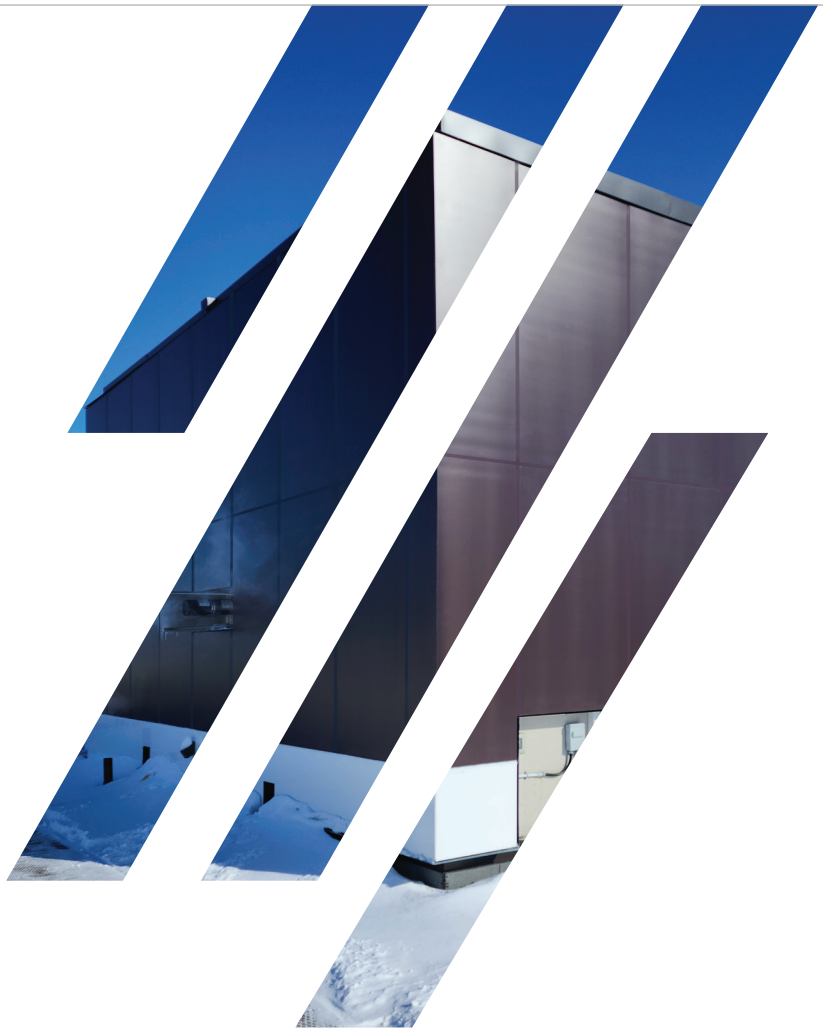
# The Kingston Box, Kingston, Ontario

Solar Facade - Case Study



## Project Overview

The Kingston Box is a Solar Facade project on the penthouse of a Kingston, Ontario building. This project incorporates active and non-active modules in the four orientations (South, West, East, and North) and features a brown pixelated color. In addition, the modules located at the bottom of the building are non-solar cladding (white color panels).

## Project Information

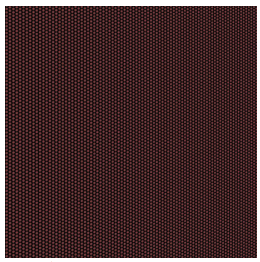
Total Project Area: **1,323 SQFT**
Active Area: **957 SQFT**
Non-Active Area: **223.75 SQFT**
Non-Solar Cladding Area: **142.25 SQFT**

**The table below shows the active, non-active and non-solar cladding area (SQFT) of each building's orientation.**

| Orientation | Non-Solar Cladding | Mitrex Active Modules | Mitrex Non-Active Modules | Total |
|---|---|---|---|---|
| East | 42.25 | 326.25 | 46.75 | 415.25 |
| South | 20.5 | 130.5 | 94.5 | 245.5 |
| West | 52.75 | 348 | 18.75 | 419.5 |
| North | 26.75 | 152.25 | 63.75 | 242.75 |

Mitrex solar module used for this project is:

| Module Code | Pmax (W) | Voc (V) | Isc (A) | Vmp (V) | Imp (A) | Tolerance (%) |
|---|---|---|---|---|---|---|
| M265-SD08F612 | 265 | 48.4 | 6.84 | 40.5 | 6.55 | +/- 5 |



Brown-1217S
Solar Solid Colors

Please note that the orientation of South facing modules is 21 degree to the East and all other orientations are based on this 21 degree shift.
A total of 44 modules (of M265-SD08F612) were installed in this project:

- 6 panels are facing South
- 16 panels are facing West
- 15 panels are facing East
- 7 panels are facing North.

Solaredge SE9KUS (9 kW) with 44 S440 optimizer have been used to convert the energy production from Mitrex modules to 208V AC usable by the building.

Two strings of 22 optimizers are used for this project.

One string has 6 panels of South and 16 panels of West, while the second has 7 panels of North and 15 panels of East orientation.

