

# Stefan Graf Solar Installation

6.11 KW Ground Mount System



# System Summary

This system will consist of 26 Mage Powertec Plus 235-watt / pl 6 solar panels, a pair of 3000HF SunnyBoy inverters and a Schletter FS 2Vx13 ground mount rack.

This system will be preinstalled at the Ypsilanti Heritage Festival before it is install permanently at Stefan Graf's house.

## Contact/Shipping Information

The billing address for this project is

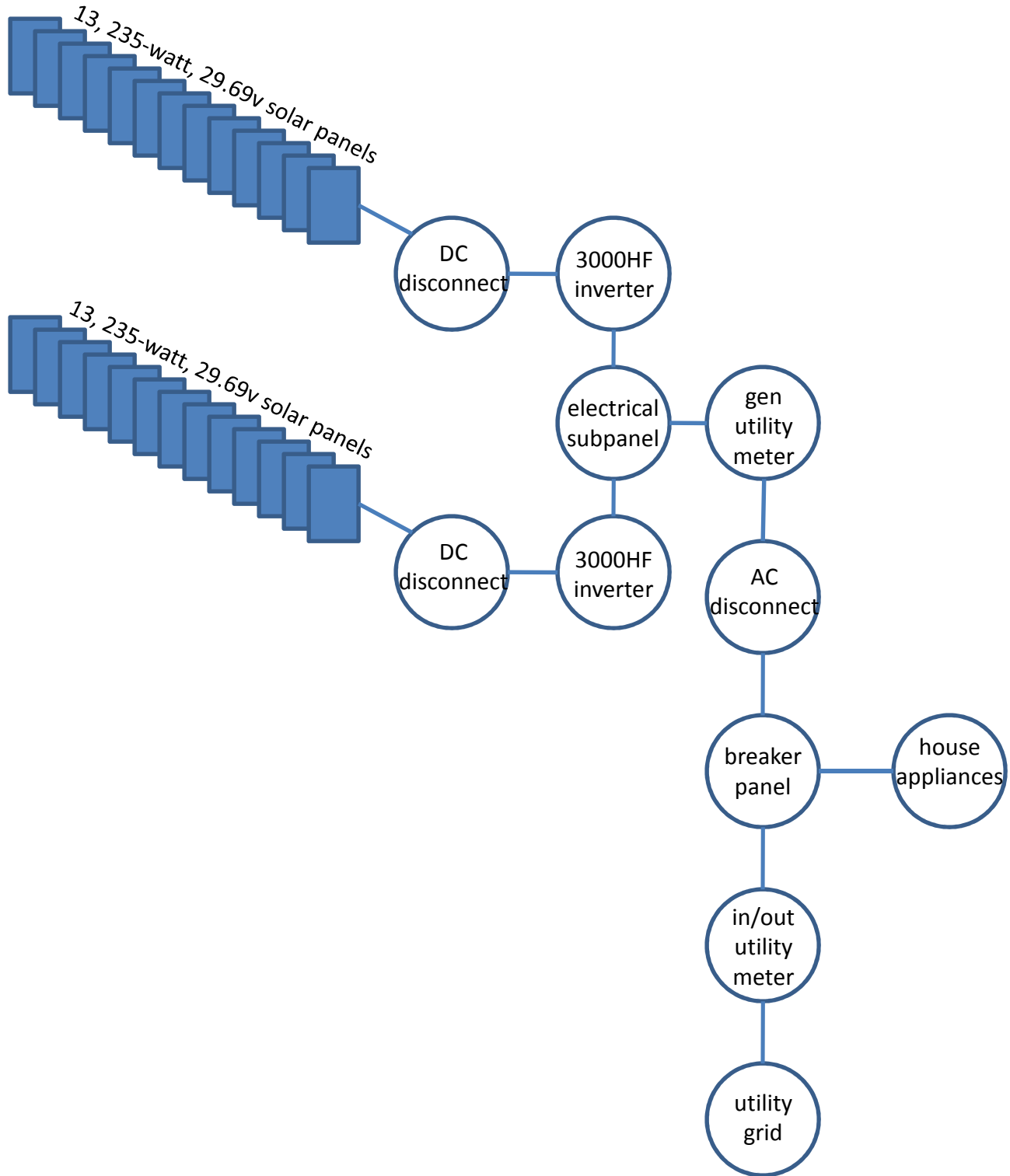
Stefan Graf  
6232 Munger Rd  
Ypsilanti, MI 48197  
Cell phone: 734-644-2804  
Email: stef.graf@comcast.net

The material should be shipped to Stefan's business, Fantasee Lighting in Belleville, where it will be stored until it is installed. This location has a loading dock and fork lifts for unloading material from a truck.

