investment (RoI) for this model were 3.60% and 146.83% respectively. In reality, the payback period should be at least a few years lower since BC Hydro's Commercial Energy Rates for a building of this size would be substantially higher than the BC Hydro Res1101 utility rate used in this model. This would also increase the values of the IRR and RoI significantly.

4. Conclusion

The system described in this report was chosen for various reasons including the solar panel locations with respect to the electrical room, the minimized loss due to shading, the availability of wall space in the electrical room, and the ease of implementation into the existing main distribution. This system is slightly more expensive than the Canadian average, by about $18,000. However, it is also able to achieve about 20MWh of energy generation more per year than a lower cost solution, while providing arc fault protection, rapid shut down, built-in module-level monitoring, and surge protection, without the addition of other devices. The payback period using BC Hydro's Res1101 utility rate was found as 16.8 years. In reality, this will be a few years less due to the commercial utility rates of a building this size costing substantially more than what was modelled using Helioscope Beta.

5. Recommendations

Moving forward with this project, it is recommended that UVic provides comments with respect to the size, generation, cost, and implementation of the design in this report. There is plenty of more usable roof space with an estimated potential generation value of 160kWh. If the client would like to add more or remove some solar generation on the roof space this can be investigated. If there is future PV expansion, then new space will need to be allocated for the solar inverters. Additionally, any solar generation that brings the system over the BC Hydro limit of 100kWh will require additional investigation from BC Hydro, which could cost a significant amount as mentioned in section 3.1. There is the potential to mount only a few more inverters onto the walls in the main electrical room, or on the walls in electrical room A004. However, it is possible to mount additional inverters on the exterior of the building if the extra space is required. If the client would like to mount all of the inverters on the exterior of the building this can be done as well. Next, the estimated cost found in section 3.3 should be assessed by the client and they should determine if they want to explore less expensive solutions with lower energy generation. This can be done by either exploring different components and manufacturers or removing some of the PV modules and inverters from the design. It is important to note that the estimated cost found in section 3.3 does not account for the cost of any additional structural support that may be required with the installation of this photovoltaic system.

6. Appendix A – Data Sheets

powered by Q.ANTUM DUO

Q.PEAK DUO L-G7.2
385-405

ENDURING HIGH PERFORMANCE

EUPD RESEARCH TOP BRAND PV MODULES AUSTRALIA 2016 · 2017 · 2018 · 2019

pv magazine award 2017 top innovation

Q CELLS YIELD SECURITY
- ANTI PID TECHNOLOGY (APT)
- HOT-SPOT PROTECT (HSP)
- TRACEABLE QUALITY (TRA.Q™)
- ANTI LID TECHNOLOGY (ALT)

LOW ELECTRICITY GENERATION COSTS
Higher yield per surface area, lower BOS costs, higher power classes, and an efficiency rate of up to 20.3%.

INNOVATIVE ALL-WEATHER TECHNOLOGY
Optimal yields, whatever the weather with excellent low-light and temperature behaviour.

ENDURING HIGH PERFORMANCE
Long-term yield security with Anti LID Technology, Anti PID Technology[1], Hot-Spot Protect and Traceable Quality Tra.Q™.

EXTREME WEATHER RATING
High-tech aluminium alloy frame, certified for high snow (5400 Pa) and wind loads (2400 Pa).

A RELIABLE INVESTMENT
Inclusive 12-year product warranty and 25-year linear performance warranty[2].

STATE OF THE ART MODULE TECHNOLOGY
Q.ANTUM DUO combines cutting edge cell separation and innovative wiring with Q.ANTUM Technology.

[1] APT test conditions according to IEC/TS 62804-1:2015, method B (−1500 V, 168 h)
[2] See data sheet on rear for further information.