Solaredge designer tool has been used to estimate the generation of this project. Annual energy production after inverter and optimizer losses is 6.91 MWh. Here is the estimated monthly generation:

**Learn More:**
mitrex.com info@mitrex.com

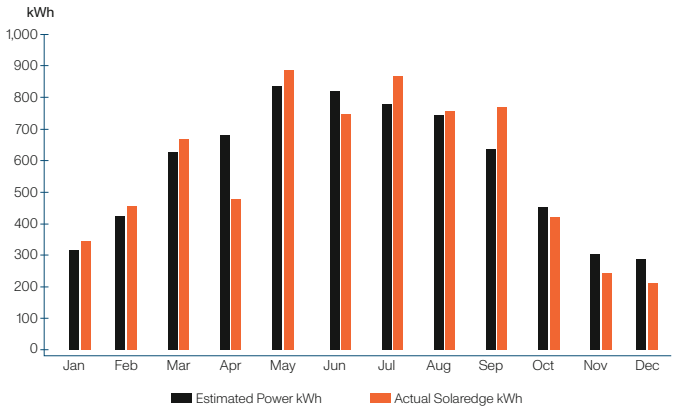
**Headquarters:**
41 Racine Rd., Toronto, ON M9W 2Z4, Canada +1 (416) 497 7120

**USA Office:**
Chrysler Building, 405 Lexington Avenue Floor 26, NY, USA +1 (646) 583 4486

## Comparative Table Between Estimated Power VS Actual Power

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimation (kWh) | 316 | 424 | 627 | 679 | 837 | 821 | 779 | 747 | 637 | 453 | 302 | 286 |
| Actual (kWh) | 333 | 457 | 668 | 479 | 976 | 759 | 882 | 782 | 784 | 418 | 242 | 216 |

## Comparative Graphic Between Estimated Power Vs Actual Power




Since the total DC size of system is 11.66 kW, specific production (Performance index) of this project is 593 kWh/KWp/Year (Equal to 593 hours).

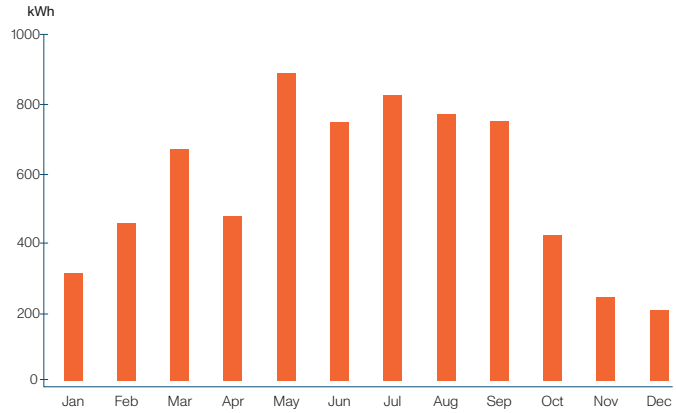
The project was completed on February 1st, 2023, and was ON for testing and commissioning. From April 19th till May 1st, 2023, the system was off and was ready for Hydro to do the final connection.

The monitoring of this project is available through Solaredge monitoring website or app. To access it, please use the following credentials:

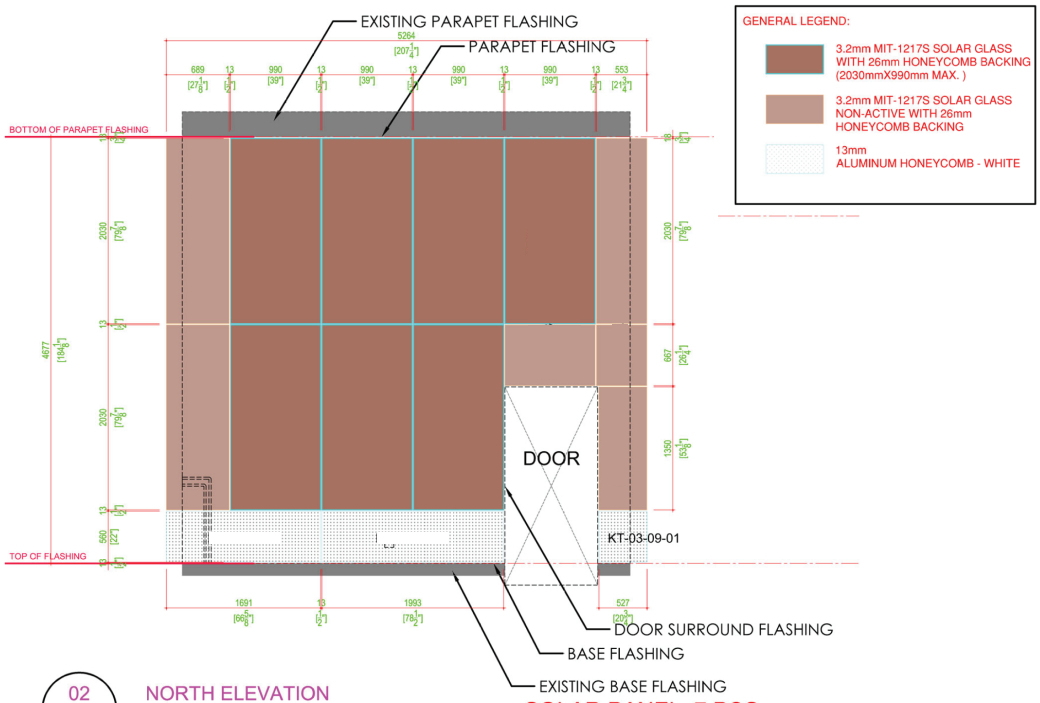
Username: info@mitrex.com
Password: Mitrex2023
Link to Access: monitoring.solaredge.com