Stefan Graf c/o  
Fantasee Lighting Company  
14857 Martinsville Rd.  
Belleville, MI 48111

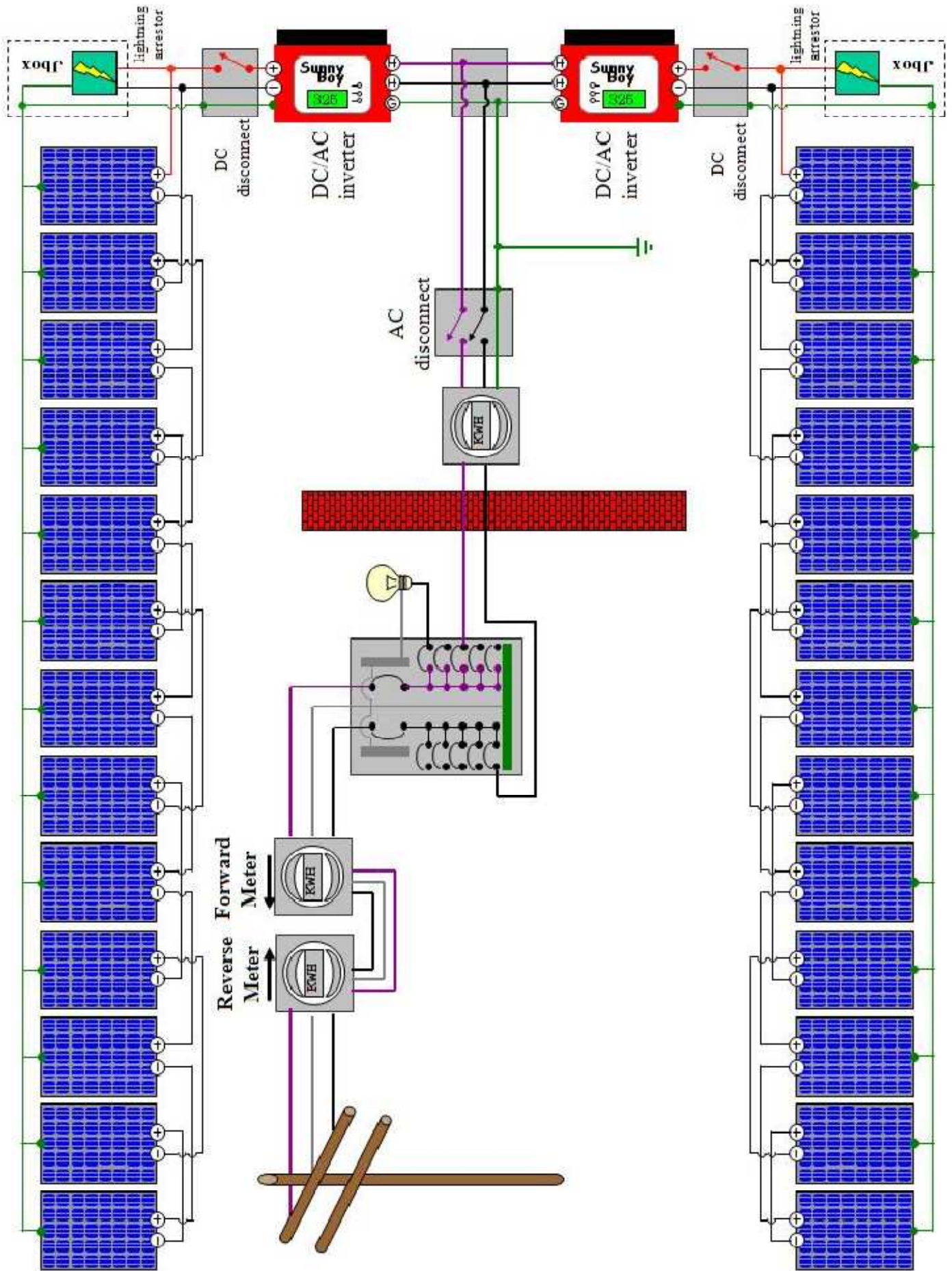
Prior to delivery, call 734-699-7200 and ask for Terry Cunningham to schedule delivery.

