

“Voor niks gaat de zon op”

**Kennismiddag Installatiejournaal**

*09-06-2022*

**Bouke van der Weerdt**

*Huawei Digital Power*



# Contents

1

Ontwerpen met string omvormers

2

Ontwerpen met optimizers

3

Ontwerpen met een EOS

# Design Tools!

Autodesign Parameter Setting

\* DC/AC:   Whether to choose the optimizer

\* Inverter Model:

- 全选
- SUN2000-8KTL
- SUN2000-12KTL
- SUN2000-17KTL
- SUN2000-20KTL
- SUN2000-33KTL-A
- SUN2000-36KTL
- SUN2000-60KTL-M0

- Met een Design Tool is het relatief eenvoudig om een installatie te ontwerpen en te simuleren.
- De opbrengstvoorspellingen zijn o.h.a. vrij betrouwbaar.
- Iedere top-5 omvormer leverancier heeft een eigen (gratis te gebruiken) Design Tool.
- Daarnaast zijn er ook onafhankelijke pakketten te verkrijgen, die in de regel nauwkeuriger zijn maar ook complexer in gebruik. (en vaak licenties nodig hebben)

Inverter Design Autodesign

Inverter Model:

**Detailed Data** In some extreme environments, such as low temperature, the inverter startup time may be affected. Total Input Power: 151.2000 kWp DC/AC: 1.26

	Max. DC Power	Startup Voltage	Normal PV Voltage	Max. DC Voltage	Max. DC Current
MPPT A	12.60 kWp	673.37 V <input checked="" type="checkbox"/>	747.40 V	982.26 V <input type="checkbox"/>	16.86 A <input checked="" type="checkbox"/>
MPPT B	12.60 kWp	673.37 V <input checked="" type="checkbox"/>	747.40 V	982.26 V <input type="checkbox"/>	16.86 A <input checked="" type="checkbox"/>
MPPT C	12.60 kWp	673.37 V <input checked="" type="checkbox"/>	747.40 V	982.26 V <input type="checkbox"/>	16.86 A <input checked="" type="checkbox"/>
Inverter		200 V		1000 V	23 A

# Stringlengte bepalen

$$V_{OP} = V_{OC} \times \left( V_{OC} \times \frac{\alpha}{100} \times (T_{OP} - T_{STC}) \right)$$

Paneelgegevens	Temperatuurgegeven	Omvormergegeven	Uitkomst
Hoogste $V_{OC}$	@ Minimale $T_{OP}$	Max. DC Spanning	Maximale String Lengte
Laagste $V_{MP}$	@ Maximale $T_{OP}$	Min. MPP Spanning	Minimale String Lengte
Optimale $V_{MP}$	@ Nominale $T_{OP}$	Nom. MPP Spanning	Optimale String Lengte

Bron: IEC 62548 Par. 7.2:

# Stringlengte bepalen

## ELECTRICAL DATA | STC\*

CS3K	315MS	320MS	325MS	330MS
Nominal Max. Power (Pmax)	315 W	320 W	325 W	330 W
Opt. Operating Voltage (Vmp)	33.1 V	33.3 V	33.5 V	33.7 V
Opt. Operating Current (Imp)	9.52 A	9.61 A	9.71 A	9.80 A
Open Circuit Voltage (Voc)	39.9 V	40.1 V	40.3 V	40.5 V
Short Circuit Current (Isc)	10.06 A	10.14 A	10.22 A	10.30 A
Module Efficiency	18.96%	19.26%	19.56%	19.86%
Operating Temperature	-40°C ~ +85°C			
Max. System Voltage	1500V (IEC/UL) or 1000V (IEC/UL)			
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)			
Max. Series Fuse Rating	30 A			
Application Classification	Class A			
Power Tolerance	0 ~ + 5 W			

\* Under Standard Test Conditions (STC) of irradiance of 1000 W/m<sup>2</sup>, spectrum AM 1.5 and cell temperature of 25°C.