From the monitoring of the project, up to November 20th 2023, the production is as below:

## Solaredge Energy Generation Monitoring

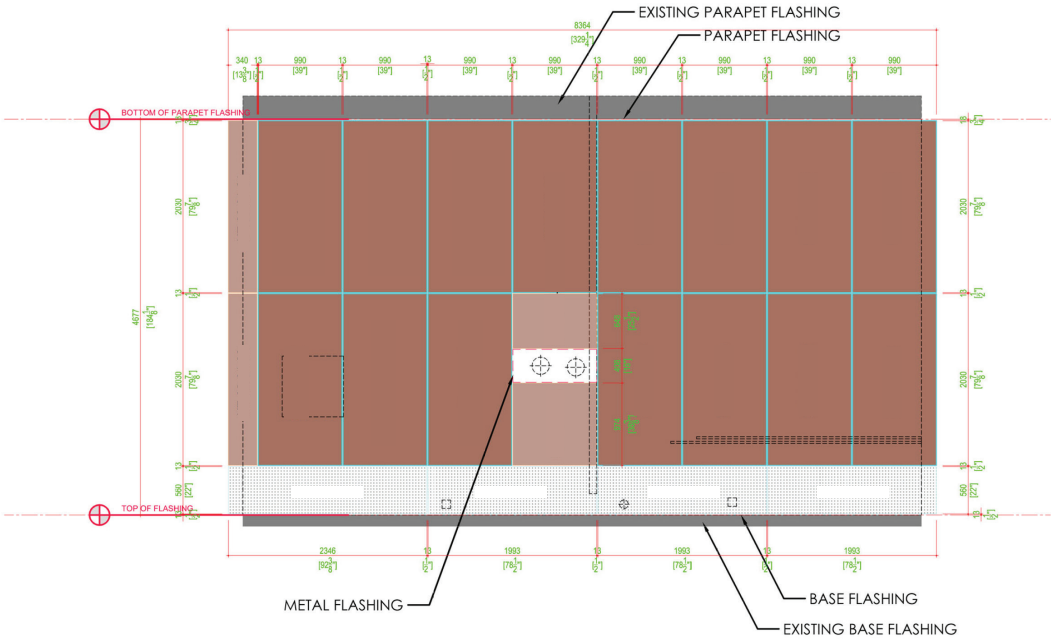


# Modules Layout Per Elevation




02 CL-001 NORTH ELEVATION
SCALE: 1:50

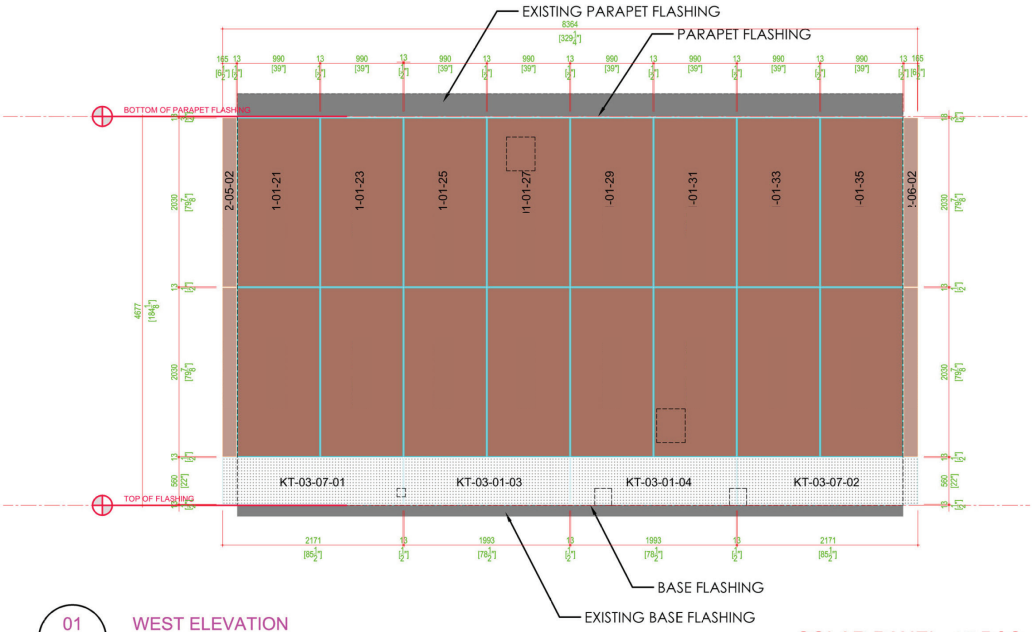
SOLAR PANEL: 7 PCS




03 CL-001 EAST ELEVATION
SCALE: 1:50

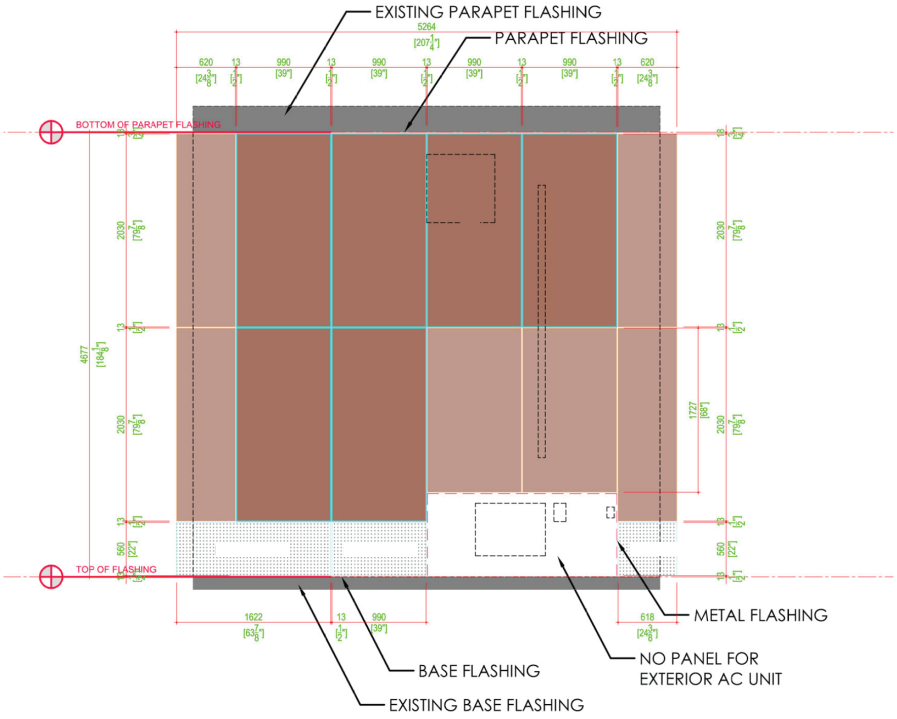
SOLAR PANEL: 15 PCS

# Modules Layout Per Elevation




01 CL-001 WEST ELEVATION
SCALE: 1:50

