

City of Ypsilanti Fire Station
50kW Solar installation
525 W Michigan Ave



Power Demands at the Fire Station

January DTE bill, 8560kWh for 31 days. Average per day usage for January is (8560kWh/31) 276kWh per day. Ypsilanti get 4 hours of peak sun per day on average, so we need approximately (276kWh/4hr) 69 kW of solar panels to be 100% solar powered based on January's energy usage.

For Service at 525 W Michigan Ave, Ypsilanti, MI

DTE Electric Company Business Electric Service - Demand Pricing

Current Charges

Power Supply Charges:

Power Supply Demand Charge	19	KW @ 12.90	245.10
1st 200 Hours use of Demand	3800	KWH @ 0.04396	167.05
Excess kWh	4760	KWH @ 0.03396	161.65
Other Power Supply Surcharges*			-1.71

Delivery Charges:

Service Charge			13.67
Distribution Demand Charge	19	KW @ 8.99	170.81
LIEAF Factor			0.98
Energy Optimization			30.39
Other Delivery Surcharges**			5.78

Total DTE Electric Company Current Charges 793.72

Current Billing Information

Service Period	Dec 28, 2015 - Jan 28, 2016
Days Billed	31
Meter Number	8187359 18
Meter Reading	4481 Actual - 4588 Actual
Difference	107
Multiplier	80
KWH Used	8560
Max kW Demand	19
Your next scheduled meter read date is on or around FEB 29, 2016	

Usage History - Average per day

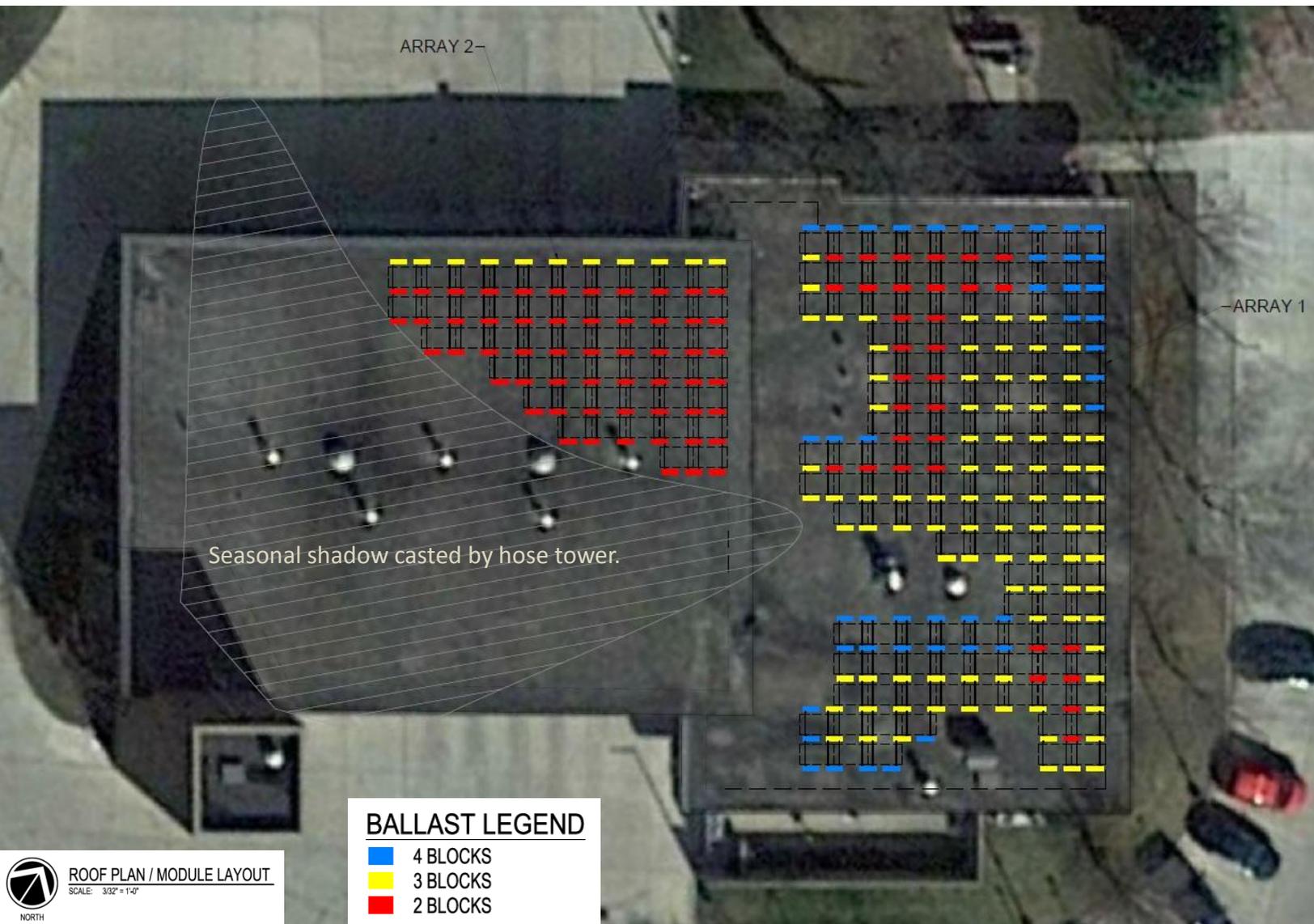
	Current Month	Last Month	Year Ago
KWH Usage	276	278	306
Change		0%	-9%