Minimum temp in NL = -10°C

Max voltage on inverter  
=  
1000V

## TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.37 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	41 ± 3°C

$$40.3V \times 0,29\% = 0,116V / ^\circ C$$


$$0,116V \times 35^\circ C = 4,09V$$


$$40,3V + 4,09V = 44,39V$$

$$1000V / 44,39V = 22,5$$

*Maximaal 22 panelen in serie*

**NEW**









MBB SBB




\*Black frame product can be provided upon request.

**KuPower**  
HIGH EFFICIENCY MONO PERC MODULE  
CS3K-315 | 320 | 325 | 330MS  
(1000 V / 1500 V)

**MORE POWER**

-  Low power loss in cell connection
-  Low NMOT: 41 ± 3 °C  
Low temperature coefficient (Pmax): -0.37 % / °C
-  Better shading tolerance
-  High PTC rating of up to: 93.11 %

**MORE RELIABLE**


-  Lower hot spot temperature
-  Minimizes micro-cracks
-  Heavy snow load up to 6000 Pa,  
wind load up to 4000 Pa\*

**25 years** linear power output warranty

**10 years** product warranty on materials and workmanship

**MANAGEMENT SYSTEM CERTIFICATES**  
ISO 9001:2015 / Quality management system  
ISO 14001:2015 / Standards for environmental management system  
OHSAS 18001:2007 / International standards for occupational health & safety

**PRODUCT CERTIFICATES\***  
IEC 61215 / IEC 61730: VDE / CE / MCS / CEC / AU  
UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)  
UL 1703: CSA / IEC61701 ED2: VDE / IEC62716: VDE / IEC60068-2-68: SGS  
Take-away



\*We can provide this product with special BOM specifically certified with salt mist, ammonia and sand blasting tests. Please talk to our local technical sales representatives to get your customized solutions.

**CANADIAN SOLAR INC.** is committed to providing high quality solar products, solar system solutions and services to customers around the world. No. 1 module supplier for quality and performance/price ratio in IHS Module Customer Insight Survey. As a leading PV project developer and manufacturer of solar modules with over 30 GW deployed around the world since 2001.

\* For detailed information, please refer to the Installation Manual.

**CANADIAN SOLAR INC.**  
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

# Stringlengte bepalen

$$V_{OP} = V_{OC} \times \left( V_{OC} \times \frac{\alpha}{100} \times (T_{OP} - T_{STC}) \right)$$

Technical Specification	SUN2000-60KTL-M0
<b>Efficiency</b>	
Max. efficiency	98.9% @480 V; 98.7% @380 V / 400 V
European efficiency	98.7% @480 V; 98.5% @380 V / 400 V
<b>Input</b>	
Max. Input Voltage	1,100 V
Max. Current per MPPT	22 A
Max. Short Circuit Current per MPPT	30 A
Start Voltage	200 V
MPPT Operating Voltage Range	200 V ~ 1,000 V
Rated Input Voltage	600 V @380 Vac / 400 Vac; 720 V @480 Vac
Number of MPP trackers	6
Max. number of inputs	12

Max. String Lengte	$T_{OP} = -10^{\circ}\text{C}$	$V_{OC} = 44.4\text{V}$	22 panelen	$V_{MAX} = 976.6\text{V}$
Min. String Lengte	$T_{OP} = 55^{\circ}\text{C}$	$V_{MP} = 30.5\text{V}$	7 panelen	$V_{MIN} = 214.1\text{V}$
Opt. String Lengte	$T_{OP} = 45^{\circ}\text{C}$	$V_{MP} = 31.6\text{V}$	19 panelen	$V_{OPT} = 600.4\text{V}$

# String Plan Bepalen

1. Overschrijd nooit de maximale stringlengte
2. Alle strings op dezelfde MPPT moeten dezelfde lengte hebben (parallelschakeling)
3. Alle strings op dezelfde MPPT moeten dezelfde oriëntatie hebben
4. Bij omvormers met meerdere MPPTs kan je variëren met stringlengte en oriëntatie