# System Line Diagram



The power at both Stefan Graf's house and the Riverside Park is single phase 220 volts.

# System Schematic

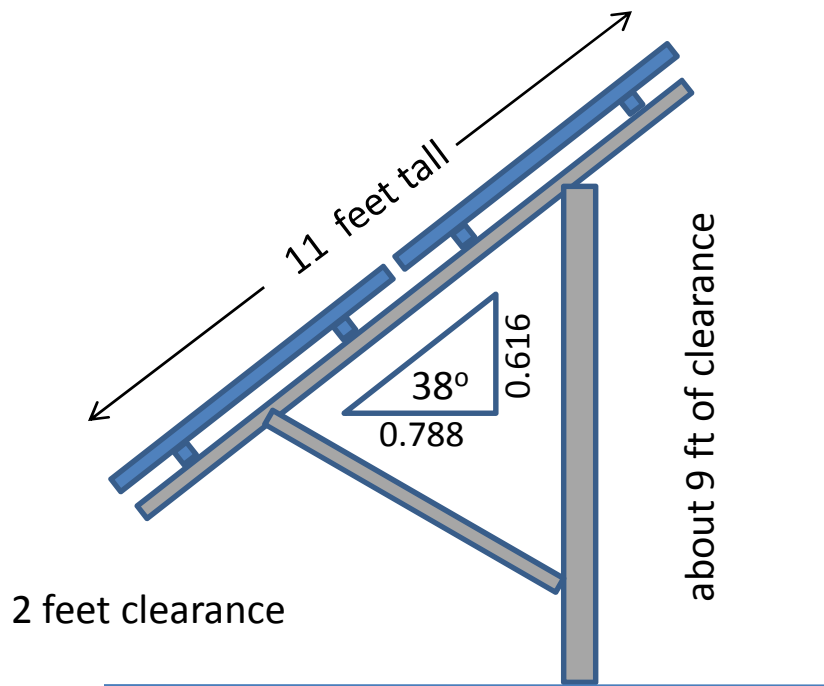
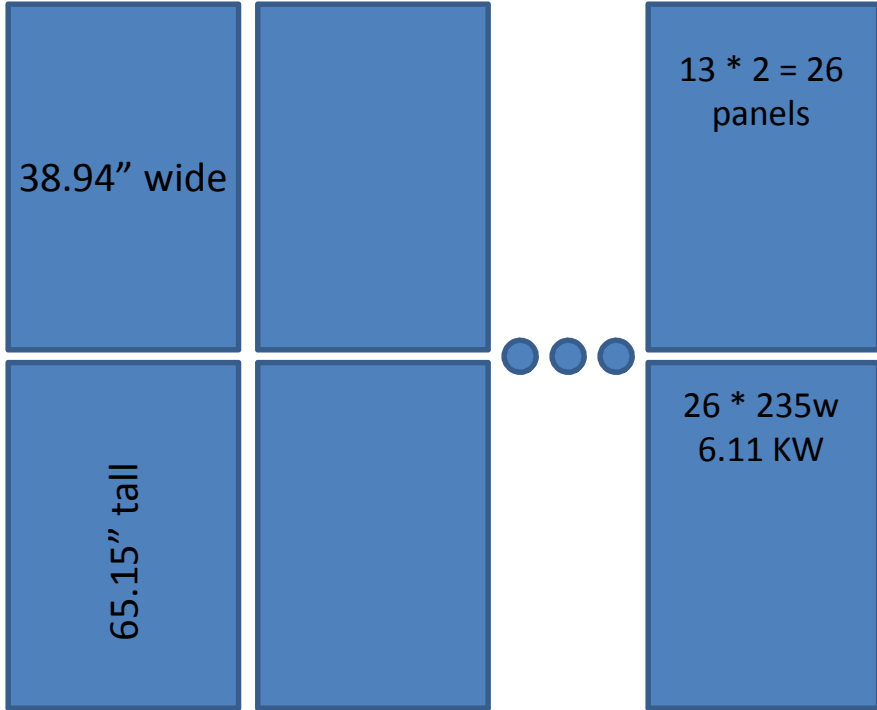