Total Current Charges

793.72

Solar Panel Layout for the Fire Station

The proposed solution would have 176 285-watt SolarWorld panels mounted on a AET Rayport-B Eco rack. The rack will be ballasted to the roof using a total of 651 32# concrete blocks. The quantity and locations of the block can be seen in the diagram below. The solar installation would provide $(176 \times 285W)$ approximately 50kW of maximum power or about 72% of the fire stations power needs. This is the maximum number of solar panels that will fit on this roof without any shading. More panels could be add but at a lower efficiency due to intermittent shade. The dead load on the lower roof (array 1) is 6.7#/sq.ft. and 5.46#/sq.ft. on the upper roof (array 2)



Solar Panel Electrical Layout for the Fire Station

SolarEdge optimizers and inverters will be used to connect and convert the power from the solar panels to the building's electrical system. The project will use the 88 SolarEdge 600W/96V optimizers wires two panels to each optimizer. This will allow the public to monitor the power generated on the roof of the first station panel by panel. This make it easy to spot any malfunctioning hardware or shading of the panels. The power from the optimizers will go to the back of the fire station and down an outside wall to a pair of SolarEdge 20kW grid-tied inverters to convert the power from direct current to 480 volt 3-phase alternating current. From the inverters the power will be connected to the building's electrical system.

An internet connect will be needed for the SolarEdge gateway to send the optimizer's data to their web portal. This will feed the data for a Ypsilanti Fire Station page on the SolarEdge website that can be view by the public.

Solar Installation Cost

	Quantity	Price	Total
SolarWorld 285-watt solar panels	176	\$279.30	49,156.80
SolarEdge 600W/96V optimizers	88	\$74.89	6,590.32
SolarEdge 20kW inverters	2	\$1403.65	2,807.30
SolarEdge monitoring hardware	1	\$217.00	217.00
AET Rayport-B racking for 176 panels	1	\$9652.00	9,652.00
AET SolarEdge optimizer mounting kit	88	\$5.85	514.80
16"x8"x4" 32# concrete blocks(HomeDepot)	651	\$1.08	703.08
10 gage THHN wire 500' spool red/black/green	3	\$80.97	242.91
Conduit 10' lengths	30	\$2.30	69.00
Conduit couplers, elbow, Jboxes, etc	1	\$50.00	50.00
5/8"x8' Grounding rod(HomeDepot)	3	\$11.28	33.84
Solid 6 gage grounding wire(HomeDepot)	500'	\$296.00	296.00
5/8 in. Ground Rod Clamp(HomeDepot)	3	\$2.18	6.54
Disconnects integrated in inverters	0	\$0.00	0.00
Building permits/DTE application	1	\$100	100.00
Labor - rack/panel/optimizers installation	80man/hr	\$0.00	0.00
Labor - Inverter/elec. (lic. electrician)	1	\$1000.00	1000.00
Equipment rental ladders/lifts (donated)	0	\$0.00	0.00
Solar contractor project management	1	\$1000.00	1000.00

Total			\$72,439.59
Dollars/watt	(\$72.439.59/ (176*285W))		\$1.44/watt

Assuming volunteer labor for rack/panel/optimizer installation.
 Assuming no tax and delivery is included.