SOLAR PANEL: 16 PCS

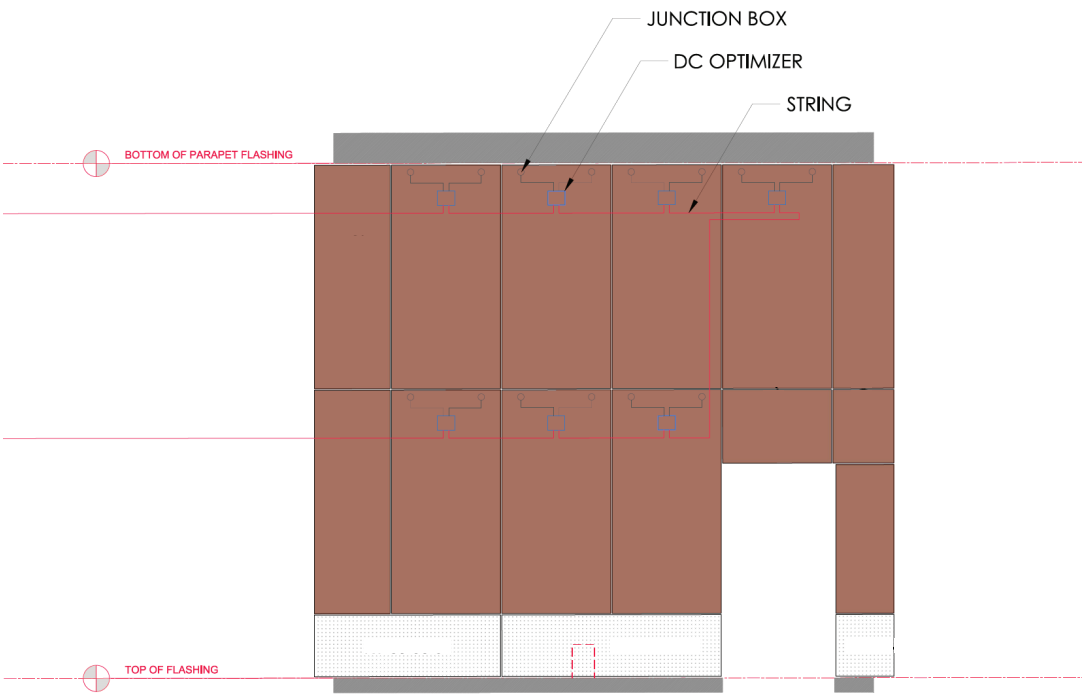



04 CL-001 SOUTH ELEVATION
SCALE: 1:50

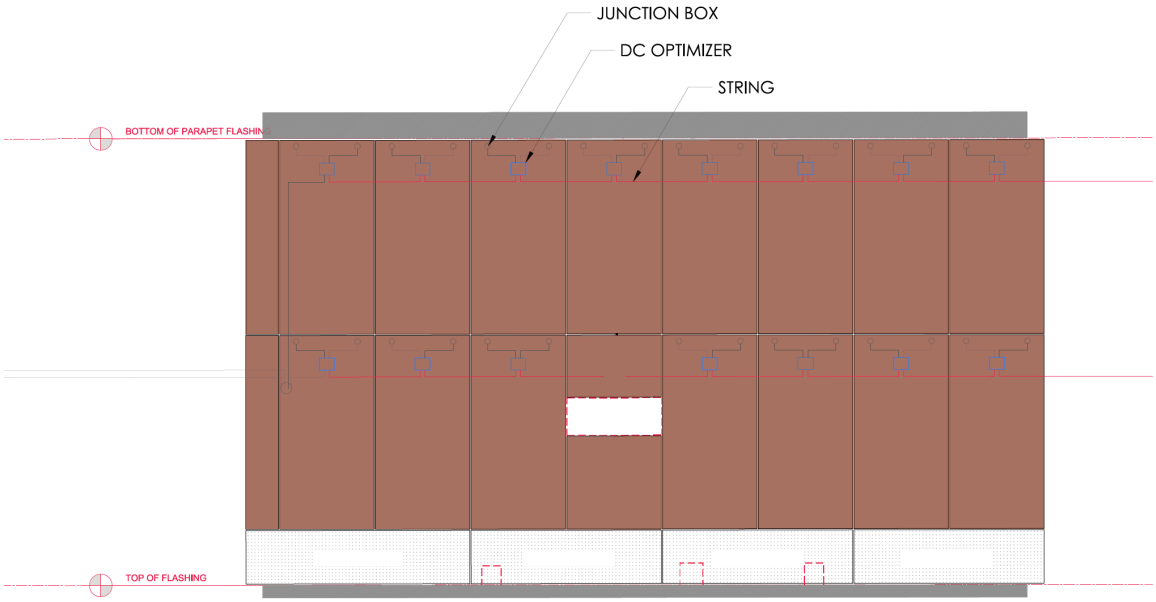
SOLAR PANEL: 6 PCS

SOLAR PANEL
TOTAL: 44 PCS

## Electrical Connections Per Elevation

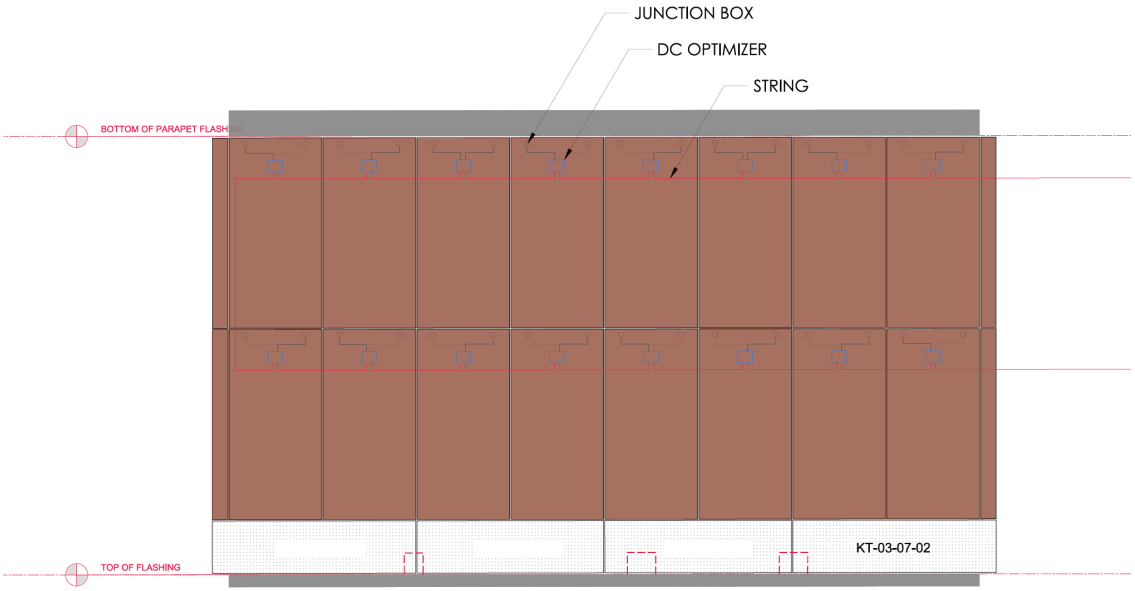



02 CL-001 NORTH ELEVATION
SCALE: 1:50

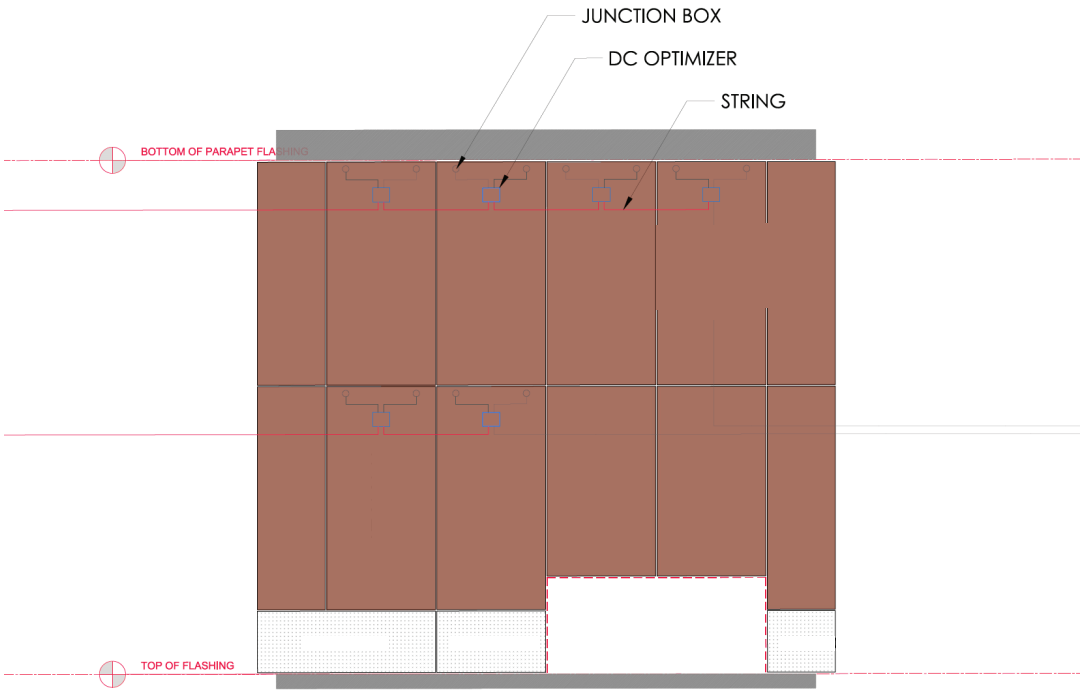



03 CL-001 EAST ELEVATION
SCALE: 1:50

# Electrical Connections Per Elevation



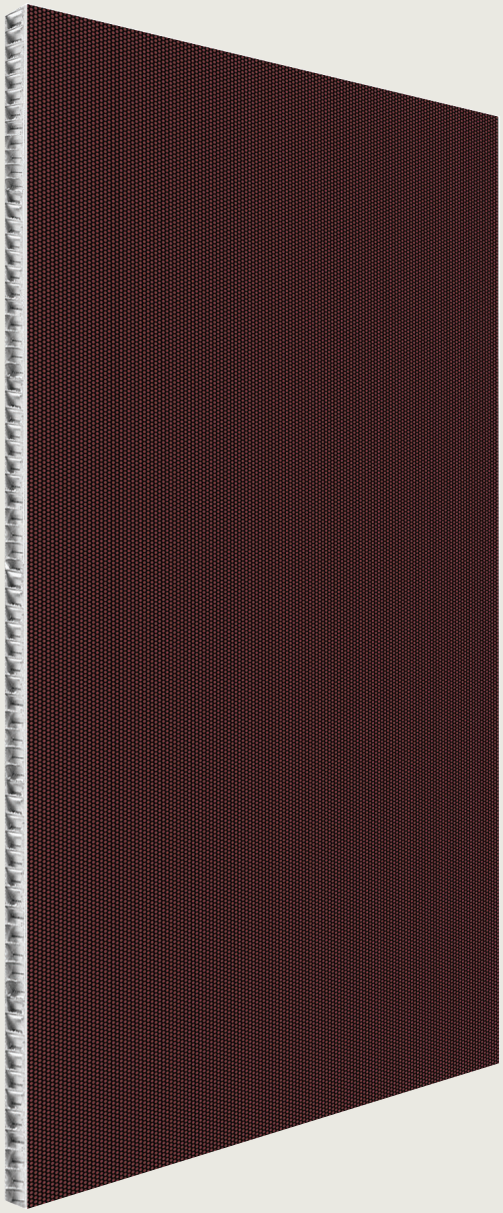

01 CL-001 WEST ELEVATION
SCALE: 1:50




04 CL-001 SOUTH ELEVATION
SCALE: 1:50

# Brown-1217S - 265W

## High Efficiency Mono
Colored PV Module



- **North American Manufacturer**

  Mitrex is a world-leading manufacturer of standard solar and BIPV products based in Canada. With over 20 years of experience, Mitrex guarantees high-quality, fully-automated manufacturing and continuous innovation in solar technology.

- **Quality, Durability And Performance**

  Mitrex panels are engineered with the highest quality-featuring wide-ranging compatibility with racking and electrical components, advanced cell technology, ability to withstand high snow/wind load conditions, and high performing modules.

- **25-Year Product And Performance Warranty**

  Made in North America, all our products come with an industry leading 25-year warranty for products and performance, ensuring the quality of the hardware, energy generation, and aesthetics are maintained.