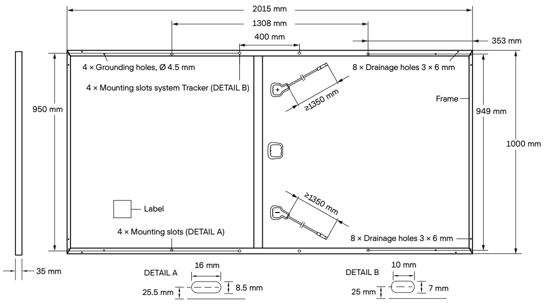
THE IDEAL SOLUTION FOR:
- Rooftop arrays on commercial / industrial buildings
- Ground-mounted solar power plants

Engineered in Germany

Q CELLS

MECHANICAL SPECIFICATION

Format	2015 mm × 1000 mm × 35 mm (including frame)
Weight	23.5 kg
Front Cover	3.2 mm thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Anodised aluminium
Cell	6 × 24 monocrystalline Q.ANTUM solar half cells
Junction box	53-101 mm × 32-60 mm × 15-18 mm Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥1350 mm, (–) ≥1350 mm
Connector	Stäubli MC4-Evo2: IP68

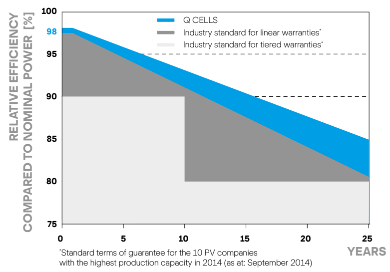


ELECTRICAL CHARACTERISTICS

POWER CLASS				385	390	395	400	405
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / −0 W)								
Minimum	Power at MPP[1]	P_{MPP}	[W]	385	390	395	400	405
	Short Circuit Current[1]	I_{SC}	[A]	10.05	10.10	10.14	10.19	10.23
	Open Circuit Voltage[1]	V_{OC}	[V]	48.17	48.44	48.70	48.96	49.22
	Current at MPP	I_{MPP}	[A]	9.57	9.61	9.66	9.70	9.75
	Voltage at MPP	V_{MPP}	[V]	40.24	40.57	40.90	41.23	41.56
	Efficiency[1]	η	[%]	≥19.1	≥19.4	≥19.6	≥19.9	≥20.1
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]								
Minimum	Power at MPP	P_{MPP}	[W]	288.3	292.1	295.8	299.6	303.3
	Short Circuit Current	I_{SC}	[A]	8.10	8.14	8.17	8.21	8.24
	Open Circuit Voltage	V_{OC}	[V]	45.42	45.67	45.92	46.17	46.41
	Current at MPP	I_{MPP}	[A]	7.53	7.57	7.60	7.64	7.67
	Voltage at MPP	V_{MPP}	[V]	38.29	38.60	38.92	39.23	39.54

[1]Measurement tolerances P_{MPP} ±3%; I_{SC}; V_{OC} ±5% at STC: 1000 W/m², 25±2 °C, AM 1.5 according to IEC 60904-3 • [2]800 W/m², NMOT, spectrum AM 1.5

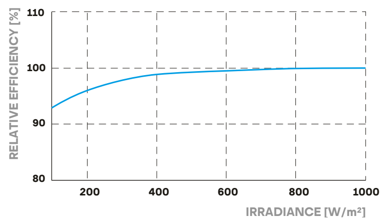
Q CELLS PERFORMANCE WARRANTY



At least 98% of nominal power during first year. Thereafter max. 0.54% degradation per year. At least 93.1% of nominal power up to 10 years. At least 85% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Q CELLS sales organisation of your respective country.

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²).

TEMPERATURE COEFFICIENTS

Temperature Coefficient of I_{SC}	α	[% / K]	+0.04	Temperature Coefficient of V_{OC}	β	[% / K]	−0.27
Temperature Coefficient of P_{MPP}	γ	[% / K]	−0.35	Normal Module Operating Temperature	NMOT	[°C]	43±3

PROPERTIES FOR SYSTEM DESIGN

Maximum System Voltage	V_{SYS}	[V]	1500 (IEC) / 1500 (UL)	Safety Class	II
Maximum Reverse Current	I_R	[A]	20	Fire Rating based on ANSI / UL 1703	C / TYPE 1
Max. Design Load, Push / Pull		[Pa]	3600 / 1600	Permitted Module Temperature on Continuous Duty	−40 °C - +85 °C
Max. Test Load, Push / Pull		[Pa]	5400 / 2400		

QUALIFICATIONS AND CERTIFICATES

IEC 61215:2016; IEC 61730:2016, Application Class II;
This data sheet complies with DIN EN 50380.