McNaughton-McKay Electric
50,160w Ypsilanti Fire Department w/ SolarEdge

2/1/2016

	<u>Qty</u>	<u>McMc Part Number</u>	<u>Description</u>	<u>Price Ea.</u>	<u>Price Ext.</u>	
Modules	176	SLWSW285MONO4.0	SolarWorld 285W Monocrystalline Module 4.0 / 33mm Frame	\$ 279.30	\$ 49,156.80	
			SolarEdge Optimizer / Inverter (Monitoring INCLUDED)		\$ -	
Inverter	88	SQXP6002NM4ARL	Optimizer 600W/96V Input (2-1, 60 cell ONLY, 3 Phase) (Qty 1 - 174)	\$ 74.89	\$ 6,590.32	INVERTER
	2	SQXSE20KUS480US	20.0 KW, 3PH Grid Tied Inverter, ETL Listed, 480 Vac (Qty 1 - 4)	\$ 1,403.65	\$ 2,807.30	\$ 9,397.62
		SQXSE1000ZBGWKNA	OPTION: Wireless Zigbee to Ethernet Interface; Gateway;Antenna	\$ 217.00	\$ -	
			AET RayPort B ECO- Ballasted			
	1	MCMXAET16967901REVO	AET 176 Panel B-ECO per Quote 16-9679-01 Rev 0	\$ 9,652.00	\$ 9,652.00	
	88	AET81068	MicroInverter/Optimizer Mounting Kit w/Ground for ECO Ballasted	\$ 5.85	\$ 514.80	
				Total	\$ 68,721.22	
				Watts	50160	
				Price / Watt	\$ 1.37	
			Ballasted Racking based on: AET ballasted x degree racking 10 Degree Slope X Rows X X Columns xPSF / xMPH Wind / Category B PE Stamped Drawings NOT Included OPTIONS: PE Stamped Drawing - \$850.00 Rail Alignment Fixture - \$75.00 Installation Spacer Bar - \$450.00 MicroInverter/Optimizer Mounting Kit w/Ground for ECO Ballasted - \$5.85 Ea			
			Price valid for 60 days All Freight to Ypsilanti, MI Included Price shown does NOT include tax, if applicable Unless otherwise noted, McMc Standard Terms & Conditions apply			
			IMPORTANT NOTES			
			1. The SolarWorld SunFix Racking is only rated for 50psf snow loads. Some areas in your region may be 60psf+. The customer must verify with their local AHJ that the snow load does not exceed 50psf. Please advise if it does & alternate racking can be quoted. 2. OUTDOOR MOUNTING OF SOLAREEDGE INVERTERS SolarEdge US Inverters (quoted) have a minimum outdoor temperature rating of (-)13 Degrees F SolarEdge CA Inverters are available with a (-)40 Degree F rating The customer must verify with their local AHJ that the minimum temperature does not exceed (-)13 Degrees F			

Rayport B-Eco - 10 Degree Ballast Design
Based on ASCE7-05



Project	Ypsilanti Fire Station		AET Project No.	16-9679-01	Date	January 28, 2016	
Customer	McNaughton - McKay Electric Co.		Contact	-	Phone	.	
Project Address	525 W Michigan Ave Ypsilanti, MI 48197		Wind Speed (mph)	90.0	Building Height (ft)	25.0	
Site Condition	No Topographical Features		Exposure Category	B	Module Tilt Angle	10.0	
			Importance Factor per ASCE7-05 Section 6.5.5	1.00			
Module Manufacturer	SolarWorld	Model Number	Sunmodule Plus SW 285 mono (Output Rating (watts))	285	Module Weight (lbs)	39.70	
Module Length (in)	65.94	Module Width (in)	39.41	Module Height (in)	1.30	Module Area (sf)	18.05