PRODUCT PERFORMANCE 25 YEAR WARRANTY

MADE IN NORTH AMERICA CERTIFIED

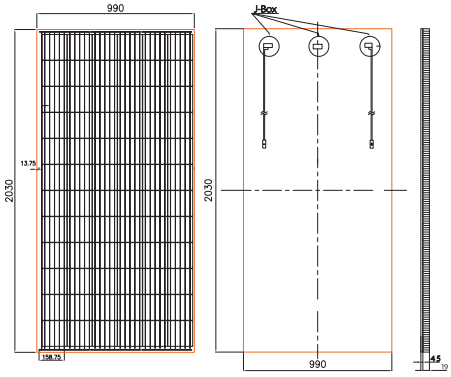
GUARANTEE HIGH EFFICIENCY

## Electrical Specifications

| Test Conditions | STC |
|---|---|
| Module Power (Pmax) | 265W |
| Maximum Power Voltage (Vpmax) | 40.5V |
| Maximum Power Current (Ipmax) | 6.55A |
| Open Circuit Voltage (Voc) | 48.4V |
| Short Circuit Current (Isc) | 6.84A |
| Module Efficiency | 13.2% |
| Maximum System Voltage (VDC) | 1000V (IEC/UL) |
| Series Fuse Rating | 20A |
| Power & Other Electrical Specification Tolerance | 5% |
| Application Classification | Class A |

Measurement Conditions: STC 1000 W/m2 - AM 1.5 - Temperature 25°C

## Engineering Drawing



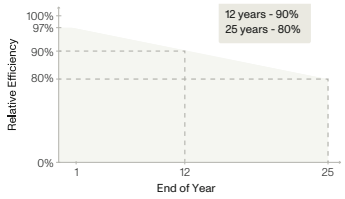

## Mechanical Properties

| | Metric | Imperial |
|---|---|---|
| Module Weight | 29 kg | 63.9 lbs |
| Dimensions (H x L x D) | 2030 × 990 × 30mm | 79.9 × 39.0 × 1.18in |
| Maximum Surface Load (Wind / Snow) | 2400Pa rear load / 2400Pa front load | 50.1psf rear load / 50.1psf front load |
| Hail Impact Resistance | ø 25mm at 83 km/h | ø 1in at 51.6 mph |
| Cells | 72 [12×6] Mono-crystalline (158.75 × 158.75mm) | 72 [12×6] Mono-crystalline (6.25 × 6.25in) |
| Glass | 3.2mm tempered glass, high transmittance, anti-reflective coating | 0.126in tempered glass, high transmittance, anti-reflective coating |
| Cables & Connectors | 300mm, 500mm, 1000mm, 1200mm - 4mm², 12 AWG (UL), MC4 from Staubli | 11.8in, 19.7in, 39.4in, 47.2in - 0.16in², 12 AWG (UL) MC4 from Staubli |
| Backsheet | High durability, UV resistant, PV backsheet | |
| Back Support | Aluminum Honeycomb | |
| Bypass Diodes | 3 diodes- 30SQ045T (45V max DC blocking voltage, 30A max forward rectified current) | |
| Junction Box | IP68 rated, TUV and UL certified | |
| Fire Rating | Spred of flame A and C burning brand. | |

## Temperature Ratings

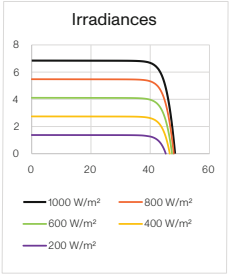
| | |
|---|---|
| Temperature Coefficient Isc | 0.036% /°C |
| Temperature Coefficient Voc | -0.27% /°C |
| Temperature Coefficient Pmax | -0.36% /°C |
| Nominal Module Operating Temperature | 42 ± 3°C |
| Operating Temperature | -40°C ~ +85°C |

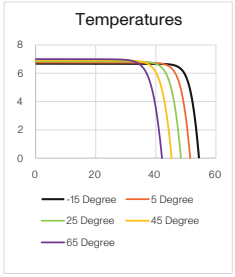
## Warranty




Product Material Warranty: 25 years
Perfomance Warranty: 25 years
≥ 97% end of 1st year
≥ 90% end of 12th year
≥ 80% end of 25th year

## I-V Curves




## Certifications

- UL 61730-1/-2
- CSA C22.2 #61730-1/-2
- IEC 61730-1/-2



**Learn More:**
mitrex.com info@mitrex.com

**Headquarters:**
41 Racine Rd., Toronto, ON M9W 2Z4, Canada +1 (416) 497 7120

**USA Office:**
Chrysler Building, 405 Lexington Avenue Floor 26, NY, USA +1 (646) 583 4486

# Power Optimizer

## For North America

S440

POWER OPTIMIZER


## PV power optimization at the module level

- Specifically designed to work with SolarEdge residential inverters
- Detects abnormal PV connector behavior, preventing potential safety issues*
- Module-level voltage shutdown for installer and firefighter safety
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch loss, from manufacturing tolerance to partial shading
- Faster installations with simplified cable management and easy assembly using a single bolt
- Flexible system design for maximum space utilization
- Compatible with bifacial PV modules
- Meets NEC requirements for arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)

* Functionality subject to inverter model and firmware version



solaredge

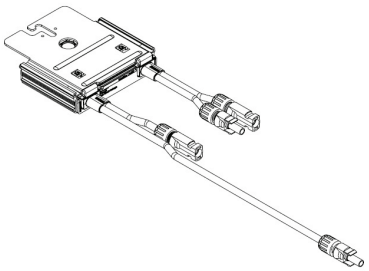
# / Power Optimizer
## For North America
### S440