C Certified UL 1703 (254141) US

PACKAGING INFORMATION

Number of Modules per Pallet	30
Number of Pallets per Trailer (24 t)	24
Number of Pallets per 40' HC-Container (26 t)	22
Pallet Dimensions (L × W × H)	2074 × 1130 × 1170 mm
Pallet Weight	761 kg

Note: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Made in China

Hanwha Q CELLS Australia Pty Ltd
Suite 1, Level 1, 15 Blue Street, North Sydney, NSW 2060, Australia | **TEL** +61 (0)2 9016 3033 | **FAX** +61 (0)2 9016 3032 | **EMAIL** q-cells-australia@q-cells.com | **WEB** www.q-cells.com/au

Engineered in Germany

Three Phase Inverters for the 120/208V Grid

for North America

SE9KUS / SE14.4KUS

12-20 YEAR WARRANTY

INVERTERS

The best choice for SolarEdge enabled systems

- Specifically designed to work with power optimizers
- Quick and easy inverter commissioning directly from a smartphone using the SolarEdge SetApp
- Internet connection through Ethernet or Wireless
- Fixed voltage inverter for longer strings
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Built-in module-level monitoring
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- Integrated Safety Switch
- Supplied with RS485 Surge Protection, to better withstand lightning events
- Small, lightweight, and easy to install outdoors or indoors on provided bracket

/ Three Phase Inverters for the 120/208V Grid(1) for North America

SE9KUS / SE14.4KUS

MODEL NUMBER	SE9KUS	SE14.4KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER	SEXXK-XXXXXBXX4		
OUTPUT			
Rated AC Power Output	9000	14400	VA
Maximum AC Power Output	9000	14400	VA
Output Line Connections	3 phase, 3-wire / PE (L1-L2-L3), TN, TT 3 phase, 4-wire / PE (L1-L2-L3-N), TN, TT		
AC Output Voltage Minimum-Nominal-Maximum(2) (L-N)	105-120-132.5		Vac
AC Output Voltage Minimum-Nominal-Maximum(2) (L-L)	183-208-229		Vac
AC Frequency Min-Nom-Max(2)	59.3 - 60 - 60.5		Hz
Maximum Continuous Output Current (per Phase)	25	40	A
GFDI Threshold	1		A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes		
THD	≤ 3		%
INPUT			
Maximum DC Power (Module STC)	12150	19400	W
Transformer-less, Ungrounded	Yes		
Maximum Input Voltage DC to Gnd	250	300	Vdc
Maximum Input Voltage DC+ to DC-	500	600	Vdc
Nominal Input Voltage DC to Gnd	200		Vdc
Nominal Input Voltage DC+ to DC-	400		Vdc
Maximum Input Current	26.5	38	Adc
Maximum Input Short Circuit Current	45		Adc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolation Detection	1MΩ Sensitivity	350kΩ Sensitivity(3)	
CEC Weighted Efficiency	96.5	97.5	%
Night-time Power Consumption	< 3	< 4	W
ADDITIONAL FEATURES			
Supported Communication Interfaces	RS485, Ethernet, Built-in Cellular (optional)		
Inverter Commissioning	With the SetApp mobile application using built-in access point for local connection		
Rapid Shutdown – NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect		
RS485 Surge Protection Plug-in	Supplied with the inverter		
Smart Energy Management	Export Limitation		
STANDARD COMPLIANCE			
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07		
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)		
Emissions	FCC part15 class B		
INSTALLATION SPECIFICATIONS			
AC output conduit size / AWG range	3/4" minimum / 8-4 AWG		
DC input conduit size / AWG range	3/4" minimum / 12-6 AWG		
Number of DC inputs	2 pairs	3 pairs(4)	
Dimensions (H x W x D)	21 x 12.5 x 10.5 / 540 x 315 x 260		in / mm
Dimensions with Safety Switch (H x W x D)	30.5 x 12.5 x 10.5 / 775 x 315 x 260		in / mm
Weight	93.6 / 42.5		lb / kg
Weight with Safety Switch	100.3 / 45.5		lb / kg
Cooling	Fans (user replaceable)		
Noise	< 55		dBA
Operating Temperature Range	-40 to +140 / -40 to +60(5)		˚F / ˚C
Protection Rating	NEMA 3R		