V	K_d	K_z	K_{zt}	I	q
90	0.85	0.70	1.00	1.00	12.34

Per Module				Average			
Max Pressure	Min Pressure	Max Load	Min Load	W _{sur} /Module	Blocks/Module	Modules/Bolt	Modules/Lag
13.1	2.3	237.1	41.4	96.7	3.02	N/A	N/A

System BOM

Array 1			
Components	Qty	Wt.	Total
Modules	127	39.7	5,042
Rails	254	4.8	1,219
Trays	165	5.6	924
Clamps / Screws	508	0.20	102
Ballast Bricks	506	32.0	16,192
Roof Penetration	0	4.0	0
Total System Dead Load (lbs)			23,478
Area - ft²			3,504
Pounds per Square Foot			6.70

Array 2			
Components	Qty	Wt.	Total
Modules	49	39.7	1,945
Rails	98	4.8	470
Trays	67	5.6	375
Clamps / Screws	196	0.20	39
Ballast Bricks	145	32.0	4,640
Roof Penetration	0	4.0	0
Total System Dead Load (lbs)			7,470
Area - ft²			1,369
Pounds per Square Foot			5.46



BILL OF MATERIALS

Quote Date: 1/28/2016

Confidential

AET Information					
Quote #	Drawing #	Account Manager	Phone	Email	Website
16-9679-01 Rev 0	16-9679-01 Rev 0	Alex Idziak	(419) 654-1067	aidziak@aetenergy.com	www.aetenergy.com

Project Information				
Project Name			Site Address	
Ypsilanti Fire Station			525 W Michigan Ave, Ypsilanti, MI 48197	
Racking System	Tilt Angle (deg)	Wind Speed	Exposure Category	Ground Snow Load
Rayport-B Eco	10	90mph ASCE 7-05 / IBC 2009	B	PSF

Customer Information			
Company	Contact	Phone	Email
McNaughton - McKay Electric Co.			

Panel Information		
Panel	Actual Qty.	Actual Wattage
SolarWorld Sunmodule Plus SW 285 mono (33mm) - 1675mm x 1001mm x 33mm @ 285W	176	50,160
Totals	176	50,160

Bill Of Materials				
Part #	Part Description	Required Qty.	Extra Qty.	Total Qty.
81277	Ballast Tray Assy	232	2	234
81312	Side Rail Assy - Folding	352	4	356
81170-33/34	Z-Bracket	704	7	711
81198	Nut - Rectangle	704	7	711
81196	Flange Bolt - 1x16	2,112	21	2,133
81255	Fixture - Rail Alignment 10 Deg Std	1	0	1



Rayport-B Eco Ballasted Roof



Rayport-G Eco Ground Mount



Rayport-P Pitched Roof



Rayport-I Inverter Rack

Sunmodule[®] Plus

SW 285 MONO



TUV Power controlled:
Lowest measuring tolerance in industry



Every component is tested to meet
3 times IEC requirements



Designed to withstand heavy
accumulations of snow and ice



Sunmodule Plus:
Positive performance tolerance



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



Glass with anti-reflective coating



World-class quality

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

SolarWorld Plus-Sorting

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

25-year linear performance guarantee and extension of product warranty to 10 years

SolarWorld guarantees a maximum performance degradation of 0.7% p.a. in the course of 25 years, a significant added value compared to the two-phase warranties common in the industry. In addition, SolarWorld is offering a product warranty, which has been extended to 10 years.*