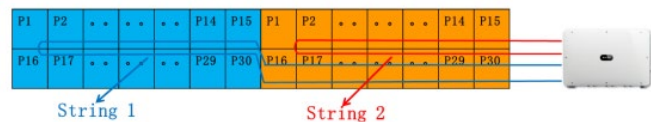
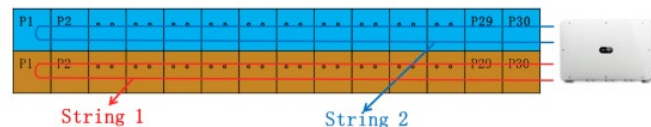


Figure 3.3 C type module wiring



Blok methode

Lange-Lijn methode



Haasje-Over methode

# Overdimensioneren

Overdimensioneren is een economische optimalisatie waarbij opbrengstverliezen worden afgewogen tegen lagere investeringskosten.

$$\text{RATIO} = P_{\text{DC,STC}} / P_{\text{AC,NOM}}$$

## ELECTRICAL DATA | STC\*

CS3K	315MS	320MS	325MS	330MS
Nominal Max. Power (Pmax)	315 W	320 W	325 W	330 W
Opt. Operating Voltage (Vmp)	33.1 V	33.3 V	33.5 V	33.7 V
Opt. Operating Current (Imp)	9.52 A	9.61 A	9.71 A	9.80 A
Open Circuit Voltage (Voc)	39.9 V	40.1 V	40.3 V	40.5 V
Short Circuit Current (Isc)	10.06 A	10.14 A	10.22 A	10.30 A
Module Efficiency	18.96%	19.26%	19.56%	19.86%
Operating Temperature	-40°C ~ +85°C			
Max. System Voltage	1500V (IEC/UL) or 1000V (IEC/UL)			
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)			
Max. Series Fuse Rating	30 A			
Application Classification	Class A			
Power Tolerance	0 ~ + 5 W			

\* Under Standard Test Conditions (STC) of irradiance of 1000 W/m<sup>2</sup>, spectrum AM 1.5 and cell temperature of 25°C.

Technical Specification	SUN2000-60KTL-M0
<b>Efficiency</b>	
Max. efficiency	98.9% @480 V; 98.7% @380 V / 400 V
European efficiency	98.7% @480 V; 98.5% @380 V / 400 V
<b>Input</b>	
Max. Input Voltage	1,100 V
Max. Current per MPPT	22 A
Max. Short Circuit Current per MPPT	30 A
Start Voltage	200 V
MPPT Operating Voltage Range	200 V ~ 1,000 V
Rated Input Voltage	600 V @380 Vac / 400 Vac; 720 V @480 Vac
Number of MPP trackers	6
Max. number of inputs	12

Regel: De gezamenlijke kortsluitstroom van de gecombineerde strings op 1 MPPT mag de maximale kortsluitwaarde van de omvormer niet overschrijden.





# Overdimensioneren

Voorbeeld 1:

3.3kWp / 3.0kVA, DC/AC = **1.1**

3239 kWh / jaar

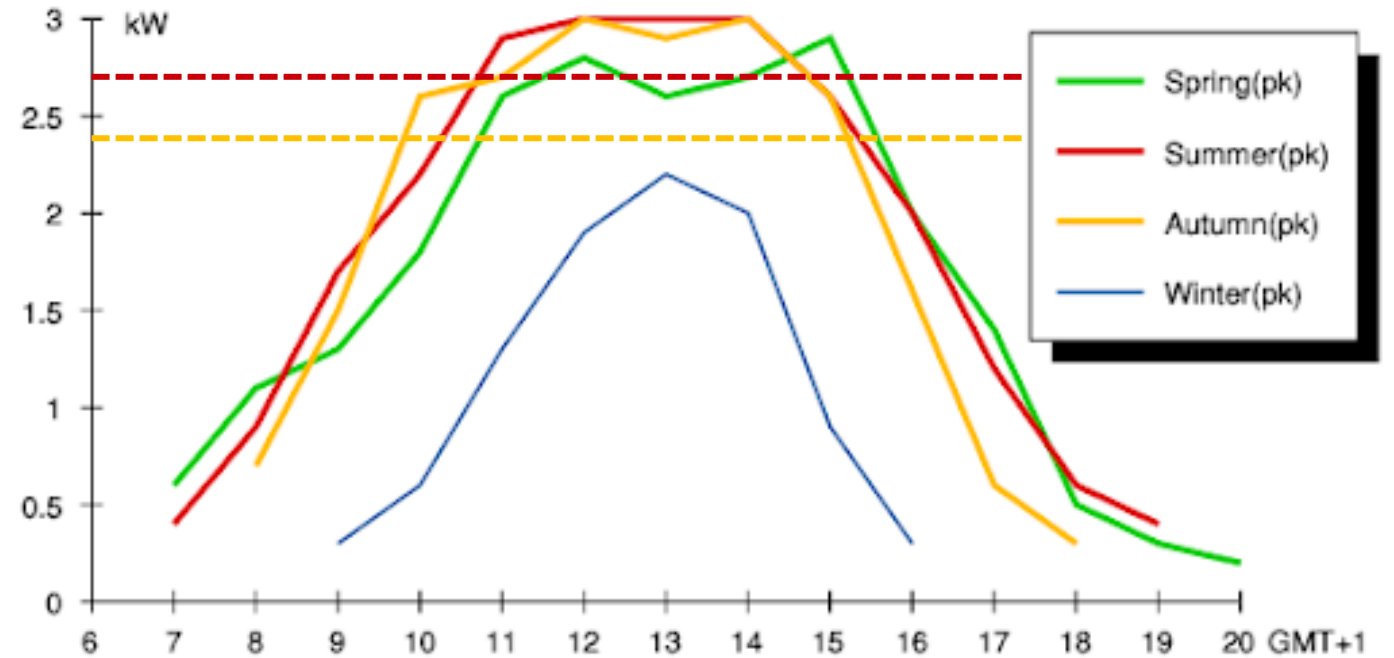
981,5 kWh / kWp / jaar

Voorbeeld 2:

3,9 kWp / 3.0kVA, DC/AC = **1.3**

3795 kWh / jaar

973,1 kWh / kWp / jaar



Dit is een zuid-georiënteerd systeem.

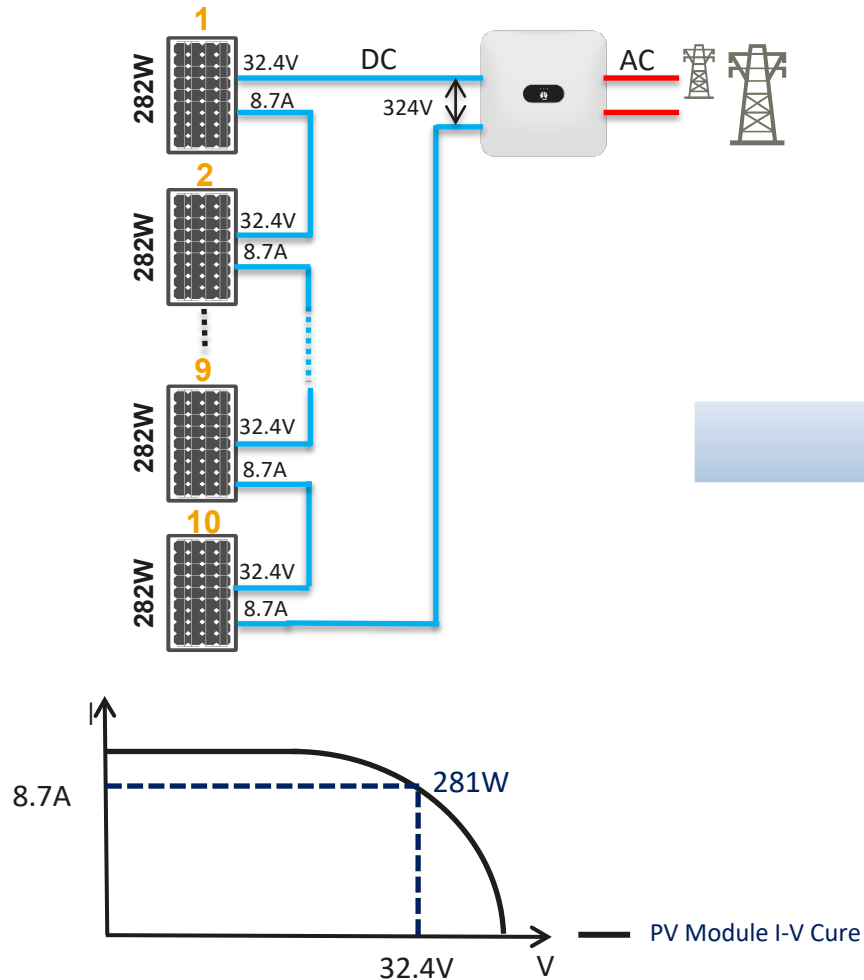
Bij een oost-west georiënteerd systeem zal de impact anders zijn.