# System Parts List

Part	Quantity	\$/unit	Total
<b>Panels/Inverter</b>			
Mage Powertec Plus 235 /pl 6 solar panels	26		
SunnyBoy 3000hf inverter w/ DC disconnect	2		
S.U.R Energy quote			\$12,791.46
State sales tax			\$745.89
<b>Rack</b>			
Schletter FS-XX rack with top clamps	1	\$2991.83	\$ 2,991.83
Concrete 24"x8' Sonotube	5	\$69.52	\$ 347.60
Concrete 80# bags, 2/3 Cu ft 38'/footing	190	\$5.69	\$ 1,081.10
<b>Grounding</b>			
Grounding rod, needed to ground the rack	1	\$15.00	\$ 15.00
Grounding wire, 500 feet spool	1	\$200.00	\$ 200.00
Lighting arrestor, one for each string	2	\$60.00	\$ 120.00
<b>Wiring</b>			
Generation utility meter socket	1	\$50.00	\$ 50.00
AC disconnect	1	\$50.00	\$ 50.00
10 gage, THHN stranded wire (red) 500'	1	\$100.00	\$ 100.00
10 gage, THHN stranded wire (black) 500'	1	\$100.00	\$ 100.00
10 gage, THHN stranded wire (green) 550'	1	\$100.00	\$ 100.00
Conduit, conduit connectors 1"x10'	10	\$5.00	\$ 50.00
<b>Permits</b>			
Building permit	1	\$100.00	\$ 100.00
Electrical permit	1		
HDC permit		N/A	
DTE Energy co-generation permit	1	\$100.00	\$ 100.00
<b>Total</b>			\$18,942.88
30% Federal tax credit			\$(5,682.86)
Actual cost			\$13,260.02

# System Rack Drawing

← 13 panels \* (38.94+1)" = 43.3ft long →





# System Location (6232 Munger Rd)





# System Location (Riverside Park Heritage Festival)







# PHOTOVOLTAIC MODULES MAGE POWERTEC® PLUS 235 / 6 PL



Number of Cells: 60  
Solar Cell Type: polycrystalline  
Power class: 235 Wp  
Cell Efficiency: 17.4 %



## MAGE POWERTEC® PLUS

### More Power

MAGE POWERTEC® PLUS modules use a polycrystalline cell technology with a module efficiency of up to 14.4%.

Allowable tolerances of up to +5 watts guarantee maximum power without compromise. The nominal power is always obtained or even exceeded.

### More Quality

The 10-year product warranty far surpasses industry standards. MAGE POWERTEC® PLUS modules go far beyond competitors' standards with the added guarantee that they'll produce 90% of their nominal power for 12 years and 80% for 30 years. That is three full decades of reassurance.

Certifications according to the most rigorous North American and International standards guarantee maximum quality.

In addition, every MAGE POWERTEC® PLUS module passes rigorous optical, mechanical, and electrical quality controls.

### More Security

Due to their engineered hollow section frame and 3.2 mm (0.13 in) special solar glass, MAGE POWERTEC® PLUS modules meet maximum demands with regard to stability and corrosion resistance. The high-quality EVA foil allows ideal embedding of the solar cells, while the weatherproof foil on the back of the modules protects against humidity.

To avoid overheating of the individual solar cells (hot-spot effect), a junction box with bypass diodes is placed on the back of the module. In addition, the extremely robust modules resist a maximum pressure of 5,400 Pa/113 psf.