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



Sunmodule[®] Plus

SW 285 MONO



PERFORMANCE UNDER STANDARD TEST CONDITIONS (STC)*

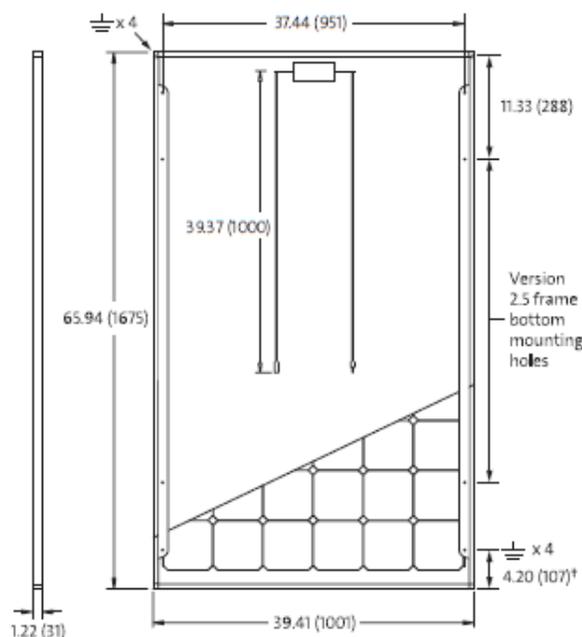
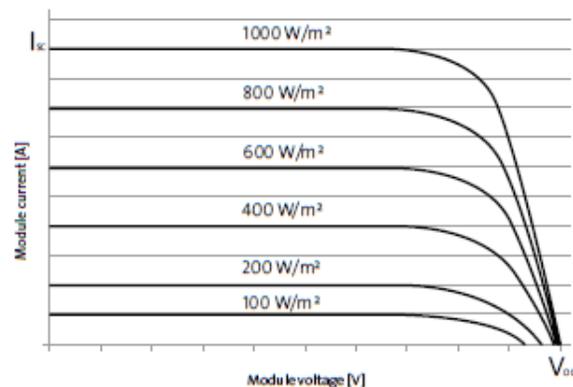
Maximum power	P_{max}	285 Wp
Open circuit voltage	V_{oc}	39.7 V
Maximum power point voltage	V_{mpp}	31.3 V
Short circuit current	I_{sc}	9.84 A
Maximum power point current	I_{mpp}	9.20 A
Module efficiency	η_m	17.0 %

* STC: 1000 W/m², 25°C, AM 1.5

†) Measuring tolerance (P_{max}) traceable to TÜV Rheinland: +/- 2% (TÜV Power Controlled).

THERMAL CHARACTERISTICS

NOCT	46 °C
TC I_{sc}	0.04 %/°C
TC V_{oc}	-0.30 %/°C
TC P_{mpp}	-0.41 %/°C
Operating temperature	-40°C to 85°C



PERFORMANCE AT 800 W/m², NOCT, AM 1.5

Maximum power	P_{max}	213.1 Wp
Open circuit voltage	V_{oc}	36.4 V
Maximum power point voltage	V_{mpp}	28.7 V
Short circuit current	I_{sc}	7.96 A
Maximum power point current	I_{mpp}	7.43 A

Minor reduction in efficiency under partial load conditions at 25°C: at 200 W/m², 100% (+/-2%) of the STC efficiency (1000 W/m²) is achieved.

COMPONENT MATERIALS

Cells per module	60
Cell type	Mono crystalline
Cell dimensions	6.17 in x 6.17 in (156.75 x 156.75 mm)
Front	Tempered glass (EN 12150)
Frame	Clear anodized aluminum
Weight	39.5 lbs (17.9 kg)

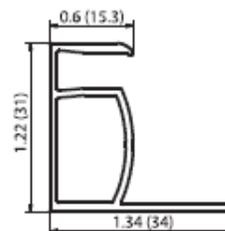
SYSTEM INTEGRATION PARAMETERS

Maximum system voltage SC II / NEC	1000 V	
Maximum reverse current	25 A	
Number of bypass diodes	3	
Design Loads*	Two rail system	113 psf downward 64 psf upward
Design Loads*	Three rail system	170 psf downward 71 psf upward
Design Loads*	Edge mounting	30 psf downward 30 psf upward