# Contents

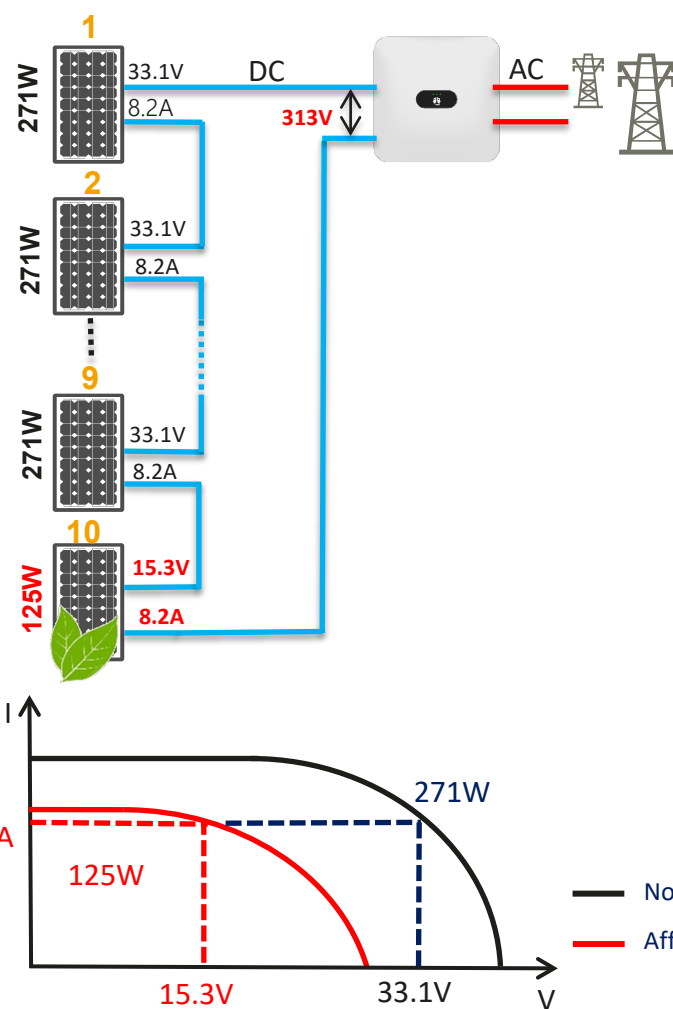
2

Ontwerpen met optimizers

# Optimizers

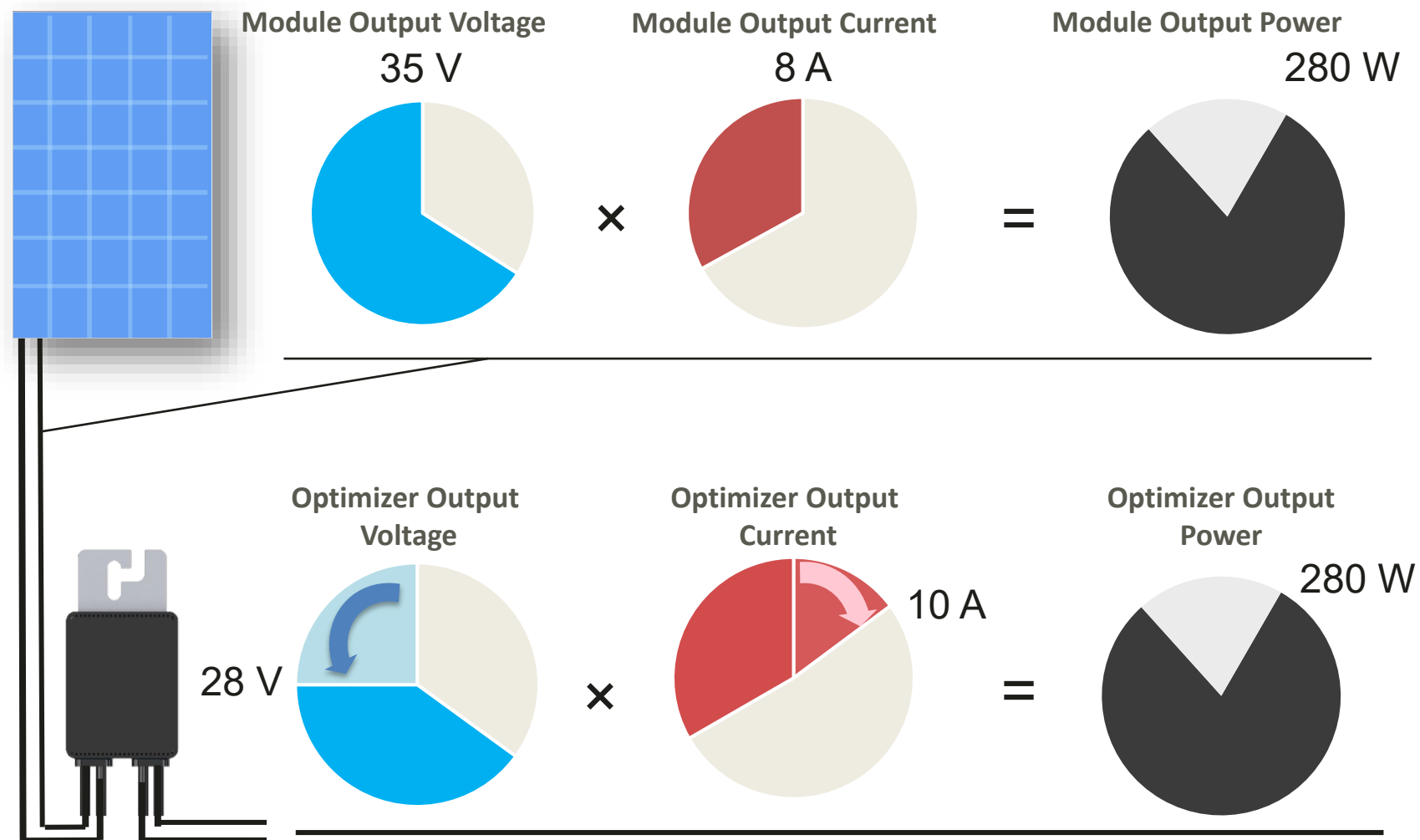


Ideal Status:  
 All the PV modules work at MPP  
 **$P_{total} = 282\text{ W} * 10 = 2,820\text{ W}$**



Panel #10 shaded, power mismatch causes string power dropping.  
 None of modules operate at MPP:  
 **$P_{total} = 271\text{ W} * 9 + 125\text{ W} = 2,564\text{ W}$**