<b>+5</b>	WATTS POSITIVE TOLERANCES	<b>10</b>	YEAR PRODUCT WARRANTY	<b>12</b>	YEAR 90% POWER GUARANTEE	<b>30</b>	YEAR 80% POWER GUARANTEE
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MAGE SOLAR PROJECTS, INC.  
720 Industrial Boulevard  
Dublin, Georgia 31021 USA  
+1 (877) 311 6243 Toll-free  
+1 (478) 609 6640 Main Office  
+1 (478) 275 7685 Fax  
info@pagesolar.com  
www.pagesolar.com

MAGE GROUP



# PHOTOVOLTAIC MODULES

## MAGE POWERTEC® PLUS 235 / 6 PL

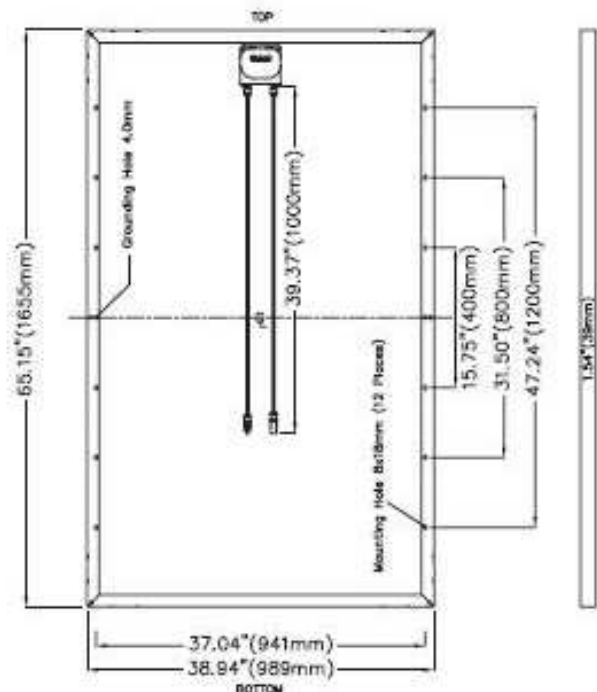
Electrical Characteristics*		235 / 6 PL
Maximum Power Rating	$P_{max}$ [Wp]	235
Tolerance of $P_{max}$	P [Wp]	-0/+5
Maximum Power Voltage of $P_{max}$	$U_{mp}$ [V]	29.69
Maximum Power Current $P_{max}$	$I_{mp}$ [A]	7.92
Short Circuit Current	$I_{sc}$ [A]	8.55
Open Circuit Voltage	$U_{oc}$ [V]	37.03
Maximum System Voltage	[V]	600
Maximum Series Fuse		15 A

\* STC @ 25° C, 1000 W/m², AM 1.5

Efficiency	235 / 6 PL
Cell [%]	17.4
Module [%]	14.4

Technical Facts	235 / 6 PL
Number of Cells (Matrix)	60 (6 x 10)
Solar Cell Type	polycrystalline
Solar Cell Size (mm)	156 x 156
Solar Cell Size (in)	6 x 6
Dimensions [L x W x H mm]	1655 x 989 x 39
Dimensions [L x W x H in]	65.15 x 38.94 x 1.54
Weight [kg]	19.6
Weight [lbs]	43.21

Thermal Characteristics		
235 / 6 PL		
NOCT	[°C]	+46 ±2
Temperature Coefficient	$\alpha_{Lc}$ [% / K]	+0.05
Temperature Coefficient	$\alpha_{Uoc}$ [% / K]	-0.32
Temperature Coefficient	$\alpha_{P_{max}}$ [% / K]	-0.43





# SUNNY BOY 2000HF-US / 2500HF-US / 3000HF-US

SB 2000HFUS-30 / SB 2500HFUS-30 / SB 3000HFUS-30



## High Yields

- Maximum efficiency 97.3%
- The best tracking efficiency with OptiTrac™ MPP tracking
- OptiCool™ active temperature management

## Safe

- Galvanic isolation
- Integrated DC switch-disconnect

## User-friendly

- Slim enclosure mounts in between wall studs
- Plug-in grounding with GFDI
- Reduced weight
- Quick and easy configuration thanks to Quick Module