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

ADDITIONAL DATA

Power sorting†	-0 Wp / +5 Wp
J-Box	IP65
Module leads	PV wire per UL4703 with H4 connectors
Module type (UL 1703)	1
Glass	Low iron tempered with ARC



VERSION 2.5 FRAME

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



SolarEdge Three Phase Inverters for the 277/480V Grid for North America

SE10KUS / SE20KUS / SE33.3KUS



INVERTERS

The best choice for SolarEdge enabled systems

- Integrated arc fault protection for NEC 2011 690.11
- Rapid shutdown for NEC 2014 690.12
- Superior efficiency (98.5%)
- Outdoor and indoor installation
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- Small, lightweight and easy to install on provided bracket
- Fixed voltage inverter, DC/AC conversion only
- Integrated Safety Switch and DC fuses (plus & minus)



Three Phase Inverters for the 277/480V Grid for North America

SE10KUS / SE20KUS / SE33.3KUS⁽¹⁾

	SE10KUS	SE20KUS	SE33.3KUS	
OUTPUT				
Rated AC Power Output	10000	20000	33300	VA
Maximum AC Power Output	10000	20000	33300	VA
AC Output Line Connections	4-wire WYE (L1-L2-L3-N) plus PE			
AC Output Voltage Minimum-Nominal-Maximum ⁽²⁾ (L-N)	244-277-305			Vac
AC Output Voltage Minimum-Nominal-Maximum ⁽²⁾ (L-L)	422.5-480-529			Vac
AC Frequency Min-Nom-Max ⁽²⁾	59.3 - 60 - 60.5			Hz
Max. Continuous Output Current (per Phase)	12	24	40	A
GFDI Threshold	1			A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes			
INPUT				
Maximum DC Power (Module STC)	13500	27000	45000	W
Transformer-less, Ungrounded	Yes			
Maximum Input Voltage DC to Gnd	490			Vdc
Maximum Input Voltage DC+ to DC-	980			Vdc
Nominal Input Voltage DC to Gnd	425			Vdc
Nominal Input Voltage DC+ to DC-	850			Vdc
Maximum Input Current	13.5	26.5	40	Adc
Max. Input Short Circuit Current	45			Adc
Reverse-Polarity Protection	Yes			
Ground-Fault Isolation Detection	1MΩ Sensitivity			
CEC Weighted Efficiency	98		98.5	%
Night-time Power Consumption	< 3		< 4	W
ADDITIONAL FEATURES				
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional)			
Rapid Shutdown – NEC 2014 690.12	With installation of rapid shutdown kit ⁽³⁾			
STANDARD COMPLIANCE				
Safety	UL1741, UL1699B, UL1998, CSA 22.2			
Grid Connection Standards	IEEE1547			
Emissions	FCC part 15 class B			
INSTALLATION SPECIFICATIONS				
AC output conduit size / AWG range	3/4" minimum / 12-6 AWG			
DC input conduit size / AWG range	3/4" minimum / 12-6 AWG			
Number of DC inputs	2 pairs	3 pairs (with fuses on plus & minus) ⁽⁴⁾		
Dimensions (HxWxD)	21 x 12.5 x 10.5 / 540 x 315 x 260			in/mm
Dimensions with Safety Switch (HxWxD)	30.5 x 12.5 x 10.5 / 775 x 315 x 260			in/mm
Weight	73.2 / 33.2	99.5 / 45		lb/kg
Weight with Safety Switch	79.7 / 36.2	106 / 48		lb/kg
Cooling	Fans (user replaceable)			
Noise	< 50	< 55		dB(A)
Operating Temperature Range	-40 to +140 / -40 to +60			"F"/°C
Protection Rating	NEMA 3R			

⁽¹⁾ For 208V inverters refer to: <http://www.solaredge.com/files/pdfs/products/inverters/se-three-phase-us-inverter-208V-datasheet.pdf>

⁽²⁾ For other regional settings please contact SolarEdge support.

⁽³⁾ Rapid shutdown kit P/N: contact SolarEdge.

⁽⁴⁾ Field replacement kit for 1 pair of inputs P/N: DCD-3PH-1TBK.