# Optimizers

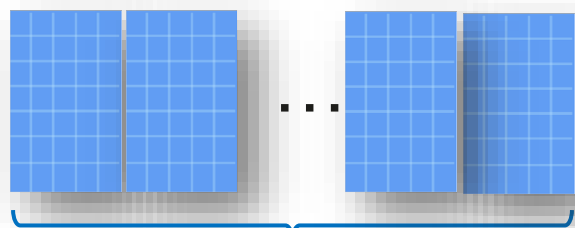


# Ontwerpen met Optimizers

## No Optimizer String Design

JAM72S01 330-350/SC/1000V Series datasheet

Maximum System Voltage 1000VDC (UL and IEC)



19 PV modules per string

Max number of PV module in the string:

$$1000 \text{ Vdc} / 52.2 \text{ Vdc} \approx 19$$

Taking JAM72S01-350/SC/1000V as example with considering temperature coefficient of Voc



## Full Optimizer String Design

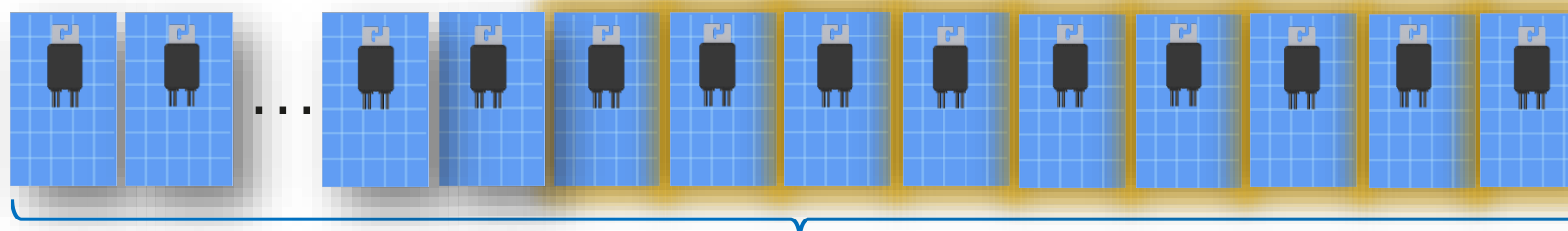
Refer to SUN2000-450W-P datasheet

Long String Design <sup>2</sup>	SUN2000L-2-6KTL-L1	SUN2000-3-10KTL-M1	SUN2000-12-20KTL-M2
Minimum optimizer number per string	4	6	6
Maximum optimizer number per string	25	50	50
Maximum DC power per string	5,000 W	10,000 W	10,000 W

Max number of PV module in the string:

$$10,000 \text{ W} / 350 \text{ W} \approx 28$$

Taking JAM72S01-350/SC/1000V as example



28 PV modules per string



# Kengetallen

Vollast Uren = Specifieke Opbrengst

(het aantal kWh per kWp)

Performance Ratio = Genormaliseerde Specifieke Opbrengst

*E = Opbrengst (Wh)*

*P = Geïnstalleerd Vermogen (Wp)*

*H = Werkelijke installing (W/m<sup>2</sup>) (gemeten in het vlak van het zonnepaneel)*

*G = Referentie instraling (1000 W/m<sup>2</sup>)*

*Y<sub>w</sub> = Werkelijke Opbrengst*

*Y<sub>r</sub> = Referentie Opbrengst*

$$Y_w = E/P$$

$$PR = \frac{E/P}{H/G} = \frac{Y_w}{Y_r}$$

(Bron: Wilfried van Sark, Universiteit Utrecht)

# Contents

3

Ontwerpen met een EOS

# Ontwerpen met een EOS

## Huishoudelijke markt (Eigenverbruik)

**Indien DC gekoppelde batterij:** Beschikbare vermogen van de batterij altijd benutbaar houden (dus niet afknijpen). Daarna zo ver mogelijk overdimensioneren om de effectiviteit van de batterij te vergroten.

**Indien AC gekoppelde batterij:** Zo min mogelijk overdimensioneren, vermogen van de batterij afstemmen op de productie van de PV installatie ( $P_{\text{batterij}} = P_{\text{pv-installatie}}$ ).