## Informative

- Modern graphic display
- Bluetooth® technology

## SUNNY BOY 2000HF-US / 2500HF-US / 3000HF-US

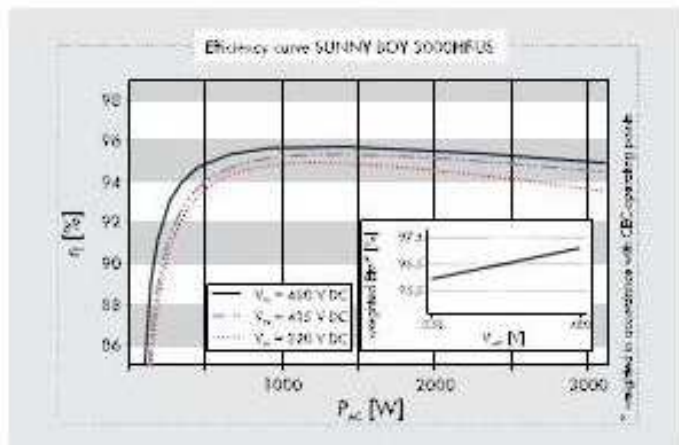
Easy installation, simple communication and maximum performance

The new Sunny Boy high frequency inverters are designed for projects requiring UL certification and represent the next step in innovative SMA technology. Featuring world-class efficiency, a slim-line enclosure and reduced weight, the Sunny Boy HF series of inverters can be mounted in between wall studs, making it perfect for new construction or space-constrained retrofits. Installation is made simple by automatic grid detection\*, field configuration for positive ground modules and a wide input voltage range of 175 to 600 V, which provides exceptional system design flexibility. The modern graphic display and wireless Bluetooth communication system provides a wealth of data in a user-friendly format.

\* US Patent US7352549B1



Technical data	Sunny Boy 2000HF-US		Sunny Boy 2500HF-US		Sunny Boy 3000HF-US	
	208 V AC	240 V AC	208 V AC	240 V AC	208 V AC	240 V AC
<b>Input (DC)</b>						
Max. recommended PV power (@ module STC)	2500 W		3125 W		3750 W	
Max. DC power (@ $\cos \phi = 1$ )	2200 W		2750 W		3300 W	
Max. DC voltage	600 V		600 V		600 V	
DC nominal voltage	480 V		480 V		480 V	
MPP voltage range	175 - 480 V		220 - 480 V		220 - 480 V	
Min. DC voltage / start voltage	175 V / 220 V		220 V / 220 V		220 V / 220 V	
Max. input current / per string	15 A / 15 A		15 A / 15 A		15 A / 15 A	
Number of MPP trackers / fused strings per MPP tracker	1 / 2 standard, extendable to 3					
<b>Output (AC)</b>						
AC nominal power	2000 W		2500 W		3000 W	
Max. AC apparent power	2000 VA		2500 VA		3000 VA	
Nominal AC voltage / adjustable	208 V / ● 240 V / ●		208 V / ● 240 V / ●		208 V / ● 240 V / ●	
AC voltage range	183 - 229 V 211 - 264 V		183 - 229 V 211 - 264 V		183 - 229 V 211 - 264 V	
AC grid frequency, range	60 Hz; 59.3 - 60.5 Hz		60 Hz; 59.3 - 60.5 Hz		60 Hz; 59.3 - 60.5 Hz	
Max. output current	9.6 A 8.3 A		12.0 A 10.4 A		14.4 A 12.5 A	
Power factor ( $\cos \phi$ )	1		1		1	
Phase conductors / connection phases	1 / 2		1 / 2		1 / 2	
Harmonics	< 4%		< 4%		< 4%	
<b>Efficiency</b>						
Max. efficiency	97.3%		96.9%		96.6%	
CEC efficiency	97.0%		96.5%		96.5%	
<b>Protection devices</b>						
DC reverse-polarity protection	●		●		●	
AC short circuit protection	●		●		●	
Galvanically isolated / all-pole sensitive monitoring unit	● / -		● / -		● / -	
Protection class / overvoltage category	I / III		I / III		I / III	
<b>General data</b>						
Dimensions (W / H / D) in mm (in)	348 / 727 / 183 (14 / 29 / 7) incl. DC Disconnect					
DC disconnect dimensions (W / H / D) in mm (in)	-					
Packing dimensions (W / H / D) in mm (in)	450 / 600 / 400 (18 / 24 / 16) incl. DC Disconnect					
DC disconnect packing dimensions (W / H / D) in mm (in)	-					
Weight / DC disconnect weight	approx. 23 kg (51 lb) incl. DC Disconnect					
Packing weight / DC disconnect packing weight	25 kg / 55 lb					
Operating temperature range (full power)	-25 °C ... +45 °C [-13 °F ... +113 °F]					
Noise emission (typical)	www.SMA-Solar.com		www.SMA-Solar.com		www.SMA-Solar.com	
Internal consumption at night	<1 W		<1 W		<1 W	
Topology	HF transformer		HF transformer		HF transformer	
Cooling concept	OptiCool		OptiCool		OptiCool	
Electronics protection rating / connection area	NEMA 3R / NEMA 3R		NEMA 3R / NEMA 3R		NEMA 3R / NEMA 3R	
<b>Features</b>						
Display: text line / graphic	- / ●		- / ●		- / ●	
Interfaces: RS485 / Bluetooth	○ / ●		○ / ●		○ / ●	
Warranty: 10 / 15 / 20 years	● / ○ / ○		● / ○ / ○		● / ○ / ○	
Certificates and permits (more available on request)	UL1741, UL1998, IEEE 1547, FCC Part 15 (Class A & B), CSA C22.2 No. 107.1-01					
Data at nominal conditions						
● Standard features ○ Optional features - Not available						
Type designation	SB 2000HFUS-30		SB 2500HFUS-30		SB 3000HFUS-30	