RoHS



SolarEdge Power Optimizer

Module Add-On for Commercial Installations
for North America OP600-96V

POWER OPTIMIZER



PV power optimization at the module-level
The most cost effective solution for commercial and large field installations

- Up to 25% more energy
- Superior efficiency (99.5%)
- Balance of System cost reduction
- Next generation maintenance with module-level monitoring
- Module-level voltage shutdown for installer and firefighter safety
- Use with 2 x 60-cell PV modules connected in series
- Compatible with three phase SolarEdge inverters



SolarEdge Power Optimizer Module Add-On

For Commercial Installations for North America OP600-96V

		OP600-96V	
INPUT			
Rated Input DC Power*		600	W
Absolute Maximum Input Voltage (Voc)		96	Vdc
MPPT Operating Range		12.5 - 80	Vdc
Maximum Short Circuit Current (Isc) of connected PV Module		10	Adc
Maximum DC Input Current		12.5	Adc
Maximum Efficiency		99.5	%
Weighted Efficiency		98.6	%
Overvoltage Category		II	
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING INVERTER)			
Maximum Output Current		15	Adc
Operating Output Voltage		10 - 85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)			
Safety Output Voltage per Power Optimizer		1	Vdc
STANDARD COMPLIANCE			
EMC		FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3	
Safety		IEC62109-1 (class II safety), UL1741	
Material		UL-94 (5-VA), UV Resistant	
RoHS		Yes	
INSTALLATION SPECIFICATIONS			
Maximum Allowed System Voltage		1000	Vdc
Dimensions (W x L x H)		143 x 210 x 45 / 5.63 x 8.26 x 1.75	mm / in
Weight		450 / 1.0	gr / lb
Input Connector		MC4 / Tyco / H+S / Amphenol – H4	
Output Wire Type		Double insulated; 6mm ² ; Amphenol – H4	
Output Wire Length		1.8 / 5.9	m / ft
Operating Temperature Range		-40 - +65 / -40 - +150	
Protection Rating		IP65 / NEMA4	
Relative Humidity		0 - 100	%
* Rated combined STC power of 2 modules connected in series. Module of up to +5% power tolerance allowed.			
PV SYSTEM DESIGN USING A SOLAREEDGE INVERTER**		THREE PHASE 208V	THREE PHASE 480V
Compatible SolarEdge Inverters		Three phase inverters	
Minimum String Length	Power optimizers	8	14
	PV modules	16	28
Maximum String Length	Power optimizers	15	30
	PV modules	30	60
Maximum Power per String		6000	12750
Parallel Strings of Different Lengths or Orientations		Yes	

** Installation of OP600-96V with OP250/OP300/OP400 in the same string is not allowed.





RAYPORT™ • B ROOF BALLAST SYSTEM

**Secure.
Convenient.
Simple.**

AET's Rayport-B™ ECO roof ballast system is constructed from galvanized steel and provides a functional, lightweight, durable and cost-effective roof top solution.



Fits most modules available



One common bolt for all joints



Panel clamps with integrated grounding



FAST INSTALLATION

- Industry-leading installation time
- Top-down assembly of PV modules
- Integrated fasteners allowing one common bolt for all joints
- Integrated panel grounding



COST-COMPETITIVE

- Once again, the industry price leader
- Available in a variety of configurations
- Improved shipping density to reduce costs



AET ENGINEERED

- Fully galvanized steel
- Wind tunnel tested to wind speeds in excess of 145mph (ASCE 7.10)
- UL 2703 listed
- 15-year limited warranty



AET CUSTOMER SERVICE

- Engineering support from conception to completion
- Full layout and loading analysis for every project
- Online and onsite installation training available

100% on time. 100% on budget. Zero warranty claims.