## Zakelijke markt:

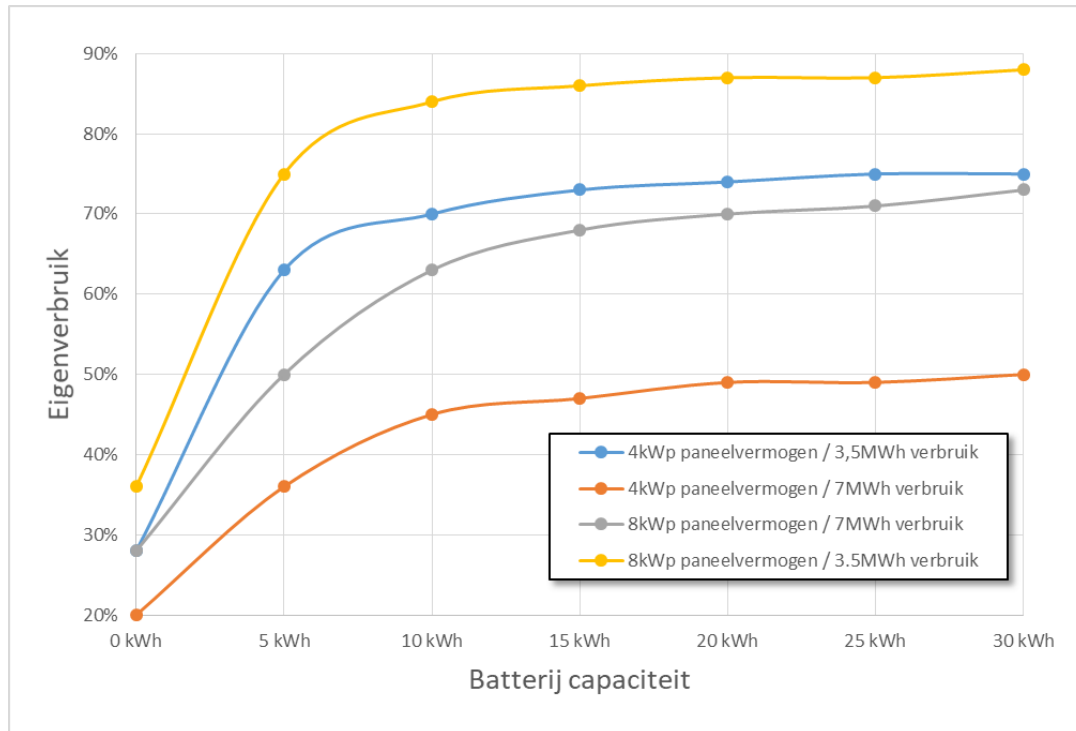
PV installatie zo min mogelijk overdimensioneren, verliezen vermijden waar mogelijk;

Vermogen van de EOS installatie afstemmen op het beoogd gebruik en vereisten om zonne-energie op te kunnen slaan





# Verhogen van Eigenverbruik met een EOS



Eigenverbruik	Zonder batterij	5kWh batterij	10kWh batterij	15kWh batterij
8kWp opwek 3,5kWh verbruik	36%	75%	84%	86%
4kWp opwek 3,5kWh verbruik	28%	63%	70%	73%
8kWp opwek 7,0kWh verbruik	28%	50%	63%	68%
4kWp opwek 7,0kWh verbruik	20%	36%	45%	47%

# Thank you.

Bring digital to every person, home, and organization for a fully connected, intelligent world.

**Copyright©2018 Huawei Technologies Co., Ltd.  
All Rights Reserved.**

The information in this document may contain predictive statements including, without limitation, statements regarding the future financial and operating results, future product portfolio, new technology, etc. There are a number of factors that could cause actual results and developments to differ materially from those expressed or implied in the predictive statements. Therefore, such information is provided for reference purpose only and constitutes neither an offer nor an acceptance. Huawei may change the information at any time without notice.