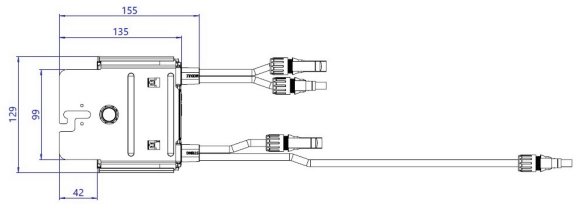
| | S440 | Unit |
|---|---|---|
| **INPUT** | | |
| Rated Input DC Power(1) | 440 | W |
| Absolute Maximum Input Voltage (Voc) | 60 | Vdc |
| MPPT Operating Range | 8 - 60 | Vdc |
| Maximum Short Circuit Current (Isc) of Connected PV Module | 14.5 | Adc |
| Maximum Efficiency | 99.5 | % |
| Weighted Efficiency | 98.6 | % |
| Overvoltage Category | II | |
| **OUTPUT DURING OPERATION** | | |
| Maximum Output Current | 15 | Adc |
| Maximum Output Voltage | 60 | Vdc |
| **OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)** | | |
| Safety Output Voltage per Power Optimizer | 1 | Vdc |
| **STANDARD COMPLIANCE** | | |
| Photovoltaic Rapid Shutdown System | NEC 2014, 2017 & 2020 | |
| EMC | FCC Part 15 Class B, IEC61000-6-2, IEC61000-6-3 | |
| Safety | IEC62109-1 (class II safety), UL1741 | |
| Material | UL94 V-0, UV Resistant | |
| 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 155 x 30 / 5.07 x 6.10 x 1.18 | mm / in |
| Weight (including cables) | 655 / 1.5 | gr / lb |
| Input Connector | MC4(2) | |
| Input Wire Length | 0.1 / 0.32 | m / ft |
| Output Connector | MC4 | |
| Output Wire Length | (+) 2.3, (-) 0.10 / (+) 7.54, (-) 0.32 | m / ft |
| Operating Temperature Range(3) | -40 to +85 | ˚C |
| Protection Rating | IP68 / NEMA6P | |
| Relative Humidity | 0 - 100 | % |

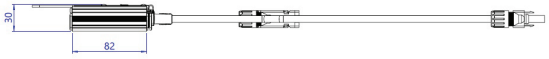
(1) Rated power of the module at STC will not exceed the Power Optimizer Rated Input DC Power. Modules with up to +5% power tolerance are allowed
(2) For other connector types please contact SolarEdge
(3) For ambient temperature above +70°C / +158°F power de-rating is applied. Refer to Power Optimizers Temperature De-Rating Technical Note for more details

| PV System Design Using a SolarEdge Inverter | | Single Phase HD-Wave | Three Phase 208V Grid | Three Phase for 277/480V Grid | |
|---|---|---|---|---|---|
| Minimum String Length (Power Optimizers) | S440 | 8 | 10 | 18 | |
| Maximum String Length (Power Optimizers) | | 25 | | 50(4) | |
| Maximum Nominal Power per String(5) | | 5700 (6000 with SE7600-US - SE11400-US) | 6000(6) | 12750(7) | W |
| Parallel Strings of Different Lengths or Orientations | | Yes | | | |

(4) A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement
(5) 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
(6) For the 208V grid: it is allowed to install up to 7,800W per string, two minimum string count are required and up to 7,200W without minimum string count. The maximum power difference between each string is 1,000W
(7) For the 277/480V grid: it is allowed to install up to 15,000W per string when the maximum power difference between each string is 2,000W
(8) It is not allowed to mix S-series and P-series Power Optimizers in new installations








Intertek RoHS

# Three Phase Inverters for the 120/208V Grid

## for North America

SE9KUS

INVERTERS


12-20 YEAR WARRANTY

## 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, 2017 and 2020, 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



solaredge

# / Three Phase Inverters for the 120/208V Grid[1] for North America

## SE9KUS

| APPLICABLE TO INVERTERS WITH PART NUMBER | SEXXK-XXXXXBXX4 | |
|---|---|---|
| MODEL NUMBER | SE9KUS | |
| **OUTPUT** | | |
| Rated AC Power Output | 9000 | VA |
| Maximum AC Power Output | 9000 | VA |
| Output Line Connections | 3 phase, 3-wire / PE (L1-L2-L3), TN, TT<br>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 | A |
| GFDI Threshold | 1 | A |
| Utility Monitoring, Islanding Protection, Country Configurable Set Points | Yes | |
| THD | ≤ 3 | % |
| **INPUT** | | |
| Maximum DC Power (Module STC) | 12150 | W |
| Transformer-less, Ungrounded | Yes | |
| Maximum Input Voltage DC to Gnd | 250 | Vdc |
| Maximum Input Voltage DC+ to DC- | 500 | Vdc |
| Nominal Input Voltage DC to Gnd | 200 | Vdc |
| Nominal Input Voltage DC+ to DC- | 400 | Vdc |
| Maximum Input Current | 26.5 | Adc |
| Maximum Input Short Circuit Current | 45 | Adc |
| Reverse-Polarity Protection | Yes | |
| Ground-Fault Isolation Detection | 1MΩ Sensitivity[3] | |
| CEC Weighted Efficiency | 96.5 | % |
| Night-time Power Consumption | < 3 | 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, 2017 and 2020 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[4] | 2 pairs | |
| 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



CE