SPECIFICATIONS

Spacing: Adjustable down to 5 1.1"

Panel tilt: 5 or 10 degrees; others available on request

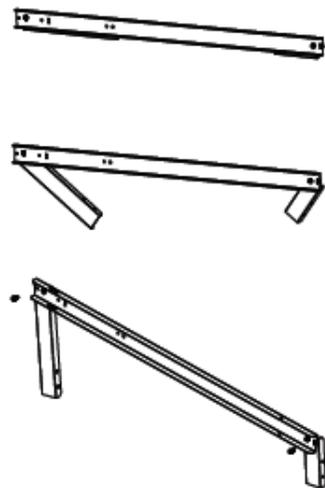
Module layout: Standard landscape configuration

Optional wind deflector available

Contact surface: EPDM

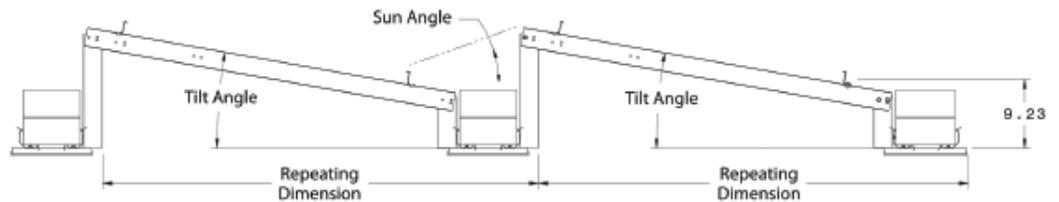
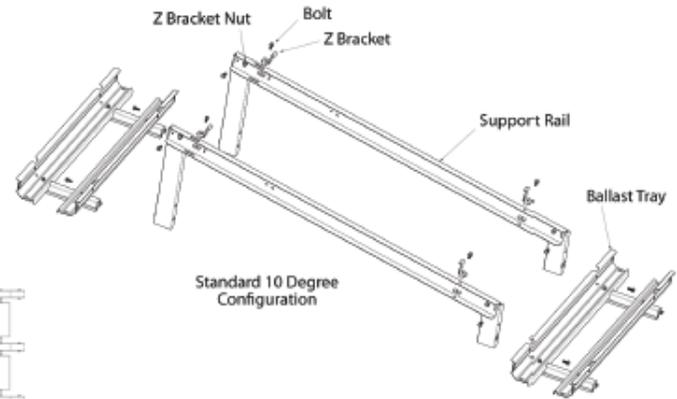
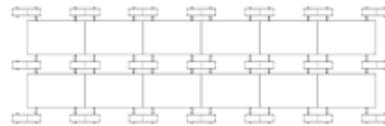
Grounding: Integrated into clamp

Can be shipped unassembled for additional savings



Improved ship density to reduce costs.

- Rails ship folded
- 2 bolts secure legs to build position
- Integrated fasteners for quick assembly



PARTS LIST

Part Name	Part Number	Tilt Angle	Standard	
			Rep Dim. (In.)	Sun Angle (In.)
Standard Parts				
Support Rail - Standard	81191	5 degree	55.50	11.9
Support Rail - Reduced Row	81193	5 degree	50.60	15.6
Support Rail - Standard	81192	10 deg ree	58.60	21.1
Support Rail - Reduced Row	81194	10 deg ree	54.90	25.7
Ballast Tray - Standard	81169			
Z-Bracket	81170-xx	Suffix (in millimeters) determined by module thickness.		
Z-Bracket Nut	81198			
Bolt	81196			
Fixture - Rail Alignment	81253/4/5/6	Based on Support rail used (5/SRR/10/10RR)		
Sizing Tool	80034	For panels 970mm - 1742mm		
Sizing Tool (large panels)	80168	For panels 1743mm - 2603mm		
Accessories				
Low Profile Hard Mount Bracket	81199	For hard mounts less than 1" tall. (Eco FASTER)		
Pad - Ballast Tray	80954-41250	4" x 12" x .50"		
Pad - Ballast Tray	80954-42050	4" x 20" x .50"		
Pad - Ballast Tray	80954-60650	6" x 16" x .50"		
Kit - Seismic Clip	TBD	For use in high seismic areas. 2 Kits per tray required.		
Kit - Wind Deflector	TBD			
Kit - Microinverter Bracket	TBD			

Custom racking option available for: Thin-film modules (minimum orders apply)
High leading-edge module applications