## Accessories



Flash Mount Kit for integration in wood-framed walls  
MOUNT KIT-104R



Quick Module RS485 + multifunction relay  
485QMUS-104R



Optional String Fuse Kit  
SB-SKFUS-104R

# Project Checklist



Salesperson:

Date:

Customer:

## Customer Contact Information

Contact Name:   
Street address:   
City:  State:   
Postal Code:   
E-mail:   
Telephone:   
Fax:

PE Stamp Requirements No. hard copies:

PE Structural Stamps Needed

## Hardcopy Mailing Address

Contact Name:   
Street address:   
City:  State:   
Postal Code:

Project Name:

Project Address (Owner of System)

Owner Name:   
Street address:   
City:  State:   
Postal Code:

## Material Delivery Information

Contact Name:   
Telephone:   
E-mail:   
Delivery address:   
City:  State:   
Postal Code:   
Country:

Special delivery instructions:

Total Project Size (kW):

*The following information is required for every type of project.*

Type of Site:   
Terrain Category:   
Importance Factor:    
Wind Load (mph):   
Ground Snow Load (psf):



Terrain Category D  
Plain, flat land near coastal areas.



Terrain Category C  
Single houses, open agricultural areas.



Terrain Category B  
Small cities, forests, or commercial areas.

Schletter is not responsible for specifying wind and snow load criteria. We recommend that you consult local building authorities for this information.

Please check the applicable box(es) for any legal compliance required for the project:

Buy American Act  American Recovery & Reinvestment Act of 2009  
 Other government funding

## Module Measurements and Configuration:

Height (mm):  Width (mm):   
Thickness (mm):  Weight (kg):   
Tilt Angle:  Orientation:

Module Manufacturer:   
Type of module:  Module power (W):   
String size:  Type of Rack:

Please include a PANEL LAYOUT DIAGRAM with checklist.



## Roof Mount

Roof Type:

Other Roof Type:

Roof Slope:

If Applicable:

Thickness (gauge) of sheet metal:

Building Height:

Type of Tile:

### Roof Framing and Composition:

Spacing:

Metal purlin thickness: (if Applicable)

Orientation:

Material type and dimension

Material:

Available dead load capacity of roof (psf):

Distance from top surface of structural beam to top surface of roofing material:

Describe other site or rack characteristics:

## Ground Mount

Type of site/soil:

Highly corrosive soils?

If Landfill:  Level and graded  Surface organic material

If yes, what depth (ft):

Water near surface (first 10 feet)?

Ground Clearance Requirements:

Site characteristics (grade, orientation, etc.):

Flat back yard

Describe other site characteristics (rocky terrain, ground cover, etc.):

grass ground cover

## Carport or Shade Structure

Carport Type:

Panel tilt angle:

Minimum spacing between supports (ft):

Maximum height of modules above ground (ft):

Desired spacing between supports (ft):

Describe other site or rack characteristics:

I'm assuming a 2 by 13 rack in portrait mode. This would make the rack about 40 feet long. I'll be using two Sunny Boy 3000HF inverters, each one tied to 13 panels.

Submit By Email

Print Form