(1) For 277/480V inverters refer to:https://www.solaredge.com/sites/default/files/se-three-phase-us-inverter-277-480V-setapp-datasheet.pdf
(2) For other regional settings please contact SolarEdge support
(3) Where permitted by local regulations
(4) Field replacement kit for 1 pair of inputs P/N: DCD-3PH-1TBK; Field replacement kit for 3 pairs of fuses and holders P/N: DCD-3PH-6FHK-S1
(5) For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf

Power Optimiser

For Australia
Module Add-On

P370 / P401 / P404 / P485 / P500 / P505

POWEROPTIMISER

PV power optimisation at the module-level

- Specifically designed to work with SolarEdge inverters
- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of modules mismatch-loss, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module level monitoring
- Module-level voltage shutdown for installer and firefighter safety

solaredge

/ Power Optimiser For Australia
Module Add-On
P370 / P401 / P404 / P485 / P500 / P505

Optimiser Model (Typical Module Compatibilty)	P370 (60&70 Cell modules)	P401 (60&70 Cell modules)	P404 (for 60-cell and 72-cell, short strings)	P485 (for high-voltage modules)	P500 (for 96-cell modules)	P505 (for higher current modules)	
INPUT							
Rated Input DC Power[1]	370	400	405	485	500	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	60		80	125	80	83	Vdc
MPPT Operating Range	8 - 60		12.5 - 80	12.5 - 105	8 - 80	12.5-83	Vdc
Maximum Short Circuit Current (Isc)	11	11.75	11		10.1	14	Adc
Maximum Efficiency	99.5						%
Weighted Efficiency	98.8						%
Overvoltage Category	II						
OUTPUT DURING OPERATION (POWER OPTIMISER CONNECTED TO OPERATING SOLAREDGE INVERTER)							
Maximum Output Current	15						Adc
Maximum Output Voltage	60		85		60	85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMISER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)							
Safety Output Voltage per Power Optimiser	1 ± 0.1						Vdc
STANDARD COMPLIANCE							
EMC	FCC Part 15 Class B, IEC61000-6-2, IEC61000-6-3						
Safety	IEC62109-1 (class II safety), UL1741						
RoHS	Yes						
Fire Safety	VDE-AR-E 2100-712:2013-05						
INSTALLATION SPECIFICATIONS							
Maximum Allowed System Voltage	1000						Vdc
Dimensions (W x L x H)	129 x 153 x 27.5	129 x 153 x29.5	129 x 153 x 42.5	129 x 159 x 49.5	129 x 153 x 33.5	129 x 162 x 59	mm
Weight (including cables)	655		775	845	750	1064	gr
Input Connector[2]	MC4[2]			Single or Dual MC4[2][3]	MC4[2]		
Input Wire Length	0.16 / 0.9[4]		0.16				m
Output Connector	MC4						
Output Wire Length	1.2						m
Operating Temperature Range	-40 to +85						˚C
Protection Rating	IP68 / NEMA6P						
Relative Humidity	0 - 100						%

(1) Rated power of the module at STC will not exceed the optimiser "Rated Input DC Power". Modules with up to +5% power tolerance are allowed
(2) For other connector types please contact SolarEdge
(3) Dual version for parallel connection of 2 modules; P/N: P485-4RMDMRM. In a case of odd number of PV modules in one string it is allowed to install one P485 dual version power optimiser connected to one PV module. When connecting a single module seal the unused input connectors with the supplied pair of seals
(4) Longer inputs wire length are available for use. For 0.9m input wire length order P370/P401-xxxLxxx

PV System Design Using a Solaredge Inverter[5]		Single Phase HD-WAVE	Single Phase	Three Phase Residential	Three Phase Commercial	
Minimum String Length (Power Optimisers)	P370, P401, P500	8		9	16	
	P404, P485, P505	6		8	14	
Maximum String Length (Power Optimisers)		25		25	50	
Maximum Nominal Power per String		5700[6] (6000 with SE8000H, SE10000H)	5250[6]	5625[6]	11250[7]	W
Parallel Strings of Different Lengths or Orientations		Yes				

(5) It is not allowed to mix P404/P485/P505 with P370/P401/P500 in one string
(7) It is allowed to install up to 13,500W per string when the maximum power difference between each string is 2,000W
(6) If the inverters rated AC power ≤ maximum nominal power per string, then the maximum power per string will be able to reach up to the inverters maximum input DC power Refer to: https://www.solaredge.com/sites/default/files/se-power-optimizer-single-string-design-application-note.pdf

CE RoHS

KB RACKING®
Simple solutions you can count on.

ANCHORRACK®

Anchored Mounting System

ZERO BALLAST - COST EFFICIENT - EASY TO INSTALL

ANCHORRACK® has been designed to eliminate rooftop ballasting and provide a system both affordable and favorable to weight-challenged roofs. Wood screws penetrate the roof surface to create a secure attachment against high wind loads while high-grade flashing allows for a permanent seal against the elements.

ANCHORRACK®'s installation is made simple with pre-punched screw holes, click-in module clamps, and light-weight aluminum components. The durable components are built-to-last with flexibility in tilt angle, row spacing and panel orientation, making it the most modular anchored systems on the market.

FEATURES

- Conforms to UL standard 2703
- Fully anchored rooftop mounting solution with zero ballast
- Designed based on SEAOC's wind design guidelines for solar arrays
- Only 2 main components for rapid installation
- Durable flashing for a long-lasting, permanent seal
- 5" roof clearance to allow for rooftop obstacles
- Easy panel mounting with self-grounding, click-in module clamps
- 25-year standard product warranty, extended warranty available

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ETL CLASSIFIED

C US

LISTED

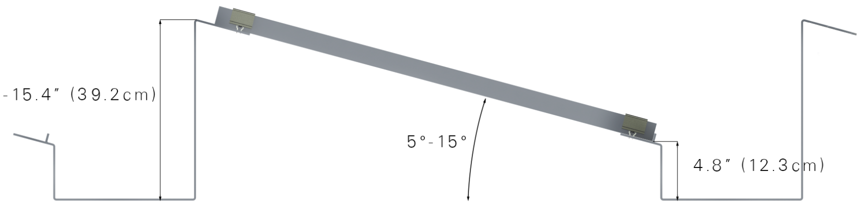
Intertek

ANCHORRACK®

Anchored Mounting System

TECHNICAL SPECIFICATIONS

Inclinations	5°, 10°, 12°, 15°
Wind Speed	Up to 170mph for Exposure B; 117mph for Exposure C
Module Sizes	All standard 60, 72 & 96 cell panels
Grounding Method	ETL certified grounding clamps, grounded only once per array
Flashing	Pre-attached tape and liner with secondary LPS sealant
Orientation	Landscape / Portrait
Certification	Conforms to UL STD 2703. Certified to ULC/ORD STD C1703
Building Height	Up to 60' (18.3m), higher upon request
Roof Type	All types of flat roofs
Roof Pitch	Up to 45°
Material	Aluminum, stainless steel fasteners and screws
Row Spacing	49.2" - 58.3" / 1.25m - 1.48m, Custom row spacing available.



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